CONECTIVIDAD INALÁMBRICA UTILIZANDO REDES MESH: ALTERNATIVAS PARA LAS SOLUCIONES INDUSTRIALES

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RESUMEN

1. TÍTULO

CONECTIVIDAD INALÁMBRICA UTILIZANDO REDES MESH: ALTERNATIVAS PARA LAS SOLUCIONES INDUSTRIALES[*]

2. AUTORES

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3. PALABRAS CLAVES

REDES MESH, REDES INALAMBRICAS, MULTI-SALTOS, ENRUTAMIENTO, SOLUCIONES EMPRESARIALES, PROTOCOLO, ROUTER MESH, CLIENTES MESH.

4. DESCRIPCIÓN

El trabajo realizado en esta monografía consiste en una descripción de las Redes Inalámbricas Mesh, las cuales, son una tecnología que ha venido evolucionando fuertemente en la última década. En este documento se explica cómo es la infraestructura de una red con esta topología, se dan a conocer las características y las ventajas que ofrece la implementación de la misma, así como las diferentes métricas implementadas, protocolos de enrutamiento estandarizados o de tipo propietario y demás parámetros que se deben tener en cuenta para el buen diseño de una Red Mesh. De igual forma se hace una revisión general de las modificaciones hechas a los protocolos y estándares de las redes inalámbricas WAN y LAN, que permiten a las mismas soportar la conectividad de las Redes Mesh. Por último, se presentan las soluciones industriales más relevantes en el mercado de esta tecnología y los dispositivos Mesh que ofrecen, enmarcados en tablas comparativas que resaltan características tales como protocolo de enrutamiento, métrica, protocolos de seguridad, bandas de frecuencia, modulación, calidad de servicio, potencia de transmisión y consumo de energía de los diferentes dispositivos ofrecidos por cada fabricante, características relevantes indicadas con el fin de dar a conocer a los interesados alternativas para el diseño y montaje de una Red Inalámbrica Mesh.

[*] Monografía

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SUMMARY

1. TITLE

WIRELESS CONNECTIVITY USING MESH NETWORKS: ALTERNATIVES FOR INDUSTRY SOLUTIONS[*]

2. AUTHORS

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Luis Hernando Santamaria Bernales[**]

3. KEY WORDS

MESH NETWORK, WIRELESS NETWORK, MULTIHOP, ROUTING, BUSINESS SOLUTION, PROTOCOL, MESH ROUTER, MESH CLIENT.

4. DESCRIPTION

The work in this monograph is a description of Wireless Mesh Networks which it is a technology that has been evolving fast over the last decade. It explains how is composed the infrastructure of a network with this topology, the characteristics and advantages and also it is shown the different metrics and routing protocols and other parameters to consider in designing a Mesh Network. It also provides an overview of changes to the protocols and standards of wireless LAN and WAN networks so they can support full connectivity with Mesh Networks. Finally we present the most relevant industrial solutions in the market for this technology and Mesh devices that are offered in order to inform interested parties, the alternatives for the design and installation of a Wireless Mesh Network.

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INTRODUCCIÓN

Durante los últimos años el uso de la redes inalámbricas wi-fi 802.11 se ha incrementado de manera notable debido a los bajos costos de esta tecnología y a su facilidad de implementación, permitiendo a los usuarios versatilidad como una alternativa a las redes cableadas ya que permiten alta movilidad manteniendo un buen ancho de banda.

Las redes enmalladas se presentan como una gran alternativa para mejorar la robustez y la calidad del servicio de un red inalámbrica 802.11 habitual a un bajo costo. Al igual que la mayoría de los desarrollos en el área de las telecomunicaciones sus orígenes están en la milicia, en esta red los radios de los soldados funcionan como nodos y a medida que nuevos usuarios ingresan a la misma, amplían el área de cobertura.

Debido a lo anterior y teniendo en cuenta las ventajas sociales de una tecnología como esta, se han venido desarrollando durante este nuevo siglo diversos proyectos alrededor del mundo, para implementar redes comunitarias en zonas urbanas, como también para zonas rurales con el fin de cerrar la brecha digital.

JUSTIFICACIÓN

En los últimos años las redes inalámbricas han tenido un enorme crecimiento a nivel industrial y doméstico. Diseñar y desarrollar estas redes con topología Mesh puede brindar numerosas ventajas en comparación con las actuales. Este trabajo de grado pretende realizar una descripción general de las Redes Inalámbricas Mesh a partir de las publicaciones existentes y de los estándares de la IEEE, para tener una noción del funcionamiento de los dispositivos que utilizan esta tecnología. Además se presentan las diferentes alternativas en cuanto a dispositivos que existen en el mercado con sus respectivas características. Tanto las empresas, como la comunidad académica y personas en general que se encuentren interesadas en utilizar las Redes Inalámbricas Mesh o en brindar este tipo de soluciones empresariales como modelo de negocio pueden ver esta monografía como un punto de partida.

OBJETIVO GENERAL

- Realizar un análisis comparativo de las alternativas de conectividad inalámbrica utilizando topologías de Redes Mesh existentes en el escenario actual de las Telecomunicaciones considerando las soluciones comerciales empleadas a nivel mundial en la industria.

OBJETIVOS ESPECÍFICOS

- Realizar una descripción general de las Redes Inalámbricas Mesh a partir de publicaciones académicas y los protocolos asociados como el 802.11s y 802.16.

- Realizar un cuadro comparativo de los productos que ofrecen las empresas fabricantes más representativas donde se observen características como tipos de modulación digital, protocolos de enrutamiento inalámbrico, bandas del espectro radioeléctrico utilizadas, tasas de transferencia, potencia de transmisión, técnicas de acceso al medio y algoritmos de seguridad utilizados.

1. REDES INALÁMBRICAS MESH

Las actuales comunicaciones inalámbricas se basan en redes cableadas que realizan funciones de puente para formar la red. La dependencia en una infraestructura cableada trae inconvenientes en muchos casos como por ejemplo sus costos para algunas zonas y la escalabilidad para ampliar la cobertura. Existen aplicaciones como juegos inalámbricos que no trabajan eficientemente sobre estructuras centralizadas. Las redes inalámbricas se pueden beneficiar si se trabajan en estas necesidades.

Las redes enmalladas o Mesh, como se les conoce comercialmente, se basan en múltiples Routers interconectados inalámbricamente capaces de escoger las mejores rutas para los paquetes dependiendo del tráfico y las características de la red. En una red con una topología fija las estaciones no tienen la posibilidad de elegir una ruta para mejorar el rendimiento de la comunicación. Es necesario el estudio y la comprensión de los protocolos enrutamiento para permitir determinar las ventajas y desventajas de cada uno en la topología de malla. Estas redes pueden integrarse mediante funciones *gateway* y de puente con redes como Internet, IEEE 802.11, IEEE 802.15, IEEE 802.16.

En base a las características únicas de las Redes Inalámbricas Mesh existen múltiples aplicaciones en las que se puede explotar esta tecnología. Las aplicaciones de mayor potencial incluyen por ejemplo servicios inalámbricos de banda ancha, sistemas de vigilancia instantánea, redes de alta velocidad de área metropolitana, redes comunitarias, los sistemas inteligentes de transporte entre otras. Las Redes Mesh también pueden llevar acceso a Internet de última milla a áreas rurales donde es sumamente inconveniente llevar una solución cableada por la dispersión de usuarios y geografía.

Para que el montaje de la red Mesh sea viable la red debe poder ampliarse en extensión sin sacrificar la capacidad del canal y mejorar la conectividad con usuarios que no estén en la línea de vista. Estas redes soportan redes ad-hoc y

son auto configurables y con capacidad de formación de la red mallada. Principalmente, las redes inalámbricas Mesh son redes multihop (que realizan múltiples saltos entre nodos) y tienen diferentes tipos de acceso a la red.

Los dispositivos hoy en día no necesitan estar ubicados dentro de la misma área del punto de acceso. Simplemente pueden disfrutar de los mismos servicios a través otros puntos de acceso que se encuentren al alcance y dentro de la misma red. Características como la calidad de servicio, la administración de la energía, la seguridad y enrutamiento pueden integrarse al desarrollo de las redes Mesh.

1.1. Características de las Redes Mesh

Las principales características de las redes Inalámbricas Mesh de las cuales se sustentan algunas de las ventajas, son las siguientes:

- Las Redes Mesh soportan redes Ad Hoc y tienen la capacidad de formarse por ellas mismas, de realizar reparaciones y organizarse por su propia cuenta.

- Para proveer mayor cobertura sin línea de vista en los nodos, tienen la función multi-salto sin cableado en su infraestructura. [1]

- Las Redes Mesh tienen múltiples accesos ya que integran redes heterogéneas que incluyen redes cableadas e inalámbricas. [2]

- Los Routers Mesh tienen poca movilidad y se dedican exclusivamente a proveer la configuración y el enrutamiento, lo cual libera a los Clientes Mesh y otros nodos finales de la carga de la red.

- El consumo de energía es diferente para los Routers Mesh y para los clientes Mesh.

1.2. Arquitectura Mesh

Una red Inalámbrica Mesh se forma interconectando múltiples Routers inalámbricamente (no se necesitan cables para interconectarlos) los cuales tienen poca movilidad y forman la estructura principal de la red, a los cuales se les llama Routers Mesh. Por otro lado están los clientes que hacen uso de la red los cuales pueden ser desde computadores, celulares, cámaras, impresoras o cualquier dispositivo que soporte conectividad inalámbrica de una red PAN, LAN o WAN. A los clientes de la red se les conoce como Clientes Mesh y son completamente móviles dentro de la red, realizando un traspaso de un Router a otro de forma automática sin perder la conectividad. Los Routers Mesh y los clientes Mesh los llamamos nodos dentro de la red y se interconectan formando la Mesh como se ve en la figura 1. [3]. Para interconectarse con el exterior, los mensajes de los Clientes Mesh viajan sobre los Routers Mesh saltando de uno a otro hasta llegar a un punto de acceso que tenga salida a Internet. Por lo general los puntos de acceso tienen tanto interfaces cableadas como interfaces inalámbricas.

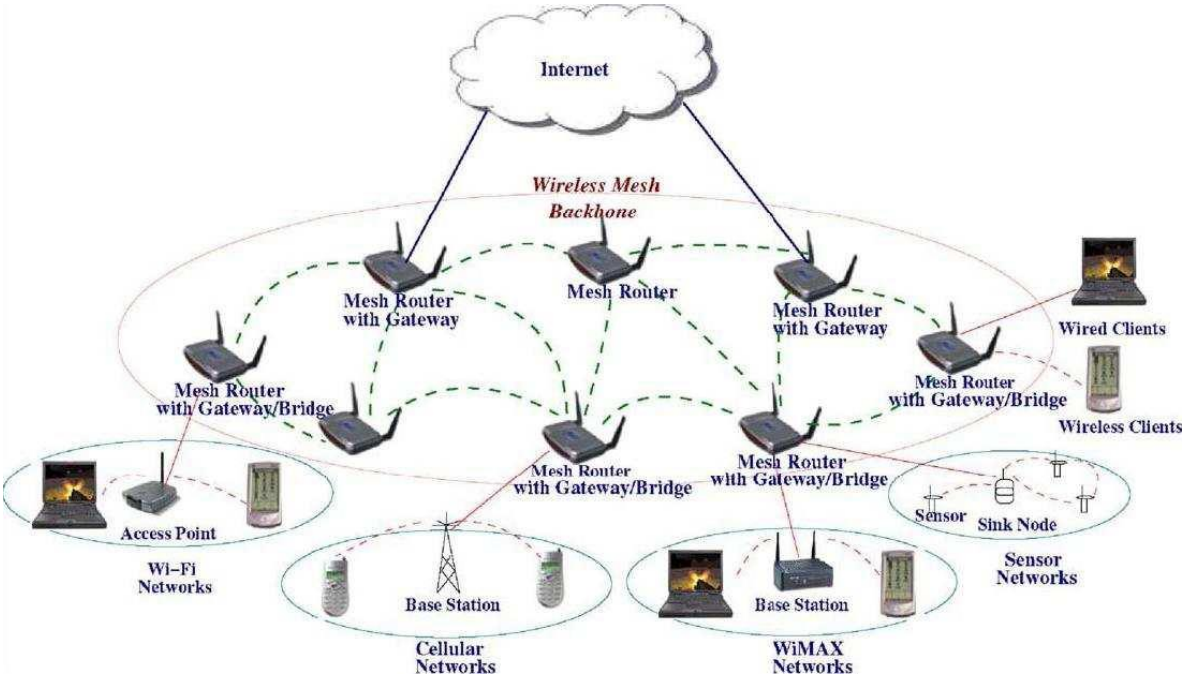

Figura 1 Infraestructura de una Red Inalámbrica Mesh [3].

2. FUNCIONALIDAD

En esta sección se describen aspectos importantes para garantizar la funcionalidad de una red Mesh.

2.1. Métrica:

La métrica es un parámetro que permite comparar una ruta con otra para que el enrutador pueda escoger el mejor camino, basado en una o varias métricas. Las más comunes son: saltos, ancho de banda, retraso, fiabilidad, carga y costo.

2.1.1. Conteo de saltos:

Es la métrica de enrutamiento tradicional más usada por protocolos de enrutamiento como AODV, DSR, DSDV diseñada para redes inalámbricas *multihop*. Simplemente se busca la ruta con el menor número de saltos. Esta métrica tiene una alta estabilidad lo cual permite que se encuentren rutas de peso mínimo eficientemente. Las desventajas es que toma todos los enlaces como si fueran iguales, lo cual puede resultar en rutas con poco rendimiento.

2.1.2. ETX:

ETX [4] (*Expected Transmission count*) está definido por el número de transmisiones requeridas para entregar un paquete en un enlace inalámbrico. La ventaja de esta métrica es que favorece las rutas con mayor rendimiento y menor número de saltos así como las rutas largas tienen un menor rendimiento debido a la interferencia intra-flujo. Sus desventajas es que es una métrica para un solo canal multihop en una red inalámbrica y no considera las diferencias entre las tasas de transmisión.

2.1.3. ETT:

La métrica ETT [5] (*Expected Transmission Time*) es una extensión del ETX la cual considera enlaces de rutas o capacidades lo cual aumenta el rendimiento de una ruta midiendo la capacidad del enlace mejorando el rendimiento de la red. El problema es que no da solución a las desventajas de ETX.

2.1.4. WCETT:

La métrica WCETT [6] (*Weigted Cumulative Expected Transmission Time*) es una extensión de la ETT y retiene muchas de sus ventajas, además considera la interferencia dentro del flujo para seleccionar la ruta. Tiene problemas de compatibilidad con protocolos de enrutamiento de estado de enlace.

2.1.5. MIC:

La métrica MIC [7] (*Metric of interference and cannel switching*) está diseñada para soportar carga balanceada de enrutamiento y para considerar la interferencia entre el flujo. La carga requerida para mantener actualizada la información ETT para cada enlace puede perjudicar considerablemente el rendimiento de la red dependiendo de las cargas de tráfico.

2.1.6. LAETT:

Los dos principales objetivos de LAETT [8] son proveer una ruta que satisfaga el ancho de banda requerido por el flujo y dejar espacio para solicitudes futuras balanceando la carga sobre la red. Combina características de acceso inalámbrico y estimación de carga. No tiene como tal en cuenta la interferencia dentro del flujo.

2.1.7. **EETT**:

La métrica EETT [9] selecciona rutas multicanales con menos interferencia para maximizar el rendimiento de extremo a extremo. Es usada para dar una mejor evaluación de la ruta multicanal.

2.1.8. **ILA**:

Esta métrica (Interference Load Aware) ILA [10] está construida sobre la métrica MIC. Se compone de *Metric of cannel interference* (MTI) y *cannel switching cost* (CSC). Esta métrica encuentra rutas con menor congestión, bajo nivel de interferencia, menor tasa de pérdida de paquetes y transferencia alta de datos. Su desventaja es que el componente CSC captura interferencia solo en dos enlaces consecutivos.

2.1.9. **iAWARE**:

Esta es la primera métrica de enrutamiento para Redes Inalámbricas Mesh multiradio que toma encuentra la interferencia en el flujo y se caracteriza por el modelo de interfaz física [11]. El inconveniente de esta métrica es que da más coeficiente de ponderación de ETT en comparación a la interferencia del enlace.

2.1.10. **Airtime Link Metric:**

Esta métrica es la que se propone usar en el borrador del IEEE 802.11s. Consiste en calcular cada enlace por pares dentro de la malla y se define como la cantidad de recursos consumidos de los canales por la transmisión de la trama sobre un enlace en particular.

2.2. Enrutamiento

Los protocolos tradicionales como RIP, EIGRP y OSPF no se adecuan bien en las redes de múltiples saltos y redes ad-hoc ya que asumen topologías

estables y no actualizan sus estados frecuentemente. La mayoría de los protocolos de enrutamiento usados en las Redes Inalámbricas Mesh son heredados de las redes Ad-Hoc como lo son Ad hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR) y Optimized Link State Routing (OLSR) [12]. Estos protocolos tienen como base la métrica de contador de saltos la cual no funciona muy bien con las Redes Mesh ya que esta métrica no tiene en cuenta la calidad del enlace y no es recomendada para construir las rutas a partir de ella. Para las Redes Mesh un óptimo protocolo de enrutamiento debe considerar una estructura de alta capacidad, métricas de múltiple rendimiento, escalabilidad, robustez y enrutamiento eficiente con la infraestructura Mesh [13]. Algunos de los protocolos de enrutamiento recientemente usados se presentan a continuación:

2.2.1. MP-DSR:

MP-DSR es un protocolo de enrutamiento de múltiples rutas compatible con calidad de servicio, basado en el protocolo *Dynamic Source Routing* (DSR), el cual crea y selecciona la ruta a partir de métricas de calidad de servicio en términos de confiabilidad de extremo a extremo. El cálculo o la forma de medir la confiabilidad de punta a punta se puede expresar como la probabilidad de tener una transmisión satisfactoria entre dos nodos en la red dentro de un periodo determinado [14].

2.2.2. AODV-ST:

El protocolo *Ad hoc On-demand Distance Vector-Spanning Tree (AODV - ST)* utiliza la métrica ETT. Utiliza una estrategia proactiva para descubrir las rutas entre Routers Mesh y los Gateways y una estrategia reactiva para encontrar rutas entre Routers Mesh [15].

2.2.3. LQSR-MR:

Este es un protocolo de enrutamiento diseñado para mejorar la calidad del enlace y trabajar con un ambiente MultiRadio el cual usa la métrica WCETT en lugar de la de contador de saltos en LQSR. El protocolo identifica a todos los nodos dentro de la red inalámbrica Mesh y le asigna pesos a todos los enlaces compartiendo dentro de la información de cada enlace a toda la red la asignación del canal, el ancho de banda y las tasas de pérdidas [16].

2.2.4. AODV-MR:

Es una mejora del AODV para que funcione con redes inalámbricas Mesh multiradio. El protocolo asume que cada nodo tiene por lo menos un canal en común con su vecino. La capacidad de la red es aumentada considerablemente ya que se tiene un nivel bajo de interferencia y contención por el tráfico distribuido en varios canales que no se sobreponen. AODV-MR [17] utiliza la métrica iAWARE.

2.2.5. AODV-HM:

Este protocolo se llevó a cabo realizando dos modificaciones al protocolo AODV-MR, cambiando su métrica por la del contador de saltos mínimo y maximizando la diversidad de canales en la ruta. Con estas modificaciones se descubren los enlaces múltiples entre los nodos vecinos para que la diversidad de canal seleccione el mejor enlace. Este protocolo puede diferenciar bien entre Routers Mesh multiradio y clientes Mesh de un sólo radio. Además, se esfuerza para maximizar el enrutamiento a través de los Routers Mesh con el fin de reducir al mínimo la carga en los clientes Mesh. La selección de la interfaz de nodos múltiples de radio se lleva a cabo de tal manera que se alcance la diversidad de canales máxima [18].

2.3. Administración de Energía

Las Redes Inalámbricas Mesh tienen muchas ventajas en cuanto a que se pueden extender fácilmente para lograr una mayor cobertura y además utilizan poca potencia para la transmisión de datos lo que las hace una solución económica. Sin embargo, existe un reto importante en cuanto al consumo de energía por parte de los usuarios o dispositivos que se encuentren cerca de la puerta de enlace (Gateway). Debido a que la información de la red va realizando saltos buscando llegar al Gateway para obtener salida a Internet, los dispositivos vecinos necesitan re transmitir mayor cantidad de tráfico, lo que implica mayor consumo de energía. A medida que hay más tráfico y carga sobre estos dispositivos el rendimiento de la red también puede verse afectado. Es por eso que hay que tener en cuenta a la hora del diseño este factor.

El problema puede ser solucionando de diferentes formas. Se puede reducir las distancias de los saltos de los nodos que se encuentren cercanos al Gateway. Otra solución es tener una redundancia en cuanto a puertas de enlaces para tener varias salidas a Internet.

2.4. Seguridad

La seguridad es otro aspecto fundamental dentro de las redes inalámbricas, para que la información que viaja a través de la red no sea alterada o copiada por otro intruso. Para las redes WLAN ya se han desarrollado muchos esquemas de seguridad, el problema es que estas mismas propuestas no sirven para las Redes Mesh por la misma razón de que no hay un nodo centralizado confiable que pueda distribuir una clave pública.

Los mecanismos desarrollados para las redes Ad-hoc pueden ser utilizados para las Mesh pero existen algunos problemas ya que estos no están lo suficientemente terminados para ser implementados en la práctica además de

las diferencias que existen entre las arquitecturas. Por estas razones para las Redes Mesh se deben implementar nuevos esquemas de seguridad que tengan algoritmos para la distribución de las claves, aseguramiento de la MAC y los protocolos de enrutamiento, entre otras, de lo cual en la siguiente sección se especifican algunos.

3. ESTANDARES Y REVISIONES

En función del tamaño de una red se establece si es una red PAN, LAN o WAN. Para las redes inalámbricas la IEEE estableció diferentes estándares dependiendo del tamaño de la red. Para las redes inalámbricas LAN el protocolo es el 802.11, para las redes inalámbricas PAN el protocolo asociado es el 802.15 y para las redes WAN el protocolo establecido fue el 802.16. En esta monografía se profundiza en los estándares y revisiones actuales que conciernen al establecimiento de una red inalámbrica con topología Mesh de área local y extendida.

3.1. IEEE 802.11s

En el 2004 la IEEE comenzó los trabajos de estandarización de las Redes Mesh, denominándolo como IEEE 802.11s, donde se busca la extender la cobertura del 802.11, con el objetivo final de proveer un protocolo para la autoconfiguración de caminos entre puntos de acceso (AP) con auto mantenimiento. La última versión del borrador es la 3.0 publicada en el 2009. Los protocolos existentes 802.11a/b/g no habían sido pensados para que funcionaran con multi-salto.

Las redes inalámbricas Mesh implementan un único dominio de difusión y por lo tanto se integran perfectamente con otras redes 802. En particular, 802.11s apoya la entrega transparente de uni- y multi-, tramas de difusión a destinos

dentro y fuera de la red. De esta forma, con el fin de identificar de forma única una estación Mesh, un BSSID de malla de igual forma cómo funciona el *Service Set Identifier* SSID para las redes 802.11[19]. Las Redes Mesh están definidas por un perfil el cual consiste de tres elementos: el Mesh ID, el protocolo de selección de ruta y una métrica para la selección de la ruta. Las estaciones Mesh pueden soportar diferentes perfiles, pero todos los nodos que la nube Mesh, en algún momento deben compartir el mismo perfil [20]. La arquitectura de la red IEEE 802.1s se puede ver en la figura 2.

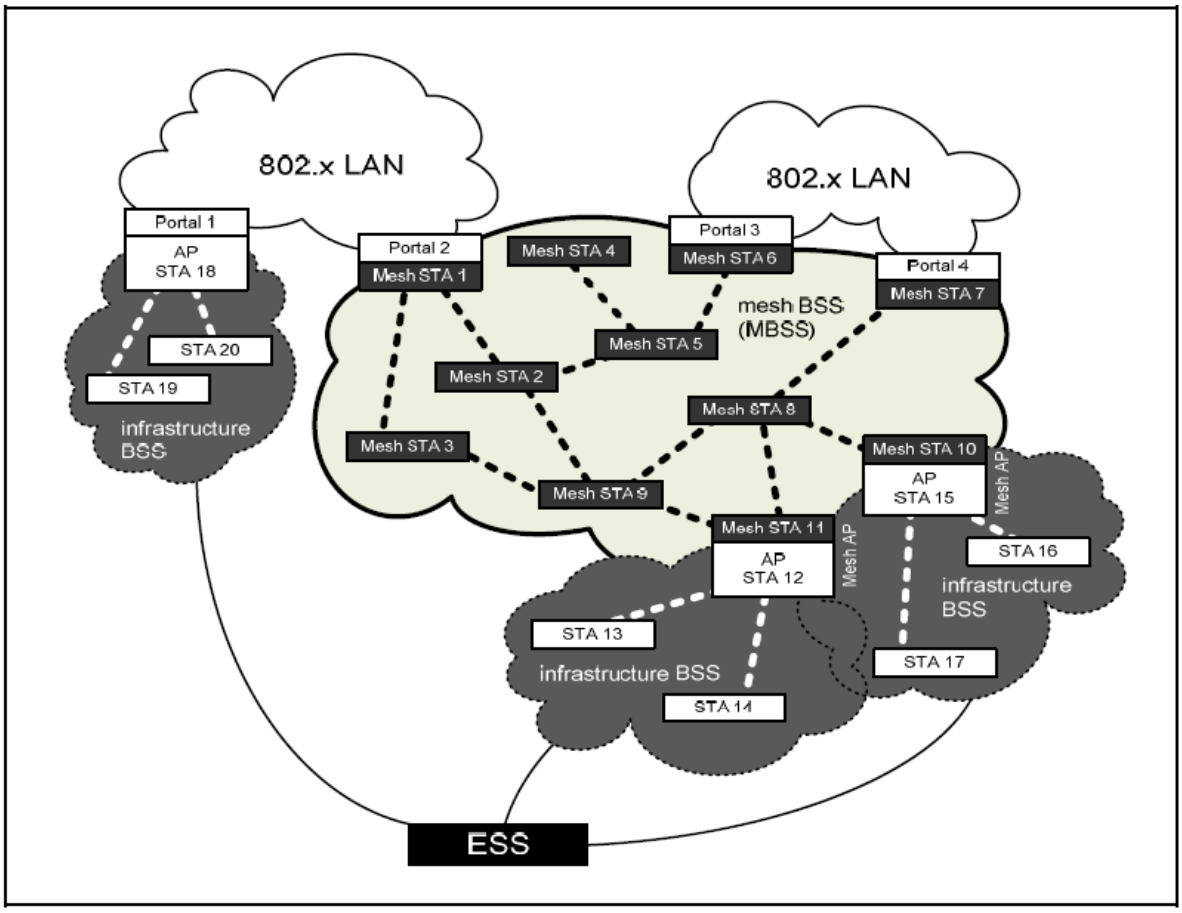

Figura 2 Arquitectura de una red 802.11s [21].

Para poder soportar multihop, que es el problema que tienen las redes 802.11, en el borrador 802.11s se extiende la estructura de la trama de

datos agregando un campo adicional de control Mesh como se observa en la figura 3. El campo añadido de control Mesh consiste en un campo de tiempo de vida de malla (TTL), un número de secuencia de malla, un campo de acoplamiento de las banderas y, posiblemente, un campo de dirección de extensión de malla. El número de campos TTL y la secuencia se usan para prevenir que las tramas se queden circulando por la red infinitamente. Cuando las estaciones de acoplamiento se comunican a través de un solo salto, las traman no llevan el campo de control Mesh. [22].

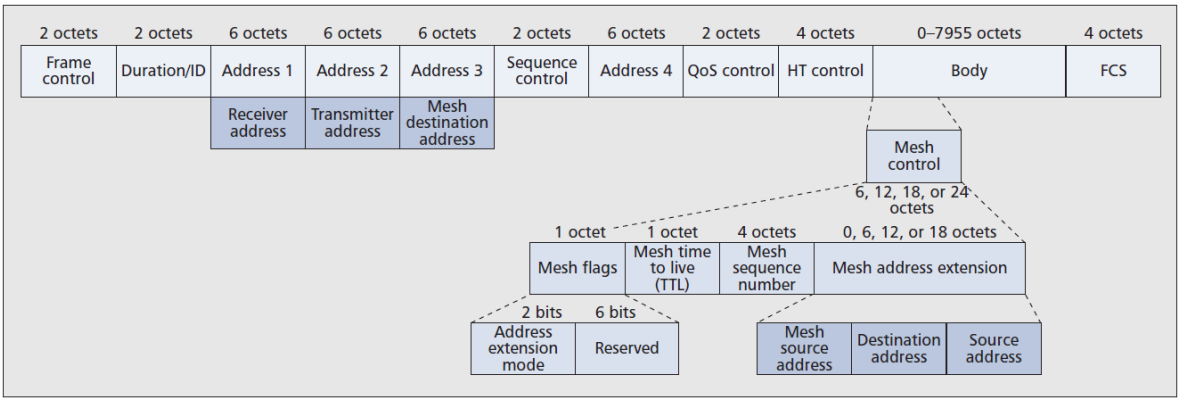

Figura 3 El campo de control del 802.11s dentro de la trama [22].

En el campo de extensión de dirección se puede observar que se permite agregar tres direcciones en vez de dos, ya que las tramas estándar de manejo tienen tres direcciones únicamente. De esta manera se incluye la dirección 4 en el campo de control Mesh reemplazando la cabecera de trama estándar. Las estaciones Mesh llevan la información acerca de la Red Mesh y ayudan a otras estaciones a detectarlas y a unirse a ellas, así como un *Access Point* ayuda a detectar a las estaciones un BSS y su configuración. Las estaciones Mesh se detectan unas a otras de acuerdo a un escaneo pasivo donde se realiza una observación de las tramas o un escaneo activo donde se realizan pruebas de transmisión con las tramas de acuerdo a su configuración. La información que se comparte es un Mesh ID el cual es el nombre que se le ha dado a la red, un elemento de configuración para conocer los servicios Mesh y

los parámetros soportados por la Red Mesh tales como protocolo y métricas. Luego de identificar una red compatible con los parámetros de la estación se utiliza el protocolo de manejo de enlace entre pares Mesh (Mesh Peer Link Management Protocol) para establecer la conectividad con otra estación Mesh. Si se llegara a perder el enlace físico las estaciones Mesh pueden mantener el estado de enlace para permitir una reconexión rápida. [22].

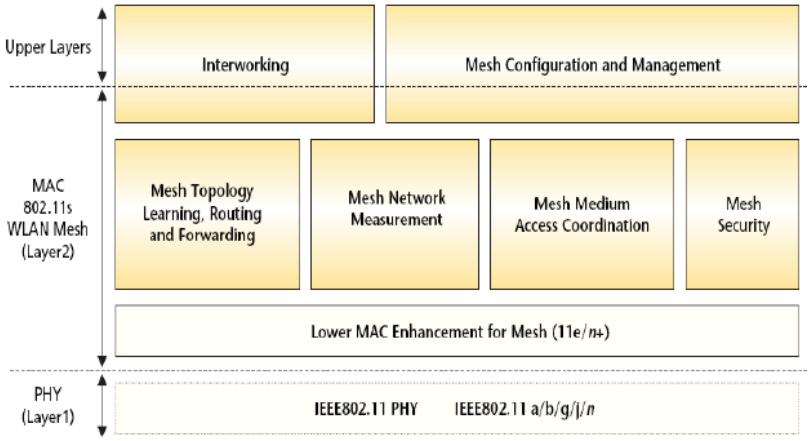

Figura 4 Capa de enlace para Redes Mesh 802.11s.[22]

Existen diferentes requisitos que imponen los organismos de control de diferentes países sobre las bandas de frecuencia usadas por 802.11 por lo cual las estaciones Mesh necesitan cumplir con la normatividad. Por ejemplo, en Europa los dispositivos se deben cambiar a un canal diferente cuando se detecta una estación de radar en la banda de 5GHz [22]. Como en las Redes Mesh no hay un coordinador central se desarrolló un algoritmo de distribución basado en 31 bits aleatorios de la prioridad del canal para el arbitraje. De acuerdo con esto si una estación Mesh requiere cambiarse de canal de frecuencia, esta comparte a la estación de al lado la nueva frecuencia y esta a su vez replica el mensaje. Después de un periodo de tiempo las estaciones Mesh realizan el cambio a la nueva frecuencia. Si alguna estación tiene un valor de prioridad mayor, esta indica el nuevo valor de frecuencia mediante un broadcast, así las estaciones finalmente llegaran a un acuerdo eventualmente del nuevo canal a utilizarse.

Las tramas proveen un tiempo de referencia utilizado para sincronizarse y para ahorro de energía. Existen 2 modos de ahorro de energía: el ligero el cual se encuentra en un modo de consumo básico y entra a funcionar a la máxima energía cuando algún vecino va a realizar una transmisión de una trama. Y está el modo de sueño profundo el cual únicamente se pone activo para transmitir sus propias tramas.

Dentro de la topología de la Red Mesh, se puede esperar que las estaciones ubicadas en la frontera estén más propensas a transmitir con mayor facilidad ya que estas tienen menos vecinos. Mientras que las estaciones localizadas en el núcleo pueden congestionarse y empezar las tramas y el tráfico agregado lo cual perjudica a la red considerablemente ya que una trama ya ha atravesado múltiples nodos para llegar ahí. Por esta razón se incluye un mecanismo de control en 802.11s el cual utiliza una trama de manejo en la cual indica la duración de la congestión y les avisa a los vecinos que disminuyan la velocidad de transmisión. Cada estación tiene la independencia de escoger si quiere utilizar estas notificaciones o no.

Para contrarrestar las desventajas de los productos de malla actual, una serie de nuevas normas se están desarrollando en el estándar IEEE 802. Estas normas prevén la integración de rutas y envío de tramas en la capa MAC, para que operen de forma transparente desde la perspectiva de las capas superiores [23]. Una característica notable de IEEE 802.11s es el hecho de que la red de malla se implementa en la capa de enlace, basándose en las direcciones MAC en lugar de direcciones IP para sus mecanismos [20]. Esta característica permite el diseño y desarrollo de nuevos dispositivos de red que proporcionan comunicación multihop para capa 2.

El IEEE 802.11s no obstaculiza que diferentes protocolos o métricas se utilicen pero se define que por defecto se use el protocolo HWMP y para el mecanismo

de descubrimiento de rutas la métrica se use el Airtime Link [20]. Si se hace énfasis en que una Red Mesh solo puede usar un perfil al mismo tiempo por lo tanto solo puede usarse un protocolo y una métrica. Esta recomendación se puede interpretar como un intento de evitar la renegociación de perfil por la complejidad y el costo que se le pueda agregar a un dispositivo para que lo soporte.

Para poder diferenciar el enrutamiento inalámbrico de la capa 3 y la 2, el basado en MAC (capa 2) se toma como de selección de ruta. De esta forma las Redes Mesh aparecen con un dominio único de broadcast en el cual se pueden soportar cualquier protocolo de capa 3 como por ejemplo *Address Resolution Protocol* (ARP), *Dynamic Host Configuration Protocol* (DHCP) y *Spanning Tree*. Además, la capa MAC tiene la información requerida en el medio inalámbrico. Por lo tanto, las soluciones de Redes Inalámbricas Mesh tienen la capacidad de operar más eficientemente que las Mesh basadas en IP. [24]

Con el fin de soportar el reenvío *Multihop* en la capa MAC, 802.11s introduce cambios en los formatos de las tramas MAC y un método opcional de acceso al medio, al igual que muchas otras optimizaciones para mejorar el rendimiento y la seguridad de las redes inalámbricas *Mesh*. Los mecanismos propuestos en el borrador inicialmente para la selección de la ruta fueron el RA-OLSR *(Radio-Aware Optimized Link State Routing)* [25] y HWMP (*Hybryd Wireless Mesh Protocol*) [26]. El primero, el cual ya se encuentra descontinuado, RA-OSLR es un protocolo basado en OLSR con la diferencia que está adaptado a trabajar en la capa de acceso en lugar de la de red. Actualmente el protocolo obligatorio en 802.11s es HWMP el cual es un protocolo de enrutamiento mixto que combina elementos reactivos y proactivos que permiten la selección optima y eficiente de la ruta dentro de una gran variedad de Redes Mesh. El protocolo utiliza varias de las reglas del protocolo AODV adaptado para la capa 2 y la métrica Airtime Link. Los fundamentes del AODV se utilizan para encontrar las rutas entre la red mallada y otras reglas se utilizan para configurar proactivamente un árbol de

vector-distancia a un nodo de la red como raíz, opcional para que un nodo construya la topología de la red.

3.2. IEEE 802.16

El IEEE 802.16 se compone de una serie de estándares avalados por la IEEE para desarrollar normas para el progreso global de las redes inalámbricas de banda ancha del Área Metropolitana WMAN comercialmente conocidas como WiMax. El estándar suministra un amplio rango de soluciones para sistemas que van desde configuraciones punto multipunto hasta configuraciones enmalladas, desde sistemas basados en portadora única hasta basados en múltiples portadoras y que incluyen rangos de modulación y codificación de acuerdo con las condiciones del canal [27].

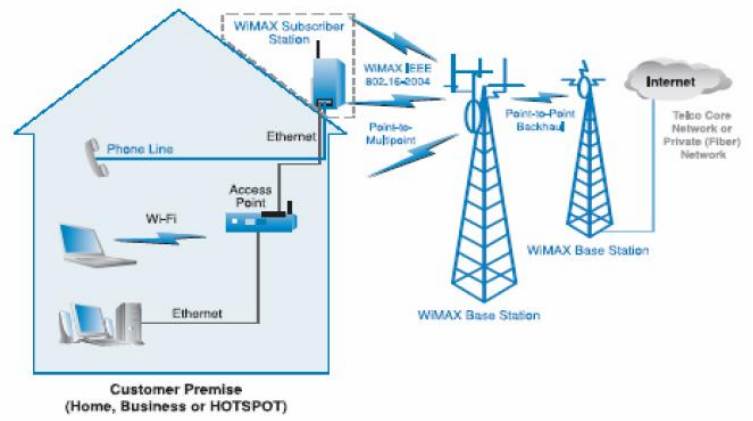

Figura 5 Red Mesh donde convergen redes Wi-Fi y WiMax.[27]

Con respecto a las Redes Mesh basadas en 802.16, tienen varias ventajas si se compara con las Redes Mesh basadas en 802.11. Por la naturaleza de WiMax se puede decir que las ventajas obvias son poder tener redes con mayor alcance y mayor ancho de banda, pero existen otras más. Hay que tener en cuenta que en principio las redes basadas en 802.11 no fueron concebidas para Redes Mesh por lo que hay falencias principalmente en proveer calidad de servicio para ambientes multihop y también carecen de extensiones de

seguridad que aseguren que la información transmitida no sea vulnerada cuando este viajando a través de los diferentes nodos de la red. La convergencia entre las redes WiMax y Wi-Fi es uno de los objetivos de la mayoría de empresas que ofrecen soluciones Mesh, ver figura 5, donde existe una infraestructura WiMax que atraviesa zonas municipales y llega a las redes Wi-Fi residenciales.

Existen varios aspectos fundamentales para el enrutamiento sobre las redes Inalámbricas Mesh. El diseño para el enrutamiento debe direccionar los inconvenientes en escalas pequeñas y grandes. Un buen algoritmo de enrutamiento tiene que asegurar la estabilidad entre una ruta larga y además brindar un buen rendimiento entre las rutas cortas. También debe garantizar la robustez frente muchos tipos de fallas, que van desde interrupciones de canal, enlaces con tasas de pérdida intermedias, desconexiones de canal y nodos con problemas [28]. El enrutamiento debe superar estos problemas y al mismo tiempo debe ser escalable a una cantidad de nodos superior.

El IEEE 802.16 define el enrutamiento aleatorio en el cual las estaciones seleccionan aleatoriamente la estación base mientras se construye el árbol. Existen dos modos de operación especificados en el estándar. El primer modo es el modo de operación punto a multipunto, el cual trabaja con una estación central base con la capacidad de manejar varios sectores al mismo tiempo. El otro modo que especifica el estándar IEEE 802.16 es el Mesh el cual utiliza la tecnología de Acceso Múltiple por división de tiempo (TDMA) para proporcionar calidad de servicio en los enlaces de la red.

La trama consiste de una sub trama de control y una sub trama de datos, en la cual cada trama es dividida en 256 ranuras para la transmisión de los mensajes. IEEE 802.16 utiliza multiplexación por división de frecuencias ortogonales (OFDM) para implementar acceso múltiple por división de tiempo en la capa física transformando bloques de bits en símbolos de constate duración que van

sobre múltiples portadoras ortogonales [29]. El ancho de banda del enlace termina siendo el rango de frecuencias utilizado por las portadoras.

Los símbolos OFDM son agrupados en tramas TDMA de igual longitudes las cuales se repiten sobre el tiempo como se observa en la figura 6. Existen dos tipos de control en la subtrama, el de control de la planificación y el de control de la red. La subtrama de control se encuentra divida en múltiples ranuras. El primer tipo de control concierne a la información de la planificación de los datos para que esta sea compartida por los nodos y el otro tipo se utiliza para compartir información de la configuración de los paquetes, donde se muestra la información de la topología, información de la red y mensajes de gestión.

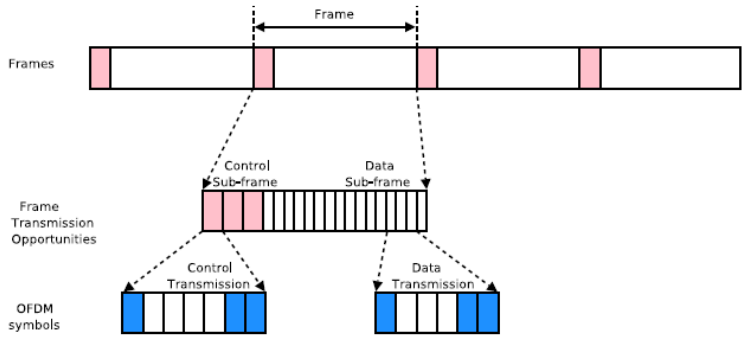

Figura 6 Estructura de la trama Mesh para IEEE 802.16. [30]

La planificación basada en TDMA para acceso de canales en redes WiMax multihop proveen una granularidad fina comparada con los sistemas 802.11 RTS/CTS. Además si se aprovechan las características de la composición de capas que utiliza el estándar 802.16 se puede mejorar la calidad de servicio considerablemente. Sin embargo, la interferencia sigue como el mayor problema en este tipo de redes, la cual depende en como los datos son enrutados en la red WiMax [31].

En cuanto a seguridad las comunicaciones de las Redes Mesh 802.16 están protegidas con cifrado de paquetes salto a salto. Los datos en los paquetes pueden ser cifrados con claves de 56bits DES o con el algoritmo AES. Para

cada caso el cifrado es realizado con una clave de cifrado de tráfico (TEK) compartida y privada para la conexión.

4. SOLUCIONES INDUSTRIALES Y PRODUCTOS MESH

Para poder llevar el servicio de conectividad inalámbrica a Internet a un bajo costo en comparación de las tradicionales redes Wi-Fi, varias compañías como Motorola con *"MotoMesh"* y Proxim Wireless Corporation con "*ORiNOCO*" han venido desarrollando investigaciones en el campo de las redes inalámbricas en malladas con el ánimo de apropiarse de esta tecnología y comercializar sus productos algunos con protocolos propietarios, encontrando en esto un muy buen modelo de negocio debido a sus bajos costos de inversión. Por su parte Intel también ha mostrado interés en las Redes Mesh desde 2002 realizando investigaciones en bajo consumo de potencia y balance de tráfico, y junto con Cisco son participes activos en el proceso de estandarización del IEEE 802.11s que involucra la topología de Redes Mesh.

La selección de empresas se realizó de acuerdo a un sondeo en los principales buscadores de Internet. La tabla 1 despliega las empresas encontradas.

Empresas Encontradas	
Empresa	**Página Web**
Aerial Broadband (descontinuada)	www.aerialbroadband.com
Arrow Span	www.arrowspan.com
BelAir Networks	www.belairnetworks.com
Cisco	www.cisco.com
Firetide	www.firetide.com
Kiyon	www.kiyon.com
LamTech	www.radiantnetworks.com
Locust World	www.locustworld.com
Mesh Dynamics	www.Meshdynamics.com
Motorola	www.Meshnetworks.com
Nokia (descontinuada)	www.rooftop.com

Netkrom Technologies	www.netkrom.com
Open-Mesh	www.open-Mesh.com
Packet Hop	www.packethop.com
Proxim Wireless Corporation	www.proxim.com
SkyPilot	www.skypilot.com
Strix Systems	www.strixsystems.com
Tropos Networks	www.tropos.com

Tabla 1 Empresas Encontradas

Se tomó en cuenta como criterios para seleccionar las soluciones industriales a las empresas que están vigentes y operando actualmente, que sean fabricantes de Routers Mesh, que ofrezcan soluciones inalámbricas LAN, WAN y MAN y que presenten las hojas de especificaciones de sus dispositivos. En la comparación de productos no se muestran los costos de los mismos, ya que es necesario ponerse en contacto directamente con las empresas para solicitar una cotización dependiendo de las necesidades del usuario. La tabla 2 muestra la información general de las empresas seleccionadas.

Descripción de las Empresas Seleccionadas	
Nombre de la Empresa	**Descripción**
MotoMesh	Empresa con aplicaciones enfocadas a dar solución de acceso a internet móvil de banda ancha, soportando usuarios móviles de alta velocidad, protocolos de enrutamiento, transmisión, radio y MAC multicanal tipo propietario.
ORiNOCO	Empresa con aplicaciones enfocadas a dar solución de voz sobre WLAN y transmisión de video inalámbrica, entregando así una convergencia de voz, datos y video con todos los beneficios de movilidad.
BelAir Networks	Empresa con aplicaciones enfocadas a dar solución de conectividad del tipo WAN, enfocada a prestar servicio de conectividad en diferentes sistemas de transporte a alta velocidad.
Firetide	Empresa con aplicaciones enfocadas a dar solución de conectividad en la capa de enlace para interiores y exteriores en los anchos de banda de 2.4GHz y 5GHz, implementando protocolos propietario, seguridad y una

	potencia de transmisión variable.
Tropos Networks	Empresa con aplicaciones enfocadas a dar solución de conectividad MAN, soportando la movilidad de sus clientes dentro de las ciudades mediante la implementación de protocolos propietario que optimizan el throughput, soportando seguridad y permitiendo una fácil instalación de sus equipos.
Strix Systems	Empresa con aplicaciones enfocadas a dar solución de conectividad a interiores y exteriores con cobertura WLAN, la cual soporta múltiples radios y es compatible con 802.11/a/b/g.
Netkrom Technologies	Empresa con aplicaciones enfocadas a dar solución de conectividad con cobertura WLAN y WMAX en capa 3, ofreciendo acceso a internet de banda ancha, vigilancia de video, y telefonía IP.
SkyPilot	Empresa con aplicaciones enfocadas a dar solución de conectividad para internet de banda ancha, soportado en las bandas de 2.4GHz y 5GHz y mediante el uso de protocolos propietario y una programación dinámica del ancho de banda.
Open-Mesh	Empresa con aplicaciones enfocadas a dar solución de conectividad con cobertura WLAN; ofrecen dispositivos de fácil implementación permitiendo al usuario diseñar su propia red mediante la implementación de un Gateway y diferentes repetidores.
ArrowSpan	Las soluciones de redes inalámbricas Mesh ArrowSpan permiten a los proveedores de servicios expandir fácilmente redes inalámbricas existentes hacia redes de mayor cobertura, ofreciendo productos de alta calidad y escalabilidad.
Cisco	Las soluciones Cisco permiten manejar múltiples tamaños de cobertura de las redes las redes para aplicaciones como Aplicaciones empresariales de campo, seguridad pública, uso público, uso municipal o de empresas en ciudad. Logrando así ser viables para hogares, oficinas, empresas o ciudades que las quieran implementar.

Tabla 2 Descripción de las Empresas Seleccionadas

A continuación se presentan las soluciones industriales seleccionadas mostrando un cuadro comparativo de los dispositivos de acuerdo a los parámetros encontrados. En los anexos se encuentran las hojas de especificaciones de los dispositivos presentados.

4.1. MotoMesh

MotoMesh [32] se enfoca en brindar soluciones a nivel municipal donde los trabajadores tengan acceso a Internet y puedan entregar fotos, planos y demás información desde el campo. También que los residentes y visitantes tengan acceso a la red Wi-Fi desde diferentes puntos clave de la ciudad como se aprecia en la figura 7. En la tabla 3 se presentan los dispositivos MotoMesh tipo Outdoor para el diseño de la red.

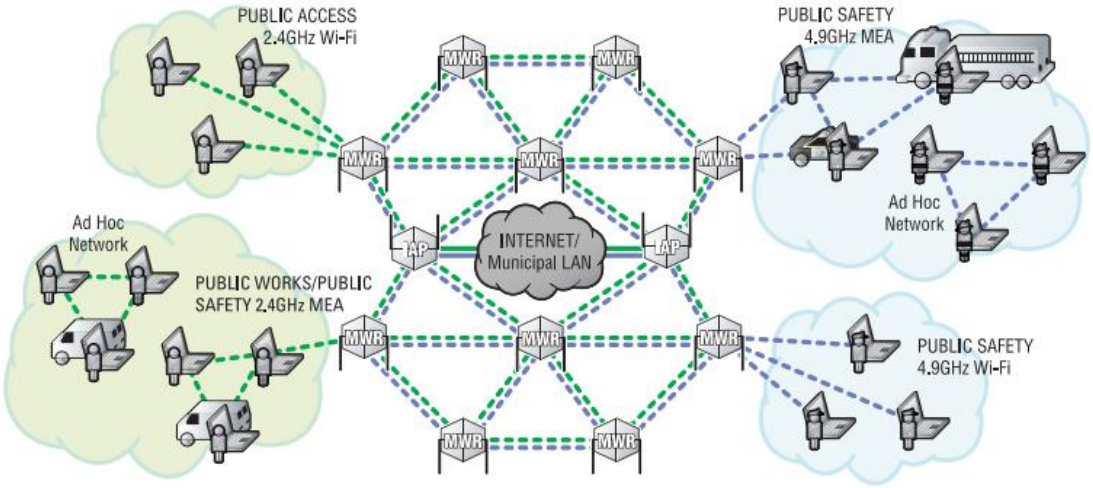

Figura 7 Solución MotoMesh para servicios municipales.[32]

	DISPOSITIVOS MOTOMESH DE MOTOROLA				
Modelo	IAP 4300 Intelligent Access Point	IAP 6300 – Intelligent Access Point	IAP 7300 – Intelligent Access Point	Motorola AP 7181	Motorola AP 7161
Bandas de espectro	2.4 GHz and 4.9, 5.4 or 5.8 GHz	2.4 GHz	2.4, 4.9 GHz	2.4 -2.462 GHz, 5.470 -5.865 GH	2.4GHz and 5Ghz

Algoritmos de seguridad	Authentication: 802.1X (Infrastructure/Client) and MAC address hardware authentication Encryption: WPA2 (AES, 802.11i), WPA (TKIP), WEP	Authentication: RADIUS, 802.1x, EAP-TTLS or EAP-PEAP. Encryption: AES, WEP, WPA2 (AES, 802.11i), WPA (TKIP)	Authentication: MEA-Hardware device authentication & EAP/802.1xmutual; 802.11 b/g-RADIUS 802.1x with EAP/TTLS (or EPP/PEAP). Encryption: AES, TKIP, WEP, WPA, WPA2	Authentication: 802.1x (Infrastructure/Client) and MAC address hardware authentication Encryption: WEP, AES-CCM, TKIP	Stateful Firewall, IP filtering, NAT, 802.1X, 802.11i WPA2, WPA. 24x7 Dual band sensor capabilities
Tasas de transferencia	54 Mpbs (burst data rate)	6 Mbps (burst data rate)	802.11b/g: 54 Mbps (burst data rate) MEA: 6 Mbps (burst data rate)	54 Mpbs (burst data rate) 802.11n: Up to 300Mbps	802.11b/g up to 54Mbps 802.11a: up to 54 Mbps 802.11n: up to 300Mbps
Máxima potencia de Transmisión	35dBm EIRP (802.11b/g), 34 dBm EiRP	N.A.	24 dBm	36 dBm EIRP	25 dBm
Protocolos de enrutamiento	Patented, Layer 2, hybrid proactive/reactive routing	Patented, Layer 2, hybrid proactive/reactive routing	Patented, Layer 2, hybrid proactive/reactive routing	Patented, Layer 2, hybrid proactive/reactive routing	Layer 3 Routing, 802.1q/p, DynDNS, DHCP server/client, BOOTP Client, PPPoE and LLDP
Calidad de Servicio	802.11e, weighted fair queuing and IP precedence bits (ToS) supported via DSCP	802.1p	802.11e, weighted fair queuing and IP precedence bits (ToS) supported via DSCP (MEA: 802.11p)	802.11e QoS	On board IDS, and secure guest hotspot access WMM, WMM-UAPSD, 802.1p, Diffserv and TOS

Tabla 3 Productos MotoMesh de Motorola.

4.2. ORiNOCO

Dentro de la solución ORiNOCO [33] ofrecen diferentes puntos de acceso Mesh con capacidad para entregar datos de forma flexible y fiable a redes de voz y video de áreas metropolitanas y con aplicación a redes empresariales Wi-Fi como se aprecia en la figura 8. La comparación de los productos que ofrece la empresa se encuentra en la tabla 4.

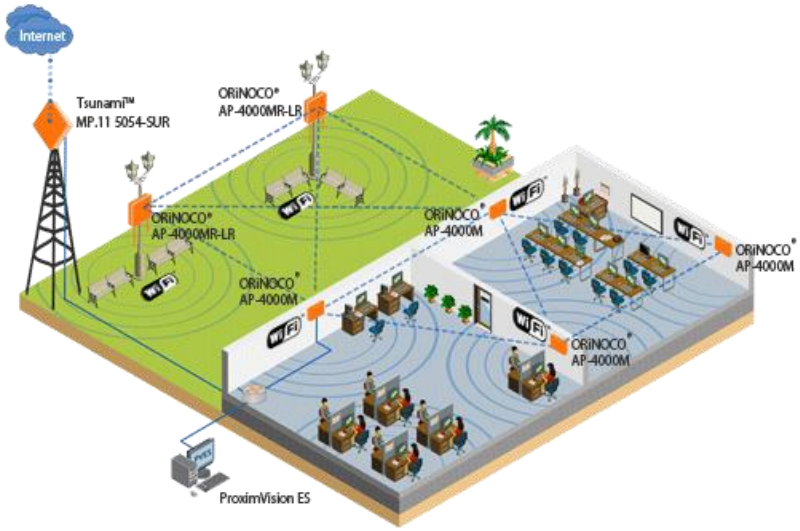

Figura 8 Solución Mesh metropolitana y empresarial ORiNOCO.[33]

	DISPOSITIVOS MESH DE ORINOCO				
Modelo	ORINOCO AP-4000M/AP-4000	ORINOCO AP-4000MR	ORINOCO AP-4000MR-LR	ORINOCO AP-4900M	ORINOCO AP-4900MR-LR
Tipo	Indoor	Outdoor	Outdoor	Indoor	Outdoor
Bandas de Frecuencia	802.11B/G: 2.412 to 2.472 GHz 802.11A: 5.15 to 5.25GHz, 5.25 to 5.35GHz, 5.47 to 5.725GHz, 5.85 to 6.08 GHz	802.11B/G: 2.412 to 2.472 GHz 802.11A: 5.15 to 5.25GHz, 5.25 to 5.35GHz, 5.47 to 5.725GHz, 5.85 to 6.08 GHz	802.11B/G: 2.412 to 2.472 GHz 802.11A: 5.745 to 5.85 GHz	802.11B/G: 2.472 to 2.462 GHz 802.11A: 5.25 to 5.35 GHz (FCC UNII 1 and UNII 2), 5.725 to 5.85 GHz (FCC UNII 3 ISM) 4.9 GHZ: 4.94 to 4.99 GHz (FCC Only)	802.11B/G: 2.472 to 2.462 GHz 4.9 GHZ: 4.94 to 4.99 GHz (FCC Only)
Seguridad	IEEE 802.11i and AES Encryption	IEEE 802.11i and AES Encryption	IEEE 802.11i and AES Encryption	IEEE 802.11i and AES Encryption	IEEE 802.11i and AES Encryption
Tipo de Modulación	OFDM; DSSS	OFDM; DSSS	OFDM; DSSS	OFDM; DSSS	OFDM; DSSS

Tasa de transferencia	802.11B: 1, 2, 5.5, 11 Mbps 802.11G: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11A: 6, 9, 12, 18, 24, 36, 48, 54 Mbps	802.11B: 1, 2, 5.5, 11 Mbps 802.11G: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11A: 6, 9, 12, 18, 24, 36, 48, 54 Mbps	802.11B: 1, 2, 5.5, 11 Mbps 802.11G: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11A: 6, 9, 12, 18, 24, 36, 48, 54 Mbps	802.11B:1, 2, 5.5, 11 Mbps 802.11G: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11A: 6, 9, 12, 18, 24, 36, 48, 54 Mbps	802.11B: 1, 2, 5.5, 11 Mbps 802.11G: 6, 9, 12, 18, 24, 36, 48, 54 Mbps
Máxima potencia de transmisión	+20 dBm for 802.11b, +18 dBm for 802.11g and 802.11a	+20 dBm for 802.11b, +18 dBm for 802.11g and 802.11a	+24 dBm for 802.11b, +24 dBm for 802.11g and 802.11a	+18 dBm for 802.11g and 802.11a/4.9 GHz; +20 dBm for 802.11b	+20 dBm for all modulations on 4.9 GHz; +24 dBm for 802.11b/g
Consumo de energía	Maximum 9 Watts	Maximum 9 Watts	Maximum 20Watts	Maximum 10 Watts	Maximum 20Watts
Protocolos de enrutamiento	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada
Calidad de Servicio	Draft IEEE 802.11e support along with 802.1p and 802.1q improve performance of video and voice application	Draft IEEE 802.11e support along with 802.1p and 802.1q improve performance of video and voice applications	Draft IEEE 802.11e support along with 802.1p and 802.1q improve performance of video and voice applications	Draft IEEE 802.11e along with 802.1p and 802.1q improve performance of video and voice application	Draft IEEE 802.11e along with 802.1p and 802.1q improve performance of video and voice application

Tabla 4 Productos ORiNOCO.

4.3. BelAir Networks

En Ontario, Canadá la empresa BelAir Networks [34] brinda por medio de 802.11b cobertura a amplias zonas ofreciendo soluciones de enrutadores con 3 radios incorporados, arreglos de 8 antenas direccionales, y balance de cargas. Una de sus aplicaciones relevantes es el monitoreo dentro de vehículos que viajan a 240Kph usando nodos BelAir100M que crean la infraestructura como se aprecia en la figura 9. También puede ser usada para dar servicio inalámbrico dentro del vehículo. La comparación de los productos de BelAir se muestra en la tabla 5.

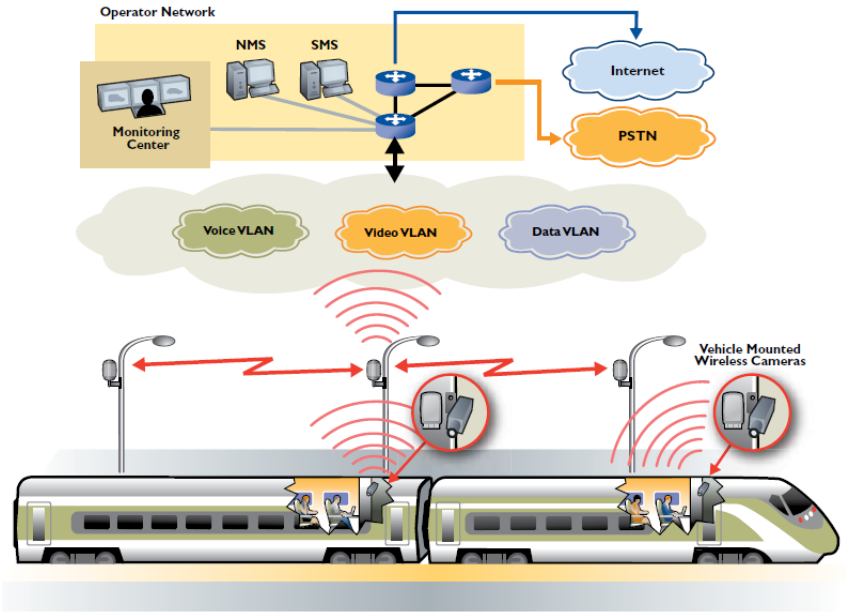

Figura 9 Solución Mesh para Monitoreo vehicular de BelAir Networks.[34]

	DISPOSITIVOS MESH DE BELAIR NETWORKS						
Modelo	BelAir100M Mobile Mesh Node	BelAir20M Mobile Bridge	BelAir100T Wireless Mesh Node"	BelAir200 Wireless Multi-service Switch Router	BelAir100N Wireless Access Point	BelAir100LP LTE Picocell	BelAir100SNE Strand-Mounted Wireless Access Point
Tipo	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
Bandas de Frecuencia	IEEE 802.11a/b/g. 4.9 GHz Public Safety, 5.9 GHz ITS	dual-band 2.4 y 5 GHz	2.3 GHz, 2.5 GHz and 4.9 GHz	Wi-Fi, WiMAX, Cellular, and 4.9 GHz Public Safety spectrums.	2.4 GHz, 5 GHz, 4.9 GHz Public Safety and 5.9 GHz ITS Spectrums	Dual 2.4/5 GHz radios and Frequency Bands 700, 800, 1700/2100, 1800, 1900, 2600MHz	Dual 2.4/5 GHz radios 802.11n Wi-Fi radios

Seguridad	Authentication: 802.1x (RADIUS) and EAP methods Encryption: WEP 64 and 128 bit,TKIP / MIC per 802.1x, 802.11i AES MAC address access control lists	Authentication: 802.1x (RADIUS) and EAP methods Encryption: WEP 64 and 128 bit,TKIP / MIC per 802.1x, 802.11i AES MAC address access control lists	Authentication: 802.1x (RADIUS) and EAP methods Encryption: WEP 64 and 128 bit,TKIP / MIC per 802.1x, 802.11i AES MAC address access control lists	Authentication: 802.1x (RADIUS) and EAP methods Encryption: WEP 64 and 128 bit,TKIP / MIC per 802.1x, 802.11i AES MAC address access control lists	Authentication: 802.1x (RADIUS) and EAP methods Encryption: WEP 64 and 128 bit,TKIP / MIC per 802.1x, 802.11i AES MAC address access control lists	Authentication: 802.1x (RADIUS) and EAP methods Encryption: WEP 64 and 128 bit,TKIP / MIC per 802.1x, 802.11i AES MAC address access control lists	Authentication: 802.1x (RADIUS) and EAP methods Encryption: WEP 64 and 128 bit,TKIP / MIC per 802.1x, 802.11i AES MAC address access control lists
Potencia de transmisión	Unknown	2.4GHz • up to 19 dBm EIRP 5GHz • up to 30dBm EIRP	transmit (17 dBm) and receive (-93dBm)	Unknown	Unknown	Transmit Power up to 2W	Up to 38 dBm EIRP transmit power
Tasas de transferencia	Unknown	600Mbps	Unknown	600Mbps	Unknown	“260 Mbps in 8 bonded 44annel operation”	“260 Mbps in 8 bonded 44annel operation”
Consumo de energía	23 Watts	16,8 Watts	Unknown	58 Watts	24 Watts	60 Watts	28 Watts
Protocolos de enrutamiento	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada

Tabla 5 Productos BelAir Networks.

4.4. Firetide

Firetide [35] ubicado en Hawaii y Silicon Valley, USA, ofrece conectividad en capa 2, tanto en ambientes *indoor* como *outdoor*, con protocolos propietarios, trabajando en las bandas 2.5GHz y 5 GHz, variando la potencia de transmisión e implementando protocolos de seguridad WEP y software de gestión aptos para la soportar video, voz y datos sobre la red. La solución que ofrecen se

acomoda perfectamente para la ampliación de una red existente e integrarla con otras como se observa en la figura 10.

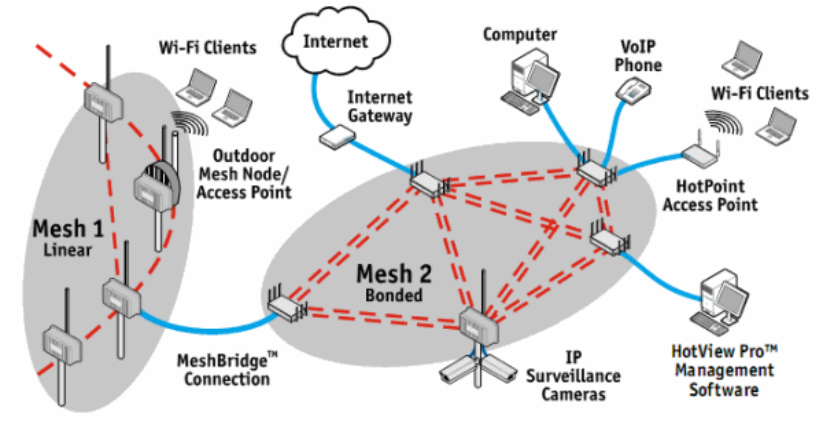

Figura 10 Solución empresarial de Firetide. [35]

	DISPOSITIVOS FIRETIDE MESH					
Modelo	HotPort 7010	HotPort 7020	HotPort 6102 – Dual-radio	HotPort 6202 – Dual-radio	HotPort 6100-900 – Dual-radio	HotPort 6200-900 – Dual-radio
Tipo	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor
Bandas de frecuencia	2.412 – 2.483 GHz 5.15 – 5.25 GHz 5.25 – 5.35 GHz 5.470 – 5.725 GHz 5.725 – 5.850 GH	2.412 – 2.483 GHz 4.94 – 4.99 GHz (US public safety band) 5.25 – 5.35 GHz 5.470 – 5.725 GHz 5.725 – 5.850 GH	2.412 – 2.483 GHz 4.94 – 4.99 GHz (US public safety band) 5.15 – 5.25 GHz 5.25 – 5.35 GHz 5.470 – 5.725 GHz 5.725 – 5.825 GHz	2.412 – 2.483 GHz 4.94 – 4.99 GHz (US public safety band) 5.15 – 5.25 GHz 5.25 – 5.35 GHz 5.470 – 5.725 GHz 5.725 – 5.825 GHz	902 – 928 Mhz 2.412 – 2.483 GHz 4.94 – 4.99 GHz (US public safety band) 5.15 – 5.25 GHz 5.25 – 5.35 GHz 5.470 – 5.725 GHz 5.725 – 5.825 GHz	902 – 928 Mhz 2.412 – 2.483 GHz 4.94 – 4.99 GHz (US public safety band) 5.15 – 5.25 GHz 5.25 – 5.35 GHz 5.470 – 5.725 GHz 5.725 – 5.825 GHz

Seguridad	40 bit, 104 bit WEP keys 128 bit, 256 bit AES keys (WPA2, end-to-end data) MAC address filtering Digitally signed firmware files Digital certificates on nodes	40 bit, 104 bit WEP keys 128 bit, 256 bit AES keys (WPA2, end-to-end data) MAC address filtering Digitally signed firmware files Digital certificates on nodes	40 bit, 104 bit WEP keys 128 bit, 256 bit AES keys (WPA2, end-to-end data) MAC address filtering Digitally signed firmware files Digital certificates on nodes	40 bit, 104 bit WEP keys 128 bit, 256 bit AES keys (WPA2, end-to-end data) MAC address filtering Digitally signed firmware files Digital certificates on nodes	40 bit, 104 bit WEP keys 128 bit, 256 bit AES keys (WPA2, end-to-end data) MAC address filtering Digitally signed firmware files Digital certificates on node	40 bit, 104 bit WEP keys 128 bit, 256 bit AES keys (WPA2, end-to-end data) MAC address filtering Digitally signed firmware files Digital certificates on node
Protocolo de enrutamiento	Firetide AutoMesh™ Protoco	Firetide AutoMesh™ Protoco	Firetide AutoMesh™ Protoco	Firetide AutoMesh™ Protoco	Firetide AutoMesh™ Protoco	Firetide AutoMesh™ Protoco
Potencia de transmisión	up to 400 mW per stream	up to 400 mW per stream	up to 400 mW	up to 400 mW	up to 400 mW for 2.4/5 Ghz radio & 630 mW for 900 Mhz radio	up to 400 mW for 2.4/5 Ghz radio & 630 mW for 900 Mhz radio
Consumo de energía	30 Watts	48 Watts	27 Watts	45 Watts	27 Watts	45 Watts
Protocolos de enrutamiento	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada
Calidad de Servicio	QoS 802.1p	QoS 802.1p	QoS 802.1p	QoS 802.1p	QoS 802.1p	QoS 802.1p

Tabla 6 Productos Firetide

4.5. Tropos Networks

La empresa Tropos Networks [36] implemento a una escala mayor la solución llamada MetroMesh la cual se basa en una arquitectura de red que utiliza estándares abiertos de radio y comunicaciones IP. Consiste en una

infraestructura física común que le permita a una ciudad trabajar en diferentes aplicaciones incluyendo Smart Grid, sistemas de transporte inteligente, video vigilancia y seguridad pública como se puede apreciar en la figura 11.

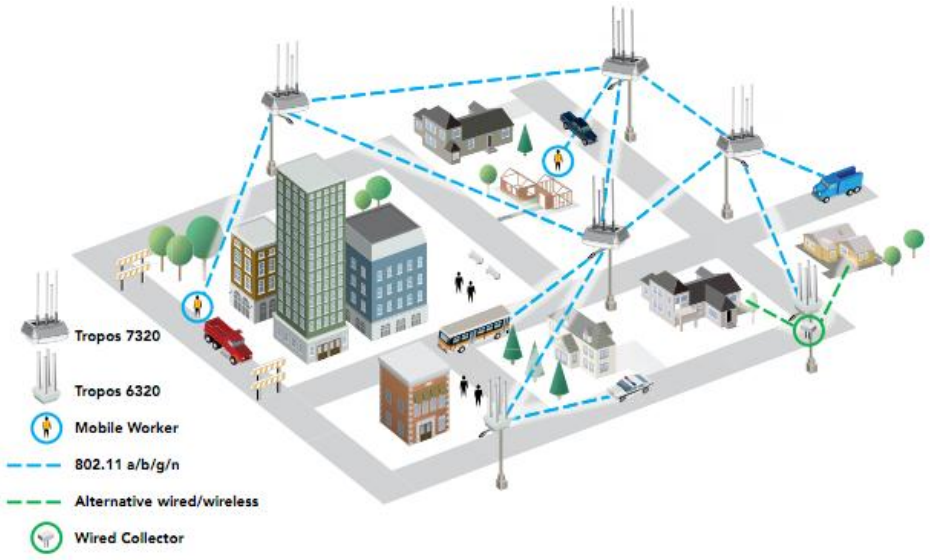

Figura 11 Solución municipal MetroMesh de Tropos Networks.[36]

MetroMesh utiliza Routers optimizados de Tropos con un sistema operativo propietario apto para Mesh que hace que la red sea muy resistente, tenga rendimiento escalable, de alto rendimiento, y la arquitectura de red segura que es escalable y económica. La tabla 7 muestra la comparación entre los dispositivos de la empresa.

	DISPOSITIVOS METROMESH DE TROPOS NETWORKS					
Modelo	7320	6320/6310	5320	9532	4310	3320/3310
Tipo	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Indoor

Bandas de frecuencia	Dual-band 2.4 y 5 GHz	Dual-band 2.4 y 5 GHz	Dual-band 2.4 y 5 GHz	Dual-band 2.4 y 4.9 GHz	Single-band 2.4Ghz	Available in single (2.4 GHz) or dual-radio (2.4/5 GHz)
Tipo de modulación digital	• 802.11g/n: OFDM (64-QAM, 16-QAM, QPSK, BPSK) • 802.11b – DSSS (DBPSK, DQPSK, CCK) • 802.11a/n: OFDM (64-QAM,16-QAM)	• 802.11g/n: OFDM (64-QAM, 16-QAM, QPSK, BPSK) • 802.11b: DSSS (DBPSK, DQPSK, CCK) • 802.11a/n: OFDM (64-QAM, 16-QAM, QPSK, BPSK)	• 802.11g - OFDM (64-QAM, 16-QAM, QPSK, BPSK) • 802.11b - DSSS (DBPSK, DQPSK, CCK) • 802.11a - OFDM (64-QAM, 16-QAM)	• 802.11g - OFDM (64-QAM, 16-QAM, QPSK, BPSK) • 802.11b - DSSS (DBPSK, DQPSK, CCK) • 802.11a - OFDM (64-QAM, 16-QAM)	• 802.11g - OFDM (64-QAM, 16-QAM, QPSK, BPSK) 802.11b - DSSS (DBPSK, DQPSK, CCK)	• 802.11g/n - OFDM (64-QAM, 16-QAM, QPSK, BPSK) • 802.11b – DSSS (DBPSK, DQPSK, CCK) • 802.11a/n - OFDM (64-QAM, 16-QAM, QPSK, BPSK)
Seguridad	Authentication: WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAPTTLS, EAP-SIM, PEAP) Encryption: Open, WEP, TKIP, AES-CCM	Authentication: WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAPTTLS, EAP-SIM, PEAP) Encryption: Open, WEP, AES-CCM, TKIP	Authentication: 802.11i, 802.1x (including EAP-TLS/TTLS/SIM/PEAP) Encryption: Open, WEP, TKIP, AES	Authentication: 802.11i, WPA, WPA2, 802.1x (including EAP-TLS/TTLS/SIM/PEAP) Encryption: Open, WEP, TKIP, AES	Authentication: WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAPTTLS, EAP-SIM, PEAP) Encryption: Open, WEP, AES-CCM, TKIP	Authentication: WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAPTTLS, EAP-SIM, PEAP) Encryption: Open, WEP, AES-CCM, TKIP
Técnicas de acceso al medio	CSMA/CA with ACK	CSMA/CA with ACK	CSMA/CA with ACK	CSMA/CA with ACK	CSMA/CA with ACK	CSMA/CA with ACK

Potencia de transmisión	• ETSI/EU 5-20 dBm (EIRP) set in 1 dB units; FCC/IC 21-36 dBm (EIRP) set in 1 dB units • ETSI/EU 15-30 dBm (EIRP) factory-set in 1 dB units; FCC/IC 20-35 dBm (EIRP) factoryset in 1 dB units	• ETSI/EU 5-20 dBm (EIRP) set in 1 dB units; FCC/IC 20-35 dBm (EIRP) set in 1 dB units • ETSI/EU 15-30 dBm (EIRP) set in 1 dB units; FCC/IC 19-34 dBm (EIRP) set in 1 dB units	• ETSI/EU 20dBm (EIRP) FCC/IC 36dBm (EIRP) • ETSI/EU 29dBm (EIRP) FCC/IC 43dBm (EIRP) point-to-point 36dBm (EIRP) point-to-multipoint, sector 33dBm (EIRP) point-to-multipoint, omni	• 36dBm (EIRP) • 29dBm EIRP	• 36dBm (EIRP)	• ETSI/EU 5-20 dBm (EIRP) set in 1 dB units; FCC/IC 20-35 dBm (EIRP) set in 1 dB units • ETSI/EU 15-30 dBm (EIRP) set in 1 dB units; FCC/IC 19-34 dBm (EIRP) set in 1 dB units
Protocolos de enrutamiento	PWRP	PWRP	PWRP	PWRP	PWRP	PWRP
Tasa de transferencia	54 Mbps con -84dBm	54 Mbps con -84dBm	54 Mbps con -76 dBm	54 Mbps con -76 dBm	54 Mbps con -76 dBm	54 Mbps con -76 dBm

Tabla 7 Productos Tropos Networks

4.6. Strix Systems

Strix Systems [37] dedicada exclusivamente a las soluciones de Redes Inalámbricas Mesh de alto rendimiento tiene una arquitectura modular que soporta varios radios, varios canales y varias tecnologías de radiofrecuencia, apta para prestar servicios e implementarse en ciudades grandes y redes con cobertura nacional. De acuerdo como se muestra en la figura 12 la solución Mesh de Strix Systems pretende ser expandible y robusta para satisfacer diferentes servicios tanto a dispositivos cercanos, en el medio y de última milla.

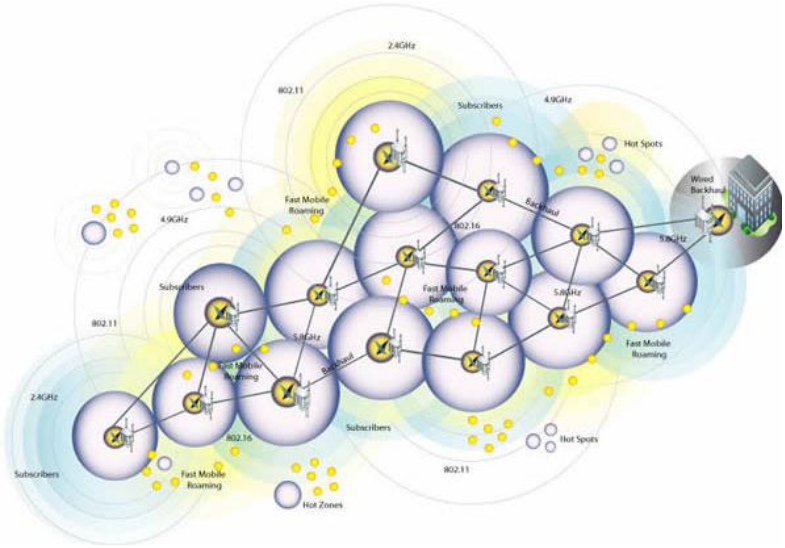

Figura 12 Solución de convergencia bandas de frecuencia de Strix Systems.[37]

	DISPOSITIVOS MESH DE STRIX SYSTEMS				
Modelo	A1N5600	OWS Outdoor	MWS100HSX	HSX Hot Zone	EWS Edge
Tipo	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
Bandas de frecuencia	2.4 GHz, 4.9 GHz, 5 GHz	2.4 GHz, 4.9 GHz, 5 GHz	2.4 GHz, 4.9 GHz, 5 GHz	Dual-band 2.4 y 4.9 GHz	Single-band 2.4Ghz
Tipo de modulación digital	• Orthogonal Frequency division Multiplexing(OFDM) • BPSK,QPSK,16-QAM, 64-QAM • 802.11b - DSS(QPSK, BPSK,CCK)	• 802.11a/4.9 – BPSK, QPSK, 16 QAM, 64 QAM • 802.11g – DBPSK, DQPSK, CCK	• Orthogonal Frequency Division • Multiplexing (OFDM) • (BPSK, QPSK, 16-QAM, 64-QAM) • 802.11b – DSS (BPSK, QPSK, CCK)		

Seguridad	Authentication: 802.1x support, RADIUS – Up to 2 RADIUS servers per BSSID, RADIUS Client Functionality, EAP-MD5, TLS, TTLS, PEAP, WPA, WPA2, PSK, ACL, Strix Access/One Encryption: Backhaul: AES CCM, Client: AES, TKIP and WEP	Authentication: 802.1x support, including RADIUS client, EAP-MD5, EAP-TLS, and PEAP-TTLS, WPA2 Encryption: IEEE 802.11i with AES and WEP	Authentication: 802.1x support, RADIUS – Up to 2 RADIUS servers per BSSID, RADIUS Client Functionality, EAP-MD5, TLS, TTLS, PEAP, WPA, WPA2, PSK, ACLs, Strix Access/One Encryption: Backhaul: AES CCM, Client: AES, TKIP and WEP	WPA-PSK, WPA2-PSK, WEP, TKIP, AES, MAC Address ACL	WPA-PSK, WPA2-PSK, WEP, TKIP, AES, MAC Address ACL
Técnicas de acceso al medio	Unknown	802.11a/g/4.9 – OFDM	802.11a/g/4.9 – OFDM	Unknown	Unknown
Potencia de transmisión	Up to 27 dBm Transmit Power Control by 1db	(802.11a/g/4.9): 26 dBm	Up to 26 dBm, 400mW	802.11a: 26 dBm 4.9 GHz: 30 dBm 802.11b/g: 26 dBm	802.11b/g: 26 dBm
Tasa de transferencia	Up to 300 Mbps -64 dBm	54 Mbps con -75 dBm	54 Mbps con -74 dBm	54 Mbps con -75 dBm	54 Mbps con -72 dBm
Protocolos de enrutamiento	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada

Tabla 8 Productos Strix Systems

4.7. Netkrom Technologies

Netkrom Technologies [38] es una empresa americana que ha incursionado en soluciones inalámbricas en diferentes países del mundo incluyendo Latinoamérica. En cuanto a Redes Mesh la empresa ofrece una solución llamada MetroMesh en la capa 3 que realiza cambio de bandas de radio de una red común de una red estándar Wi-Fi para ofrecer servicios de Internet

móvil, vigilancia de video, acceso a Internet de banda ancha en residencias y pequeños negocios, y acceso de telefonía IP. Además ofrecen una solución municipal a ciudades o pueblos que no tengan otra fuente de acceso, instalando nodos MetroMesh en lo alto de los edificios para tener cobertura dentro del área de la ciudad hasta el suelo. Se benefician igualmente los residentes del edificio donde exista un nodo, ya que pueden tener acceso a través de la tecnología “Ethernet over Powerline” obteniendo una conexión de hasta 10MB. El tiempo de saltos que tomaría para un usuario salir a la infraestructura inalámbrica y llegar a un nodo principal no supera los 10ms. Igualmente el sistema ha sido probado ingresando desde vehículos que viajan a 140km/h.

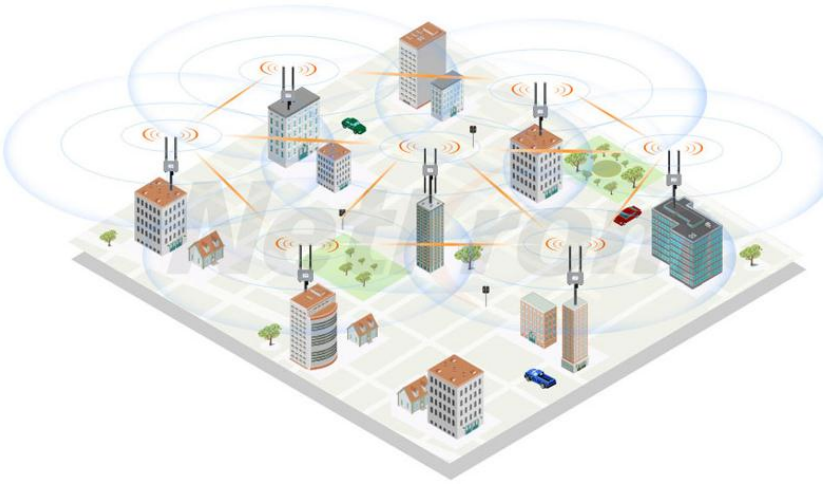

Figura 13 Solución municipal de Netkrom Technologies.[38]

	DISPOSITIVOS DE NETKROM TECHNOLOGIES	
Modelo	Multi-band Backhaul/AP Dual Radio	ISPAIR Multi-band Base Station 500 Series
Tipo	Outdoor	Outdoor

Bandas de frecuencia	902 - 928MHz 2400-2497MHz (*) 5150-5850MHz (*) Banda Extendida: 2312-2500MHz Banda Extendida: 4920-6100MHz (*)programable de acuerdo a las regulaciones de cada país)	Banda 2.4GHz: 2400-2497MHz(*) 2300 ~ 2500 MHz(*) Banda 4.9GHz: 4940-4990MHz (Banda de Seguridad Pública) Banda 5GHz: 5150-5850MHz (*) (*Programable de acuerdo a las distintas regulaciones de cada país)
Tipo de modulación digital	DSSS/OFDM (BPSK,QPSK, 16-QAM, 64-QAM)	DSSS (DBPSK, DQPSK, CCK) OFDM (BPSK,QPSK, 16-QAM, 64-QAM)
Seguridad	Lista de Control de Acceso WEP 64/128 WPA1/WPA2 con cifrado TKIP & AES	Lista de Control de Acceso WEP 64/128 WPA1/WPA2 con cifrado TKIP & AES
Técnicas de acceso al medio	Time Division Duplex (TDD) con CSMA/CA	TDD (CSMA/CA)
Potencia de transmisión	1 Watt	1 Watt
Tasa de transferencia	54/108 Mbps	216 Mbps (54 Mbps por cada radio)
Calidad de Servicio	Commited Information Rate (CIR) Peak Information Rate (PIR) Commited Burst Size (CBS) Excess Burst Size (EBS)	Commited Information Rate (CIR) Peak Information Rate (PIR) Commited Burst Size (CBS) Excess Burst Size (EBS)

Tabla 9 Productos de Netkrom Technologies.

4.8. SkyPilot

SkyPilot [39] es una empresa con base en Santa Clara, California que ofrece a nivel mundial una solución llamada SyncMesh que se caracteriza por ser robusta y ofrecer diferentes tipos de servicio dentro de un área extendida. SyncMesh es escalable, reduce el tiempo de diseño de la red y es compatible con otros sistemas de redes.

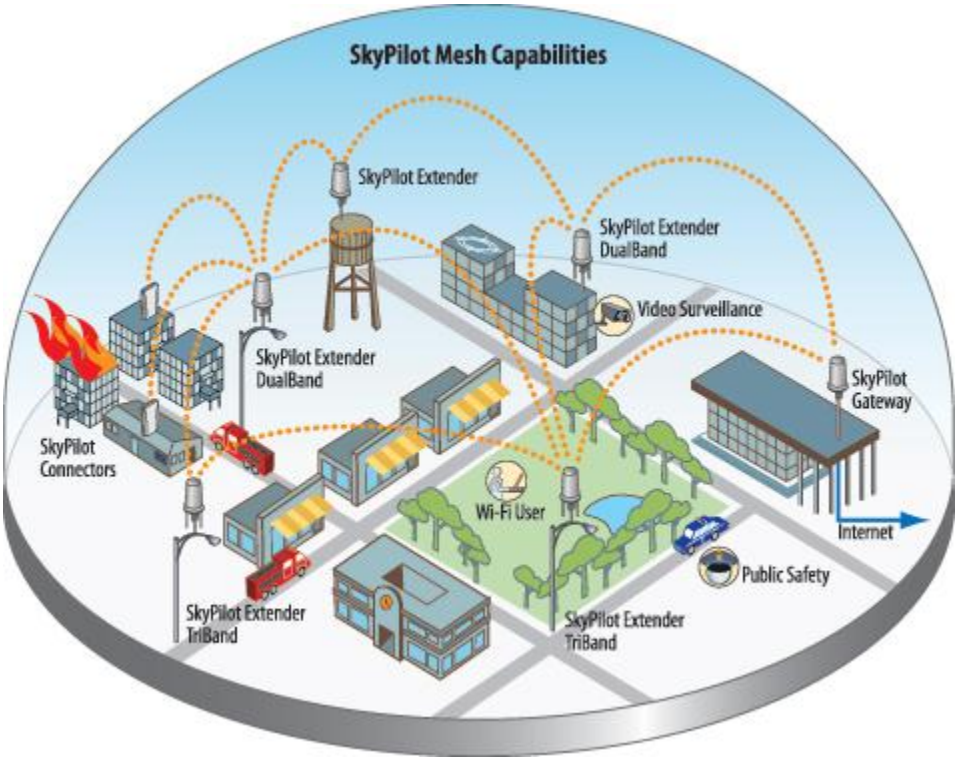

Figura 14 Solución SyncMesh de SkyPilot.[39]

	DISPOSITIVOS DE SKYPILOT		
Modelo	SkyPilot Gateway	SkyPilot Gateway DualBand	SkyPilot Gateway TriBand

Bandas de frecuencia	4.940 – 6.075 GHz	4.940 – 6.075 GHz	5.250 – 6.075 GH
Tipo de modulación digital	OFDM with adaptive modulation	OFDM with adaptive modulation	OFDM with adaptive modulation
Técnicas de acceso al medio	Time Division Duplex (TDD	Time Division Duplex (TDD	Time Division Duplex (TDD
Acceso local inalámbrico	Ninguno	802.11b/g (2.4 GHz) or 802.11a (4.9 GHz	802.11b/g (2.4 GHz) and 802.11a (4.9 GHz
Seguridad	AES-128 encryption Certificate-based authentication	AES-128 encryption Certificate-based authentication	AES-128 encryption Certificate-based authentication
Tasas de transferencia	6 / 9 / 12 /15 / 18 / 24 / 36 /48 / 54 Mbps	6 / 9 / 12 /15 / 18 / 24 / 36 /48 / 54 Mbps	6 / 9 / 12 /15 / 18 / 24 / 36 /48 / 54 Mbps
Potencia de transmisión	30 dBm (maximum at radio antenna port	30 dBm (maximum at radio antenna port	30 dBm (maximum at radio antenna port
Protocolos de enrutamiento	Información no suministrada	Información no suministrada	Información no suministrada

Tabla 10 Productos de Skypilot.

4.9. Open-Mesh

Open-Mesh [40] es una empresa establecida desde el 2007 que ofrece una solución que dice ser de bajo costo para dar conectividad de Internet en cualquier lugar que se necesita, ya sea en un hotel, un apartamento, una

oficina, el vecindario, centro comercial, café como por ejemplo. Ofrecen todos los componentes necesarios desde los puntos de acceso, enchufes y software para el montaje de la red. La empresa tiene soluciones alrededor del mundo como se observa en la figura 15.

Figura 15 Lugares donde se encuentra la solución Open-Mesh [40]

	DISPOSITIVOS OPEN-MESH	
Modelo	MR500	OM1P
Tipo	Outdoor	Indoor / Outdoor
Bandas de frecuencia	2.4 & 5Ghz	2,4 GHz
Protocolos de enrutamiento	Información no suministrada	Información no suministrada
Seguridad	WPA2 / WPA-Enterprise	WPA encrypted.

Tasas de transferencia	300mbps	108 mbps
Potencia de transmisión	18-21dBm	100mw (20dBm)
Calidad de servicio	Voice, video prioritization VLAN tagging (not in beta	NA

Tabla 11 Productos de Open-Mesh

4.10. ArrowSpan

ArrowSpan Inc. [41] es una empresa fundada en 2005 la cual desarrolla equipos para redes MESH de alto rendimiento, ofreciendo productos multi-radio para el diseño de redes Wi-Fi MESH y movil MESH, dando solución a espacios indoor y outdoor ofreciendo un alto nivel de escalabilidad y seguridad en sus sistemas, con productos como el Quad RF MeshAP 3800 y el 700MHz mobile MESH 7700.

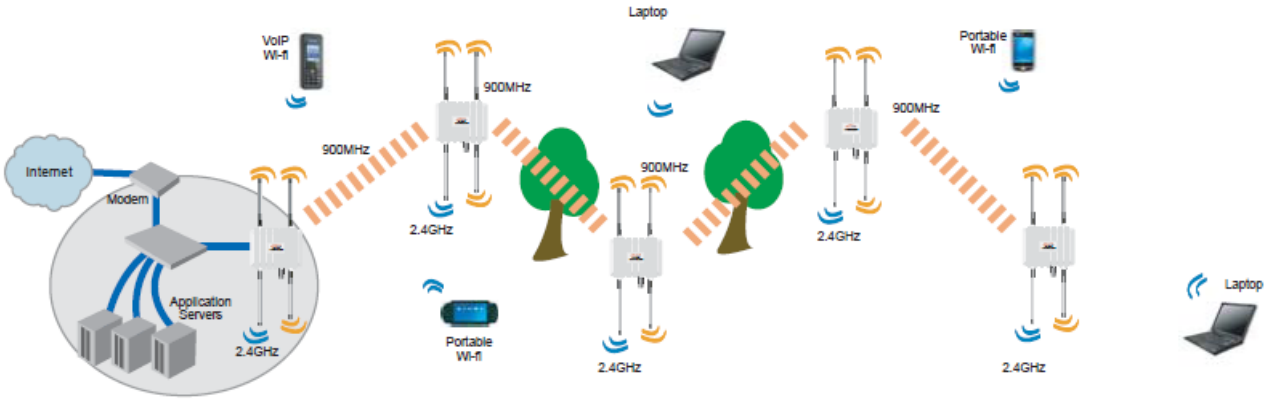

Figura 16 Solución ArrowSpan [41]

	DISPOSITIVOS DE ARROWSPAN			
Modelo	MA3100-X	MA388-A9	MAM7700	MeshAP3800
Bandas de frecuencia	5.725 - 5.850 GHz/2.4GHz (optional)	2.4GHz ISM radio band	700 – 721MHz, 760 – 781MHz	5.8GHz/5.4GHz/5.3GHz/4.9GHz ISM radio band
Tipo de modulación digital	OFDM (64-QAM, 16-QAM, QPSK, BPSK)	OFDM (64-QAM, 16-QAM, QPSK, BPSK)	Orthogonal Frequency Division Multiplexing (OFDM)	OFDM(64-QAM, 16-QAM, QPSK, BPSK)
Técnicas de acceso al medio	CSMA/CA with ACK	CSMA/CA with ACK	N.A.	CSMA/CA with ACK
Seguridad	64/128/152bit WEP encryption WPA/WPA-2 (Hardware Accelerated, 128bit AES) Radius support Multi-level Mesh operator username/password Mesh ID protection MAC address based filtering AP Features (3100-X only)	64bit, 128bit WEP encryption (Hardware Accelerated) WPA/WPA-2 (Hardware Accelerated) Mesh operator username/password Mesh ID protection Software RESET button to factory default	Advanced 128-bit AES Encryption (Hardware Accelerated)	64bit, 128bit WEP encryption (Hardware Accelerated) WPA/WPA-2 (Hardware Accelerated, 128bit AES) Radius support Multi-level Mesh operator username/password Mesh ID protection MAC based filter
Tasas de transferencia	6, 9, 12, 18, 24, 36, 48, 54Mbps (x2 trunk optional)	802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11b: 1,2, 5.5, 11Mbps	N.A.	802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11b: 1,2, 5.5, 11Mbps
Potencia de transmisión	Hasta 27dBm	Hasta 1W	Hasta 1W	Hasta 27dBm
Protocolos de enrutamiento	Patent pending, auto-discovery, auto-configure, and auto-healing POP (Predictable Optimum Path) Mesh routing algorithm	Patent pending, auto-discovery, auto-configure, and auto-healing POP (Predictable Optimum Path) Mesh routing algorithm	Patent pending, auto-discovery, auto-configure, and auto-healing POP (Predictable Optimum Path) Mesh routing Algorithm	Patent pending, auto-discovery, auto-configure, and auto-healing POP (Predictable Optimum Path) Mesh routing Algorithm

Tabla 12 Dispositivos ArrowSpan

4.11. Cisco Wireless MESH

Cisco Wireless Mesh Networking Solution [42] ofrece una solución con alta escalabilidad, despliegue de seguridad, capacidad de redes outdoor metropolitanas MAN para acceso público, así como extensiones Wi-Fi outdoor para redes empresariales. Esta es una solución robusta de alto rendimiento de fácil despliegue, escalabilidad, movilidad asi como políticas y protocolos de funcionamiento unificados para soluciones de redes indoor y outdoor.

Estas es una solucion de tipo empresarial que busca agilizar los flujos de trabajo, disminuir la necesidad de mano de obra y aumentar la productividad de las empresas en las ciudades y en el campo.

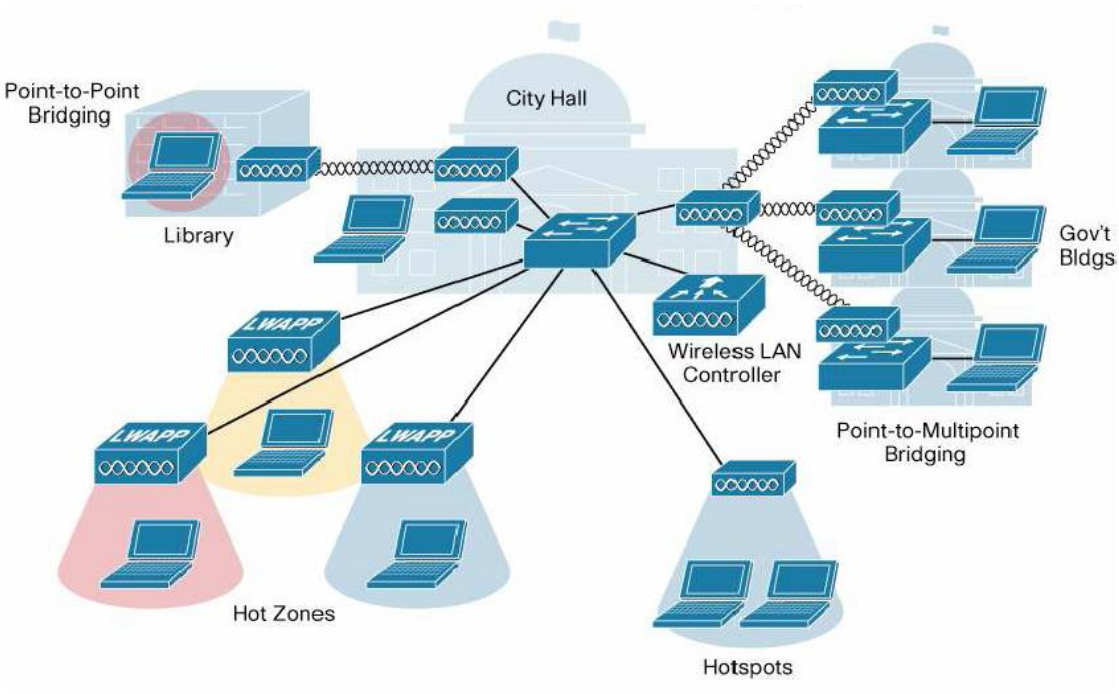

Figura 17 Despliegue de Dispositivos Cisco [42]

	DISPOSITIVOS DE CISCO			
Modelo	Cisco Aironet 1520 Series	Cisco Aironet 1550 Series	Cisco Aironet 1300 Series	Cisco Aironet 1400 Series

Bandas de frecuencia	2.401 to 2.473 GHz; 11 channels 4.940 to 4.990 GHz; 5MHz-10 channels 10MHz-5 channels 20MHz-2 channels 5.250 to 5.850 GHz; 16 channels (excludes channel 120, 124, 128)	2.400 to 2.4835 GHz; 11 channels 5.725 to 5.850 GHz; 5 channels	2.412 to 2.462 GHz (FCC) 2.412 to 2.472 GHz (ETSI) 2.412 to 2.472 GHz (TELEC)	5.725 to 5.825 GHz (FCC UNII 3)
Tipo de modulación digital	802.11a: Orthogonal Frequency Division Multiplexing (OFDM) 802.11b: Direct Sequence Spread Spectrum (DSSS) 802.11g: OFDM	Modulation and Coding Scheme (MCS)	802.11b Direct Sequence Spread Spectrum (DSSS): Differential Binary Phase Shift Keying (DBPSK) at 1 Mbps Differential Quadrature Phase Shift Keying (DQPSK) at 2 Mbps Complementary Code Keying (CCK) at 5.5 and 11 Mbps 802.11g Orthogonal Frequency Divisional Multiplexing (OFDM): BPSK at 6 and 9 Mbps QPSK at 12 and 18 Mbps 16-quadrature amplitude modulation (QAM) at 24 and 36 Mbps 64-QAM at 48 and 54 Mbps	BPSK @ 6 and 9 Mbps QPSK @ 12 and 18 Mbps 16-QAM @ 24 and 36 Mbps 64-QAM @ 48 and 54 Mbps
Técnicas de acceso al medio	N.A.	N.A.	Carrier-Sense Multiple Access with Collision Avoidance (CSMA/CA)	Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)

Seguridad	Wireless bridging/Mesh X.509 digital certificates MAC address authentication Advanced Encryption Standards (AES), Temporal Key Integrity Protocol (TLIP) Wireless access 802.11i, Wi-Fi Protected Access (WPA2), WPA 802.1X authentication, including Extensible Authentication Protocol and Protected EAP (EAP-PEAP), EAP-Transport Lauer Security (EAP-TLS), EAP-Tunneled TLS (EAP-TTLS), and Cisco LEAP Advanced Encryption Standards (AES), Temporal Key Integrity Protocol (TLIP) VPN pass-through IP Security (IPsec), Layer 2 Tunneling Protocol (L2TP) MAC address filtering	Wireless bridging/Mesh X.509 digital certificates MAC address authentication Advanced Encryption Standards (AES), Temporal Key Integrity Protocol (TLIP) Wireless access 802.11i, Wi-Fi Protected Access (WPA2), WPA 802.1X authentication, including Extensible Authentication Protocol and Protected EAP (EAP-PEAP), EAP Transport Lauer Security (EAP-TLS), EAP-Tunneled TLS (EAP-TTLS), and Cisco LEAP Advanced Encryption Standards (AES), Temporal Key Integrity Protocol (TLIP) VPN pass-through IP Security (IPsec), Layer 2 Tunneling Protocol (L2TP) MAC address filtering	Cisco Wireless Security Suite supporting WPA and WPA2, including: Authentication: Management frame protection provides for the authentication of 802.11 management frames by the wireless network infrastructure. This allows the network to detect spoofed frames from access points or malicious users impersonating infrastructure access points. If an access point detects a malicious attack, an incident will be generated by the access points and reports will be gathered on the Cisco wireless LAN controller, Cisco WCS, or CiscoWorks WLSE. 802.1X support including Cisco LEAP, Protected EAP-Generic Token Card (PEAP-GTC), PEAP-Microsoft Challenge Authentication Protocol Version 2 (MSCHAPv2), EAP Message Digest 5 (EAP MD5), EAP-Transport Layer Security (EAPTLS), EAP-Tunneled TLS (EAP-TTLS), EAP-Subscriber Identity Module (EAP-SIM), and EAP-Flexible Authentication via Secure Tunneling (EAP-FAST) to yield mutual authentication and dynamic per user, per-session encryption keys Encryption: WPA: Cisco TKIP or WPA TKIP; key hashing (per-packet keying), MIC and broadcast key rotation WPA2: AES (802.11i)	Cisco Wireless Security Suite, including: Authentication 802.1X support including LEAP to yield mutual authentication and dynamic per-user, per-session encryption keys Encryption Support for static and dynamic IEEE 802.11 WEP keys of 40 bits and 128 bits WPA TKIP and Cisco TKIP enhancements: key hashing (per packet keying), Message Integrity Check (MIC), and broadcast key rotation

Tasas de transferencia	802.11a: 54, 48, 36, 24, 18, 12, 9, 6 Mbps 802.11b: 11, 5.5, 2, 1 Mbps 802.11g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps 4.9 GHz: 5 MHz: 13.5, 12, 9, 6, 4. 5, 3, 2.25, 1.5 Mbps 10 MHz: 27, 24, 18, 12, 9, 6, 4.5, 3 Mbps 20 MHz: 54, 48, 36, 24, 18, 12, 9, 6 Mbps	802.11a: 6, 9, 12, 18, 24, 36, 48, and 54 Mbps 802.11g: 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, and 54 Mbps 802.11n data rates (2.4 GHz and 5 GHz)	Data rates of 54 Mbps in the 2.4-GHz band	Data rates up to 54 Mbps
Potencia de transmisión	2.4GHz y 5GHz 28 dbm 4.9GHz 20dbm Maximum power setting will vary according to individual country regulations	2.4 GHz 802.11b (CCK) 28 dBm with 2 antennas 802.11g (non HT duplicate mode) 28 dBm with 2 antennas 802.11n (HT20) 28 dBm with 2 antennas 5 GHz 802.11a 28 dBm with 2 antennas 802.11n non-HT duplicate (802.11a duplicate) mode 28 dBm with 2 antennas 802.11n (HT20) 27 dBm with 2 antennas 802.11n (HT40) 27 dBm with 2 antennas Maximum power setting will vary according to individual country regulations	802.11b: 100 mW (20 dBm) 50 mW (17 dBm) 30 mW (15 dBm) 20 mW (13 dBm) 10 mW (10 dBm) 5 mW (7 dBm) 1 mW (0 dBm) 802.11g: 30 mW (15 dBm) 20 mW (13 dBm) 10 mW (10 dBm) 5 mW (7 dBm) 1 mW (0 dBm) Maximum power setting will vary according to individual country regulations	250 mW (24 dBm) 200 mW (23 dBm) 155 mW (22 dBm) 125 mW (21 dBm) 60 mW (18 dBm) 30 mW (15 dBm) 15 mW (12 dBm) Maximum power setting will vary according to individual country regulations
Protocolos de enrutamiento	Información no suministrada	Información no suministrada	Información no suministrada	Información no suministrada

Tabla 13 Dispositivos Cisco Wireless MESH

4.12. Diseño de en una Red MESH

Para escoger la mejor alternativa para desarrollar una Red Inalámbrica MESH se deben tener en cuenta varios factores. Primero se debe tener claro los elementos necesarios para crear la red, los cuales se muestran a continuación:

Nodo Mesh: Los nodos MESH son los que conforman la infraestructura de la red y los encargados de establecer las mejores rutas y de soportar la comunicación. Estos dispositivos implementan funcionalidad de los controladores inalámbricos dependiendo del fabricante.

Punto de acceso: Además de tener la funcionalidad de un nodo MESH, tiene la función de dar acceso a los clientes a la infraestructura.

Puerta de enlace: La puerta de enlace o *Gateway* permite la salida de la red a una red externa (Internet).

Software de gestión: Es necesario un software de gestión y administración de la red que permita conocer la operatividad de los nodos, mostrar las conexiones y propagar los cambios en las configuraciones realizadas. La mayoría de las soluciones MESH presentadas anteriormente ofrecen un software de gestión para el control de sus dispositivos.

Todas las soluciones tienen sus ventajas y desventajas por lo que depende de las necesidades de cada usuario para escoger la mejor opción. Factores como la facilidad de administración de la red, la implementación, la escalabilidad de la red, el soporte técnico, soporte de servicios de tiempo real, deben ser tenidos en cuenta.

A título personal de los autores, se considera que una de las soluciones MESH que se podría implementar en Colombia es la de Motorola con MotoMesh. Si se observan los cuadros comparativos, la mayoría de empresas ofrece dispositivos con soporte de doble radio (2.4Ghz – 5Ghz), una para interconectar nodos y la otra para los usuarios. La solución MotoMesh además de tener este servicio se destaca por su algoritmos de seguridad y además por ser muy flexibles con diseños livianos y pequeños. Entre su oferta se puede destacar el AP 7181 el cual puede ser fácilmente instalado en edificios, techos y postes de luz, reduciendo el tiempo requerido para la implementación.

Motorola además de ser una empresa bien posicionada en el mundo, ofrece su solución MotoMesh en Latinoamérica lo cual es importante ya que seguramente se puede tener acceso y soporte a la solución en las instalaciones de Motorola en el país. La solución MOTOMESH Duo fue seleccionada como finalista en el Grupo de Diseño de Redes y Servicios, dentro de la categoría Servicios Inalámbricos Móviles de Redes, por su implementación en un proyecto de investigación y educación en China, además de obtener el premio de Eos Excellence of Achievement Award de NXTcomm [43].

CONCLUSIONES

- A pesar de que las Redes Inalámbricas Mesh son una solución compatible con otras tecnológicas cableadas e inalámbricas existentes y se han realizado diferentes actividades de estandarización, aun no se encuentra el estándar IEEE 802.11s definitivo que se reconozca a nivel mundial, lo que ha dado paso a la implementación de la tecnología por parte de empresas que no están vinculadas al proceso de estandarización como BelAir Networks, Tropos Networks y Strix Systems, a desarrollar protocolos propietarios para sus dispositivos inalámbricos. Como consecuencia los dispositivos de diferentes fabricantes no se pueden interconectar entre sí, perjudicando la expansión de las Redes Mesh.

- Dentro de los productos ofrecidos en las soluciones empresariales se encuentran dispositivos que tienen múltiples interfaces de radio y diferentes canales, con lo cual se aumenta la capacidad de las Redes Mesh, dedicando así un radio para la interconexión de las diferentes interfaces alambicas e inalámbricas y los demás canales para la comunicación de los Routers y clientes Mesh. Igualmente se debe considerar el aumento de consumo de energía que implica tener un mismo nodo con múltiples radios incorporados.

- Se debe tener en cuenta los requerimientos de la red para la selección de un protocolo de enrutamiento ya que a pesar de que una Red Mesh puede soportar protocolos ya existentes como los tradicionales RIP y OSPF, la mayoría no tienen un buen desempeño sobre esta. Utilizar un protocolo de enrutamiento hibrido como el HWMP que combine las características de los protocolos proactivos y reactivos es la recomendación de la última revisión IEEE 802.11s.

- Existen diferentes empresas en el mundo que han trabajado en el desarrollo de la tecnología y la utilizan para proveer servicios en muchas aplicaciones como acceso a Internet de banda ancha, aplicaciones de voz y video, conectividad en medios de transporte a altas velocidades, vigilancia, y han demostrado que son una opción que le hace contrapeso a las tecnologías actuales WLAN, WMANs y sistemas 3G.

- En Colombia la implementación de una Red Mesh puede ser una buena alternativa de negocio para ofrecer servicios municipales al estado, servicios de acceso a Internet en áreas rurales y para empresas privadas donde es complejo y costoso llegar con una solución cableada.

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ANEXOS

ANEXO 1 Hojas de Especificaciones Motorola

PRODUCT SPEC SHEET
AP 7161

WiNG 5 ENABLED OUTDOOR 802.11N MESH ACCESS POINT

AP 7161

Breakthrough your walls and extend to the outdoors with WiNG 5 and the AP 7161, delivering ruggedized outdoor performance and the ability to defend your perimeters from intrusion. AP7161 brings together the latest in 802.11n 3x3 MIMO tri-radio design with 24x7 Intrusion protection system AirDefense both in software and dedicated sensor radio support, big things can come in small packages.

CAPACITY AND PERFORMANCE LEADING MESH DEPLOYMENTS

AP 7161 has been optimized within the Motorola WiNG 5 platform to provide leading capacity, performance and design and is ideal for industrial and enterprise campus, video surveillance, public safety, and smartgrid utility deployments.

MOTOROLA MESHPATROL PERIMETER INTRUSION SECURITY

Extending the indoor network to the outdoors increases the need to guard against unwanted intruders and attackers, and monitor the performance and availability of mesh networks. In addition to industry standard security for clients and radio backhaul, the AP 7161 provides true perimeter security using either a dedicated dual-band sensor or software mode in 2.4GHz and 5Ghz bands. Concurrent around-the-clock dual-band Network Assurance sensing and wireless traffic is provided together with spectrum analysis — eliminating the need for separate devices. The Integrated Wireless IPS sensor option enables the configuration of one radio for 24x7 rogue detection and termination, and two others can simultaneously be dedicated to wireless client access and/or meshing. As a result, enterprises can now deploy the most robust Wireless IPS solution while saving money — the cost to purchase, deploy and manage dedicated sensor hardware is eliminated.

INDUSTRIAL AND ENTERPRISE CAMPUS DEPLOYMENTS

The AP 7161, specifically designed for outdoor use, delivers enterprise-class wireless networking in harsh environments. In addition to a NEMA 4X-modified housing, AP 7161 has extended temperature range operation and an array of weatherized antenna and power accessories.

Motorola AP 7161 gives campus environments, self-forming, self-healing MESH capabilities, and support for Wi-Fi multimedia (WMM) extensions to ensure quality of service (QoS) while cost-effectively extending networks beyond and between buildings —with no need to install additional Ethernet cable or fiber. With integrated router, firewall, DHCP, AAA and hotspot services, the AP 7161 offers a superior outdoor WLAN solution.

VIDEO SURVEILLANCE NETWORKS

Capacity in video surveillance solutions is critical to the performance of many networks designed to monitor and provide safety. To assist with the deployment of video where the camera application resides, the AP 7161 offers band unlocked radio flexibility letting the user choose the radio type, between 2.4Ghz, 5Ghz and 4.9Ghz bands. The AP 7161 supports 3x3 MIMO (Multiple Input Multiple Output) technology reaching a maximum data rate of 300 Mbps, to maintain high performance and better quality of transmission.

RELIABLE SECURE PUBLIC SAFETY NETWORKS

The AP 7161 is designed to optimize network availability through its central and pre-emptive intelligence which dynamically senses weak or failing signals, securely moves mobile users to alternate APs, and boosts signal power to automatically fill RF holes and ensure uninterrupted mobile user access.

LESS IS MORE

Motorola's WiNG 5 WLAN solutions offer all the benefits of 11n—and then some. Our distributed architecture extends QoS, security and mobility services to the APs so you get better direct routing and network resilience. That means no bottleneck at the wireless controller, no latency issues for voice applications, and no jitter in your streaming video. And with our broad selection of access points and flexible network configurations, you get the network you need with less hardware to buy. Let us show you the less complicated, less expensive way to more capacity, more agility, and more satisfied users.

PRODUCT SPEC SHEET
AP 7161

The AP 7161 band unlocked radios allow flexibility and deployment options for the public safety market. The powerful radio increases coverage, performance and obstruction penetration for outdoor use. In addition, receiver sensitivity has been increased proportionally so users have an increased ability to maintain high-performance access for mobility and client devices in the network.

SMART GRID ULTITIES

Automatic Metering Infrastructure (AMI) is being deployed by utilities companies to increase efficiency and eliminate the need for their workforce to manually read utilities meters. The AP 7161 is designed to optimize wireless data for this application and will have sufficiently more bandwidth for multiple agencies applications, thus increasing the ROI for the different agencies.

AP 7161 SPECIFICATIONS CHART

HARDWARE SPECIFICATIONS	
Operating Voltage	36-57 VDC
Operating Current	Not to exceed 750 mA@48VDC
Power In (POE)	POE support inbound power - 802.3AT on GE1
Dimensions (unit) * mounted	32cm W x 22.5cm H x 10cm D 12.6in W x 8.9in H x 3.9in D
Weight (Unit)	6.4lbs/2.9Kg
Mounting	Adaptable mounting kit for wall & pole deployments with optional extension arm accessory
LED	6 Top Mounted weatherized LEDs, with multi function read
Uplink	Outdoor Rated N –TYPE connectors
Antenna Connectors	Outdoor Rated N –TYPE connectors
Console Port	Outdoor rated RJ 45 Console Port
Hardware Reset	External Hardware Reset Button
Multi Band Security Sensor	Outdoor 24x7 Intergrated Wireless Intrusion Prevention System (IPS)/Assurance Sensor (SKU : AP-7161-66S40-INTL, AP-7161-66S40-US)
ENVIRONMENTAL SPECIFICATIONS	
Operating Temperature	-40 to +70 Degrees Celsius
Storage Temperature	-40 to +85 Degrees Celsius
Operating Humidity	5-100%
Operating Altitude	8000 Feet
Storage Altitude	30,000 Feet
Electrostatic Discharge	EN61000-4-2. Air +/-15kV, Contact +/-8kV
Enclosure	Outdoor IP67 rated, corrosion resistant enclosure ASTM B117 Salt, Fog, And Rust resistance
Wind Ratings	150 mph * (unit bracket measurement)
Operational Shock	IEC60721-3-4, Class 4M3, MIL STD 810F
Operational Vibration	IEC60721-3-4, Class 4M3
RADIO SPECIFICATIONS	
General Radio Specifications	
Network Standards	IEEE 802.11 a/b/g/n, 802.11e, 802.11i, WPA2, WMM, and WMM-UAPSD
Supported Data Rates	802.11b/g :1,2,5.5,11,6,9,12,18,24,36,48 and 54Mbps 802.11a : 6,9,12,18,24,36,48 and 54 Mbps 802.11n : MCS 0-15 up to 300Mbps
802.11n Capabilities	3x3 MIMO with 2 Spatial Streams 20MHz and 40MHz Channels Supported 300Mbps Data Rates per Radio Packet Aggregation (AMSDU,AMPDU) Reduced Interframe Spacing

802.11 b/g/n	
Operating Frequency	2.4 – 2.483 GHz
Max AP Transmit Power *	26 dBm
802.11 a/n	
Operating Frequency	4.940Ghz – 4.990 GHz and 5.25Ghz - 5.35Ghz and 5.470GHz – 5.825GHz
Max AP Transmit Power*	25 dBm

*Transmit Power may vary based upon the deployed country

NETWORKING AND SOFTWARE SPECIFICATIONS	
Security	Stateful Firewall, IP filtering, NAT, 802.1X, 802.11i WPA2, WPA. 24x7 Dual band sensor capabilities * (subject to software license keys and sensor radio SKU) Advanced Forensics Connectivity Troubleshooting Wireless Intrusion Prevention LiveRF Spectrum Analysis
Quality of Service	On board IDS, and secure guest hotspot access WMM, WMM-UAPSD, 802.1p, Diffserv and TOS
Routing	Layer 3 Routing, 802.1q/p, DynDNS, DHCP server/client, BOOTP Client, PPPoE and LLDP
APPROVALS	
Radio*	FCC Title 47, part 15, part 90; EN 301 489-17 EN 301 893 v1.5.1 DFS; EN 302 502 DFS; EN 300 328; Industry Canada; China SRRC Australia/New Zeland *For more country specific regulatory information please contact Motorola or your authorized Partner
Safety*	UL 60950-1, -22; CSA C22.2 No.60950-1-07, -22 CB-IEC 60950 -1, 22; EN 60950-1:2006+ A11:2009 RoHS/WEE/CMM; CE *For more country specific regulatory information please contact Motorola or your authorized Partner
OPTIONAL ACCESSORIES	
Mounting Kit	
Extension Arm for Mounting Kit	
IP66 Outdoor Rated 802.3AT Power Injector	
Mounting Kit for Outdoor IP 66 802.3AT Power Injector	
External Antenna Options	
WARRANTY	
One (1) year on AP 7161 hardware *accessories not included	
(30) Day on Accessories	
(90) Day on Software	

FEATURES

Ideal Applications

- Industrial and Warehouse operations
- Public Safety
- Municipal and Operator Access
- Smart Grid Applications
- Video surveillance applications
- Extended hotspots for public access
- Enterprise, Education and Healthcare campus facilities

802.11n support with 3X3 MIMO

Delivers maximum wireless network throughput to support virtually any enterprise application, including voice and video

Band-unlocked dual band design

The ability to dedicate multiple radios to multiple functions increases security without increasing costs; band-unlocked radios enable 24x7 dual band Wireless IPS sensing on both 2.4GHz and 5GHz with concurrent 802.11a/b/g/n client access and mesh

Mesh networking

Patented Mesh Networking alogirthms that allow wireless extension of existing wired or wireless networks in remote or outdoor locations

Outdoor rated IP 67 Cast Aluminum Enclosure

Equipment designed to withstand wind, rain, and extreme temperatures

For more information on how the AP 7161 can benefit your business, please visit us on the web at www.motorola.com/mesh or access our global contact directory at www.motorola.com/enterprisemobility/contactus

G3-29-114

MOTOROLA

Elevating Bandwidth to the Nth Power: The Motorola AP 7181

The Motorola Mesh Wide Area Network (MWAN) portfolio includes the AP 7181, an outdoor high performance, multi-radio 802.11n mesh access point that delivers exceptional network capacity and performance. By embracing the 802.11n standard and optimizing radio hardware and software components, maximum throughputs and connections for mesh networking are realized. The AP 7181 delivers fast, stable connections and allows 802.11n capabilities to be extended outdoors. The AP 7181 is the result of years of customer research and development and is designed specifically to meet the outdoor network needs of enterprises, municipal agencies, and transit systems.

About Motorola Wireless Broadband

Motorola's comprehensive portfolio of reliable and cost-effective wireless broadband solutions, together with our WLAN solutions, provide and extend coverage both indoors and outdoors. The Motorola Wireless Broadband portfolio offers high-speed Point-to-Point, Point-to-Multipoint, Mesh, WiFi and WiMAX networks that support data, voice and video communications, enabling a broad range of fixed and mobile applications for public and private systems. With Motorola's innovative software solutions, customers can design, deploy and manage a broadband network, maximizing uptime and reliability while lowering installation costs.

Superb Antenna Technology

Motorola's exclusive intelligent ADEPT (ADvanced Element Panel Technology) antenna system was developed specifically for the AP 7181. The ADEPT system allows the AP 7181 to achieve maximum data rates by enabling dual data stream communication via dual polarization antennas. Leveraging multiple transmit and receive RF chains, dual polarized antennas and software configurable down tilt, the AP 7181 achieves excellent coverage without the self-shadowing caused by multiple dipole antennas.

High Capacity

The AP 7181 features 2.4 GHz and 5.x GHz radios that support 3x3 MIMO (Multiple Input Multiple Output) technology reaching a maximum data rate of 300 Mbps. This results in additional capacity, which delivers improvements at both the client and backhaul level. The MIMO technology is combined with high performance radios designed by Motorola to maintain high power transmissions at some of the highest data rates. These radios, coupled with the ability to use 40 MHz channel widths, allows the added capacity of the AP 7181 to be leveraged for advanced applications.

Excellent Mesh Routing

The AP 7181 offers robust data connections throughout the network by leveraging Motorola's leading routing technology, MeshConnex™. MeshConnex provides efficient routing, low latency, low routing overhead, high-speed handoffs and proven scalability. The Opportunistic Radio Link Adaptation (ORLA) is a key decision-making element within MeshConnex™, designed to select data rates that will provide the best throughput at any given time. ORLA helps ensure Motorola mesh networks deliver sustained throughput at the highest possible data rate.

The AP 7181 features fast hand-offs, intelligent routing and seamless security, all key mobility enhancements exclusive to Motorola. The AP 7181 enables a true mobile office in the field, keeping highly mobile workers connected to key office applications, resulting in improved response times and greater process efficiencies.

Mesh Wide Area Network Management and Deployment

The AP 7181 has been designed to provide added flexibility in both mounting location and software configuration to help minimize deployment and installation costs, maximize ROI and provide for a lower total cost of ownership (TCO). From a mounting perspective, the AP 7181 has been designed for easy installation on buildings, roof tops and light poles, reducing the time required for deployment.

The unit's deployment process offers a clear work flow and organized menu options for configuration. Coupled with network wide management through One Point Wireless Manager, one application can be used to monitor and maintain AP 7181 configuration consistency throughout a deployed network, and further assist with post deployment optimization via templates and discovery of installed nodes.

One Company. One Network. One Complete Solution.

Only Motorola delivers mobility and agility inside the enterprise, between locations and out to end-user devices. The AP 7181, together with the AP-7131 indoor access point, creates one of the only seamless indoor/outdoor mesh network solutions in the industry, ensuring contiguous coverage throughout city or campus environments.

Radio Features

802.11 b/g/n Radio

Operating Frequency: 2.4 - 2.462 GHz

Modulations:

- Orthogonal Frequency Division Multiplexing (OFDM)
- (BPSK, QPSK, 16-QAM, 64-QAM)
- 802.11b – DSS (BPSK, QPSK, CCK)

3x3 MIMO with 2 Data Streams

Supported Channels: 20 and 40 MHz

Maximum Transmit Power:

36 dBm EIRP*

Settable in 1 dB increments

Receiver Sensitivity

- 802.11g 2.4 GHz: -78 dBm @ 54 Mbps to -89 dBm @ 6 Mbps
- 802.11n 2.4 GHz: -70 dBm @ MCS 15 to -80 dBm @ MCS0

802.11 a/n Radio

Operating Frequency: 5.470 - 5.865 GHz (ETSI/EU), 5.725-5.850 GHz (FCC/IC)

Modulations:

- Orthogonal Frequency Division Multiplexing (OFDM)
- (BPSK, QPSK, 16-QAM, 64-QAM)

3x3 MIMO with 2 Data Streams

Supported Channels: 20 and 40 MHz

Maximum Transmit Power:

32 dBm EIRP

Settable in 1 dB increments

Receiver Sensitivity

- 802.11a 5.x GHz: -72 dBm @ 54 Mbps to -89 dBm @ 6 Mbps
- 802.11n 5.x GHz: -63 dBm @ MCS15 to -88 dBm @ MCS0

DFS Support:

ETSI EN 301 893 v1.5.1 for 5.4 GHz

ETSI EN 302 502 v1.2.1 for 5.8 GHz

Antenna Specifications

ADvanced Element Panel Technology (ADEPT)

- Integrated 2.4/5.x GHz antenna system
- Dual polarization
- Software configurable down tilt antennas
- Optional remote mounted panel antennas

*Transmit power may vary based upon the deployed country

Hardware Specifications

AC Option: 100 – 240 VAC at 47-63 Hz

AC Power Consumption: 84 Watts Average, 126 Watts Peak

DC Option: 48 VDC

DC Power Consumption: 66 Watts Average, 99 Watts Peak

Ethernet Ports:

- 2 ports auto sensing 10/100/1000 Base-T Ethernet
- RJ45 Console port
- Integrated 802.3af PoE out

Hardware reset button

Network status LEDs

Dimensions: (height x diameter at widest point): 15.35" x 14" (39cm x 35.5cm)

Weight: 39 pounds (17.7 kilograms)

Environmental Specifications

Operating: -40 to +55 °C

Storage: -40 to +85 °C

Humidity: 5 to 95 % RH non-condensing

Enclosure:

- IP67 rated, corrosion resistant enclosure
- ASTM B117 salt, fog, and rust resistance

Wind Ratings: Wind survivability > 160 Mph

Operational Shock: MIL-STD-516.5 Procedure

Operational Vibration: MIL-STD-810F method 514.5A Procedure

Routing Protocol

MeshConnex™

- Layer 2 based routing providing greater performance and less overhead
- Multi-Radio mesh allows meshing on each radio
- Automatic neighbor detection and route determination
- Self-healing enabled by dynamic path selection

Security

Client Security: WPA, WPA2-PSK, WEP, 802.11i, RADIUS, 802.1X (Includes EAP-TLS, EAP-TTLS)

Encryption: WEP, AES-CCM, TKIP

Intra-Mesh Encryption: Secure Mesh with AES

Authentication: 802.1x (Infrastructure/Client) and MAC address hardware authentication

Software Features

- 16 WLANs
- Multi-Radio mesh routing
- 802.11e QoS
- 4 BSSIDs per radio
- On demand channel scan
- Auto channel select
- Frame aggregation
- WEB-based GUI for local configuration
- Ethernet filters

Management

One Point Wireless Manager

- Device discovery
- Inventory management
- Alarm/event management
- Google Maps network view
- Over-the-air upgrades
- Fault, Configuration, Administration, Performance and Security (FCAPS)

BroadbandPlanner

- Performance prediction tools
- Streamline mesh deployments

Approvals

FCC CFR 47 Part 15, Class B Subpart C

Industry Canada RSS 210

UL 60950-1, -22

CE

EN 301 489-17

EN 300 328

EN 302 502 v1.2.1

EN 301 893 v1.5.1 DFS

CB – IEC 60950-1, -22

RoHS/WEEE, EPP, CMM

Optional Accessories

Optional mounting kits

Optional remote mounted panel antennas

Street light power tap adaptor

US, EU, DC power cables

Warranty

One (1) year on hardware, parts and software

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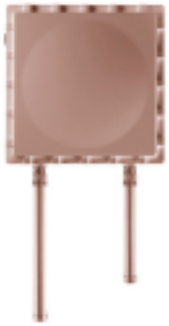
motorola.com/mesh

ANEXO 2 Hojas de Especificaciones ORiNOCO

Proxim wireless

ORiNOCO® Wi-Fi Mesh Series

For Metropolitan and Enterprise Applications



Outdoor Mesh Access Point (AP-4000MR and AP-4000MR-LR)

Indoor Mesh Access Point (AP-4000M or AP-4000)

Outdoor Broadband Wireless Access

Proxim Wireless offers the industry's most complete suite of outdoor broadband wireless access products. This portfolio includes:

- **Tsunami® MP.11 –** Capabilities of fixed and mobile WiMAX for U.S. and global markets
- **Tsunami® MP.16 –** WiMAX for the 3.5 GHz frequency band
- **ORiNOCO® Wi-Fi Mesh –** Outdoor and indoor Wi-Fi mesh for service providers and municipalities

Proxim Wireless is a global pioneer in scalable broadband wireless networking. From Wi-Fi to wireless Gigabit Ethernet – our WLAN, mesh, point-to-multipoint and point-to-point products are available through our extensive global channel network.

Wi Fi CERTIFIED

High Capacity Mesh Access Points Deliver Flexible, Scalable and Reliable Data, Voice and Video for Large Metropolitan and Enterprise Wi-Fi® Deployments

Powered by the ORiNOCO Mesh Creation Protocol, the dual-radio ORiNOCO Wi-Fi Mesh Access Points deliver data, voice and video over Wi-Fi to the edge of a network over a flexible, auto-forming, self-healing, near line of sight mesh backbone. The dual-radio architecture separates the mesh backbone traffic from the edge access traffic, increasing capacity compared to single-radio mesh architectures. The ORiNOCO Wi-Fi Mesh Series consists of an indoor form factor (AP-4000 and AP-4000M) and a ruggedized, outdoor form factor (AP-4000MR and AP-4000MR-LR*). Seamless integration between ORiNOCO indoor and outdoor mesh access points enable existing outdoor Wi-Fi mesh networks to extend indoors.

- ORiNOCO Mesh Creation Protocol (OMCP) enables mesh backhaul and Wi-Fi coverage on one radio, while the second radio is used exclusively for Wi-Fi coverage
- Industry-leading throughput with 802.11b/g and 802.11a simultaneous operation
- Robust RADIUS accounting and authorization interface enables detailed subscriber usage tracking
- WMM/802.11e draft Quality of Service (QoS) support on access and enhanced QoS on mesh backhaul for triple play applications
- Wi-Fi certified to interoperate with any Wi-Fi certified client access product

Proactive Security Measures to Protect Your Network

ORiNOCO access points support the latest security standards, including IEEE 802.11i and AES encryption, and add proactive security measures to prevent attacks.

- Intra-cell blocking and traffic redirection to prevent subscriber-to-subscriber attacks
- Broadcast bandwidth throttling prevents broadcast attacks
- IEEE 802.1x mutual authentication with dynamic per-user, per-session rotating keys
- Rogue access point detection and notification
- Secure management interfaces: SNMPv3, SSL and SSH
- Encrypted storage for security and management parameters eliminates unauthorized access

Self-Forming/Self-Healing Mesh Reduces Total Cost of Ownership (TCO)

Ease of deployment and integration with the wired network are critical factors in a successful, profitable wireless network rollout. ORiNOCO mesh access points excel with key capabilities that simplify metropolitan and enterprise deployments.

- Self-forming and self-healing ORiNOCO Mesh Creation Protocol automatically routes traffic through the best path as mesh access points are added or removed from the network
- Tools to speed installation and optimization: automatic channel selection, adjustable transmit power, external antenna connectors†
- Ethernet redundancy sustains network connection: automatically configures mesh portals to mesh access points when mesh portals lose Ethernet link eliminating cost of installing a redundant switch
- Remote management via SNMP, HTTP and Telnet
- Additional mesh link statistics improve mesh network monitoring
- Low power consumption reduces operating expenses

Reliable by Design

With over 25 years of experience in the design and manufacture of wireless LANs, Proxim Wireless understands that service providers and enterprises require the same uptime and reliability in a wireless network as in a wired network. ORiNOCO mesh access points offer:

- Robust features for metropolitan Wi-Fi and enterprise applications
- Automatic reconfiguration of security policy in the event of power loss
- Power-over-Ethernet support
- AC Power option for outdoor light pole installations

*Available for FCC only

†External antenna connectors not available on models AP-4000M-US2 and AP-4000M-AU.

APPLICATIONS

- Fixed Edge Access
  Provides near line of sight Wi-Fi coverage by automatically routing traffic through the mesh backbone
- Mobile Edge Access
  Enables Wi-Fi coverage in automobiles, buses, and trains
- Enterprise
  Lowers infrastructure costs by not requiring Ethernet cabling to every access point

PERFORMANCE AND SCALABILITY

ORINOCO Mesh Creation Protocol (OMCP)	Self-forming/self-healing dual-radio wireless mesh backhaul for industry leading throughput and availability
Tri-mode 802.11b, 802.11g and 802.11a Support	Pre-configured, simultaneous 802.11b, 802.11g, 802.11a support
Field Upgradeable	Software upgradeable to support new standards
IEEE 802.11i and AES Encryption	Highest authentication and encryption methods including mutual authentication, message integrity check (MIC), per-packet keys, initialization vector hashing and broadcast key rotation
Rogue AP and Client Detection	Detects and alerts unauthorized rogue Access Points and clients in both the 2.4 and 5 GHz bands
Secure Management Interfaces	SNMPv3, SSL and SSH protect against unauthorized AP changes via the management interface
Multiple VLAN Support with Different Security Settings	Up to 16 separate VLANs per radio each able to support multiple authentication and encryption algorithms simultaneously
Multiple BSSID Support	Up to 4 Basic Service Set Identifiers (BSSIDs) per radio
Auto Configuration via DHCP	Ensures new APs automatically receive correct configuration and prevents security vulnerabilities with deliberate resets
Assured Software Upgrades	Guarantees new AP image is valid before deleting current image
Quality of Service (QoS)	Draft IEEE 802.11e support along with 802.1p and 802.1q improve performance of video and voice applications
Transmit Power Control	Supports selectable transmit power levels to adjust coverage cell size
Automatic Channel Selection	Simplifies installation by choosing best possible channel upon installation
RADIUS Support	Extensive RADIUS Authentication and RADIUS Accounting support
Super Mode	Delivers greater than 30 Mbps throughput for ORINOCO and Atheros-based clients while maintaining simultaneous compatibility with non-Atheros clients
Advanced Filtering Capabilities	IEEE 802.1d bridging with static MAC address filtering, network protocol filtering, Proxy ARP, multicast/broadcast storm threshold filtering, TCP/UDP port filtering, Intra-cell traffic filtering to prevent client-to-client snooping
Near Line of Sight Capable	Line of sight and near line of sight connectivity extends deployment flexibility in rural as well as high-density urban areas

ORiNOCO Wi-Fi Mesh Series
Technical Specifications

	ORINOCO AP-4000M/AP-4000	ORINOCO AP-4000MR	ORINOCO AP-4000MR-LR*
PRODUCT MODELS	IEEE70M-XX ORINOCO AP-4000M Tri-mode, Mesh Access Point IEEE70-XX ORINOCO AP-4000 Tri-mode, Mesh Access Point	IEEE70-MR-XX ORINOCO AP-4000MR Tri-mode, Outdoor Mesh Access Point	IEEE70-MR-LR-US ORINOCO AP-4000MR-LR Tri-mode, High Power Outdoor Mesh Access Point
RADIO & TRANSMISSION			
MODULATION METHOD			
802.11B OR G	OFDM; DSSS	OFDM; DSSS	OFDM; DSSS
802.11A	OFDM	OFDM	OFDM
FREQUENCY BAND*			
802.11B/G	2.412 to 2.472 GHz	2.412 to 2.472 GHz	2.412 to 2.462 GHz
802.11A	5.15 to 5.25 GHz; 5.25 to 5.35 GHz; 5.47 to 5.725 GHz; 5.85 to 6.08 GHz	5.15 to 5.25 GHz; 5.25 to 5.35 GHz; 5.47 to 5.725 GHz; 5.85 to 6.08 GHz	5.745 to 5.85 GHz
DATA RATE			
802.11B	1, 2, 5.5, 11 Mbps	1, 2, 5.5, 11 Mbps	1, 2, 5.5, 11 Mbps
802.11G	6, 9, 12, 18, 24, 36, 48, 54 Mbps	6, 9, 12, 18, 24, 36, 48, 54 Mbps	6, 9, 12, 18, 24, 36, 48, 54 Mbps
802.11A	6, 9, 12, 18, 24, 36, 48, 54 Mbps	6, 9, 12, 18, 24, 36, 48, 54 Mbps	6, 9, 12, 18, 24, 36, 48, 54 Mbps
MAX OUTPUT POWER	+20 dBm for 802.11b, +18 dBm for 802.11g and 802.11a	+20 dBm for 802.11b, +18 dBm for 802.11g and 802.11a	+26 dBm for 802.11b, +24 dBm for 802.11g and 802.11a
INTERFACES			
WIRED ETHERNET	10/100Base-T Ethernet (RJ-45)	10/100Base-T Ethernet (RJ-45)	10/100Base-T Ethernet (RJ-45)
WIRELESS	1 integrated 802.11b/g radio and 1 integrated 802.11a radio	1 integrated 802.11b/g radio and 1 integrated 802.11a radio	1 integrated 802.11b/g radio and 1 integrated 802.11a radio
ANTENNA CONNECTOR	Integrated diversity 2.4 and 5 GHz antennas with horizontal and vertical polarization, and external antenna connectors 802.11b/g and 802.11a	Two external Type-N Female connectors, one connector for a 2.4 GHz antenna and one connector for a 5 GHz antenna	Two external Type-N Female connectors, one connector for a 2.4 GHz antenna and one connector for a 5 GHz antenna
PHYSICAL			
DIMENSIONS			
PACKAGED UNPACKAGED	11.375 x 9.25 x 2.75 in (288.9 x 235 x 69.9 mm) 7.1 X 4.75 X 1 in (180.3 x 121 x 25 mm)	14.57 x 13.7 x 8.19 in (370.1 x 348 x 208 mm) 10.5 x 10.5 x 3.25 in (267 x 267 x 83 mm)	14.57 x 13.7 x 8.19 in (370.1 x 348 x 208 mm) 10.5 x 10.5 x 3.25 in (267 x 267 x 83 mm)
WEIGHT			
PACKAGED UNPACKAGED	2.05 lbs (0.93 kg) 0.65 lbs (0.29 kg)	11.1 lbs (5.03 kg) 5.5 lbs (2.49 kg)	11.1 lbs (5.03 kg) 5.5 lbs (2.49 kg)
ENVIRONMENTAL			
TEMPERATURE	0° to 55°C (Operating) -20° to 85°C (Storage)	-40° to 60°C (Operating) -55° to 85°C (Storage)	-35° to 60°C (Operating) -55° to 85°C (Storage)
HUMIDITY	Max 95% relative humidity (non-condensing)	Max 100% relative humidity (non-condensing)	Max 100% relative humidity (non-condensing)
WIND LOADING	N/A	125 mph	125 mph
WATER & DUST PROOF	N/A	IP65	IP65
ELECTRICAL			
POWER SUPPLY	AC: 110/240 VAC, 50/60 Hz (input); 5V 3A (output)	PoE: 110/240 VAC (input); 48 VDC ± 10% (output)	PoE: 110/240 VAC (input); 48 VDC ± 10% (output)
(OPT) POWER SUPPLY	IEEE 802.3af Active Ethernet Support (Purchased separately)	N/A	110/240 VAC light pole power tap (purchased separately)
POWER CONSUMPTION	Maximum 9 Watts	Maximum 20 Watts	Maximum 20 Watts
LEDS	Power, Ethernet LAN Activity, Wireless 802.11b/g Activity, Wireless 802.11a Activity	Power/Ethernet LAN Link, Wireless Link	Power/Ethernet LAN Link, Wireless Link
MANAGEMENT			
LOCAL	RS-232 Serial Port; DB9 Female	RS-232 Serial Port; mini-DIN	RS-232 Serial Port; RJ11
REMOTE	DHCP, Telnet, HTTP, TFTP, BootP, SNMPv1/v2c/v3; ORINOCO MIB, Etherlike MIB, 802.11 MIB, Bridge MIB, MIB-II	DHCP, Telnet, HTTP, TFTP, BootP, SNMPv1/v2c/v3; ORINOCO MIB, Etherlike MIB, 802.11 MIB, Bridge MIB, MIB-II	DHCP, Telnet, HTTP, TFTP, BootP, SNMPv1/v2c/v3; ORINOCO MIB, Etherlike MIB, 802.11 MIB, Bridge MIB, MIB-II
SECURE	SNMPv3, SSH, HTTPS	SNMPv3, SSH, HTTPS	SNMPv3, SSH, HTTPS
MTBF AND WARRANTY	100,000 hours; 1-year on parts and labor	100,000 hours; 1-year on parts and labor	100,000 hours; 1-year on parts and labor
PACKAGE CONTENTS	• (1) AP-4000M mesh access point or (1) AP-4000 mesh access point • (1) Power adapter • (1) Cable cover and Ceiling or Wall mounting Plate • (1) Installation CD-Rom with Software and Documentation • (1) Quick Start Flyer	• (1) AP-4000MR dual-radio mesh access point • (1) Power injector and power cord • (1) Mini-DIN to DB9 serial connector • (1) Cable termination kit • (1) Wall/Pole Mounting bracket and hardware • (1) Installation CD-Rom with Software and Documentation	• (1) AP-4000MR-LR dual-radio mesh access point • (1) Power injector and power cord • (1) Mini-DIN to RJ11 serial connector • (1) Cable termination kit • (1) Wall/Pole Mounting bracket and hardware • (1) Installation CD-Rom with Software and Documentation
RELATED PRODUCTS	ORINOCO AP-4000MR, AP-4000MR-LR and AP-4900MR-LR to extend mesh networks outdoors, 2.4 GHz antennas, 5 GHz antennas, ProximVision™ Network Management System, Tsunami MP.11 for backhaul between groups of mesh radios, SwiftPack (USA/CAN Only)	ORINOCO AP-4900MR-LR 2.4/5.8 GHz mesh access points for public safety networks, 2.4 GHz Direct Connect Antennas (1088-OMNI-DC5 & 1088-OMNI-DC8), 5 GHz Direct Connect Antennas (1088-OMNI-DC8), ProximVision Network Management System, Tsunami MP.11 for backhaul between groups of mesh radios, SwiftPack (USA/CAN Only)	ORINOCO AP-4900MR-LR 2.4/5.8 GHz mesh access points for public safety networks, 2.4 GHz Direct Connect Antennas (1088-OMNI-DC5 & 1088-OMNI-DC8), 5 GHz Direct Connect Antennas (1088-OMNI-DC8, 1088-OMNI-DC8), AC Power Kit (1088-AC-KIT-NW), Wide-Light Pole Mounting Kit (1000-LP-MNT-WD), ProximVision Network Management System, Tsunami MP.11 for backhaul between groups of mesh radios, SwiftPack (USA/CAN Only)

*Available for FCC only.
†Frequency Band support varies with regional regulatory domain and country.

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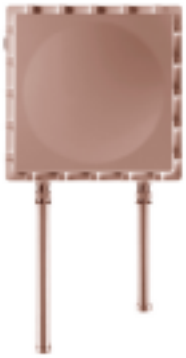
Proxim Wireless Corporation
www.proxim.com

ORiNOCO® Public Safety Wi-Fi® Mesh

For Emergency Response and Metro Wi-Fi Applications



Outdoor Mesh Access Point (AP-4900MR-LR)

Indoor Mesh Access Point (AP-4900M)

Outdoor Broadband Wireless Access

Proxim Wireless offers the industry's most complete suite of outdoor broadband wireless access products. This portfolio includes:

- **Tsunami™ MP.11 –** Capabilities of fixed and mobile WiMAX for U.S. and global markets
- **Tsunami™ MP.16 –** WiMAX for the 3.5 GHz frequency band
- **ORiNOCO® Wi-Fi Mesh –** Outdoor and indoor Wi-Fi mesh for service providers and municipalities

Proxim Wireless is a global pioneer in scalable broadband wireless networking. From Wi-Fi to wireless Gigabit Ethernet – our WLAN, mesh, point-to-multipoint and point-to-point products are available through our extensive global channel network.

High Capacity Mesh Access Points Deliver Flexible, Scalable, and Reliable Data, Voice and Video for Large Public Safety and Wi-Fi Deployments

Supporting both 4.9 GHz public safety and 2.4 GHz metropolitan Wi-Fi networks through dual 4.9/2.4 GHz radios, ORiNOCO Public Safety Wi-Fi Mesh delivers the versatility and feature robustness required by today's demanding emergency response and metro Wi-Fi applications. Delivering unparalleled enterprise-scale security, management and Quality of Service (QoS) features, the access points are preconfigured with tri-mode support for best in class performance and flexibility in large public safety deployments. Offering a cost-effective, scalable mesh solution, ORiNOCO Public Safety Wi-Fi Mesh Series consists of indoor and outdoor form factors. The AP-4900M indoor access point's small form factor enables installation in a building or a vehicle trunk. Housed in a ruggedized enclosure, the AP-4900MR-LR[1] may be deployed outdoors in extreme weather conditions.

- The ORiNOCO Mesh Creation Protocol (OMCP) enables mesh backhaul and Wi-Fi coverage on one radio, while the second radio is used exclusively for Wi-Fi coverage
- Industry-leading throughput with 802.11g and 4.9 GHz simultaneous operation
- Robust RADIUS accounting and authorization interface enables detailed subscriber usage tracking
- WMM/802.11e draft Quality of Service support for data, voice, and video

Proactive Security Measures to Protect Your Network

ORiNOCO access points support the latest security standards, including IEEE 802.11i and AES encryption, and add proactive security measures to prevent attacks.

- Intra-cell blocking and traffic redirection to prevent subscriber-to-subscriber attacks
- Broadcast bandwidth throttling prevents broadcast attacks
- IEEE 802.1x mutual authentication
- Dynamic per-user, per-session rotating keys
- Rogue access point detection and notification
- Secure management interfaces: SNMPv3, SSL and SSH

Easy to Deploy and Manage

Ease of deployment and integration with the wired network are critical factors in a successful, profitable wireless network rollout. ORiNOCO access points excel with key capabilities that simplify WLAN deployment.

- Self-forming and self-healing ORiNOCO Mesh Creation Protocol automatically routes traffic through the best path as mesh access points are added or removed from the network
- Tools to speed installation and optimization: automatic channel selection, adjustable transmit power, external antenna connectors[2]
- Remote management via SNMP, HTTP and Telnet

Reliable by Design

With over 25 years of experience in the design and manufacture of wireless LANs, Proxim Wireless understands that service providers and enterprises require the same uptime and reliability in a wireless network as in a wired network. ORiNOCO access points offer:

- Robust features for metropolitan Wi-Fi and enterprise applications
- Automatic reconfiguration of security policy in the event of power loss
- Dual firmware image support – for rollback in the event of software or configuration change problems
- Power-over-Ethernet support
- AC Power option for light pole installations[3]

[1] Available for FCC only
[2] External antenna connectors not available on all indoor models.
[3] Available for AP-4900MR-LR version only

ORiNOCO Public Safety Wi-Fi Mesh Features

APPLICATIONS

- **Emergency Services**
  Real-time computer-aided-dispatch on the move. Mobile office, voice, live-streaming video, and data connectivity for first responder vehicles.
- **Metro Wi-Fi & 4.9 GHz Public Safety**
  Simultaneous 4.9 GHz Public Safety access and 2.4 GHz Metro Wi-Fi coverage on a single, dual-radio platform.

PERFORMANCE AND SCALABILITY

ORiNOCO Mesh Creation Protocol (OMCP)	Self-forming/self-healing dual-radio wireless mesh backhaul for industry leading throughput and availability
Tri-mode 802.11b, 802.11g and 4.9 GHz Support	Pre-configured, simultaneous 802.11b, 802.11g, 4.9 GHz support
Field Upgradeable	Software upgradeable to support new standards
IEEE 802.11i and AES Encryption	Highest authentication and encryption methods including mutual authentication, message integrity check (MIC), per-packet keys initialization vector hashing and broadcast key rotation
Rogue AP and Client Detection	Detects and alerts unauthorized rogue Access Points and clients in both the 2.4 and 4.9 GHz bands
Secure Management Interfaces	SNMPv3, SSL and SSH protect against unauthorized AP changes via the management interface
Multiple VLAN Support with Different Security Settings	Up to 16 separate VLANs per radio each able to support different authentication and encryption algorithms simultaneously
Multiple ESSID Support	Up to 4 Basic Service Set identifiers (BSSIDs) per radio
Auto Configuration via DHCP	Ensures new APs automatically receive correct configuration and prevents security vulnerabilities with deliberate resets
Assured Software Upgrades	Guarantees new AP configuration file is valid before deleting current image - dual image support
Quality of Service (QoS)	Draft IEEE 802.11e along with 802.1p and 802.1q improve performance of video and voice applications
Transmit Power Control	Supports selectable transmit power levels to adjust coverage cell size
Automatic Channel Selection	Simplifies installation by choosing best possible channel upon installation
RADIUS Support	Extensive RADIUS Authentication Accounting support
Super Mode	Delivers greater than 30 Mbps throughput for ORiNOCO and Atheros-based clients while simultaneously compatible with non-Atheros clients
Advanced Filtering Capabilities	IEEE 802.1d bridging with static MAC address filtering, network protocol filtering, Proxy ARP, multicast/broadcast storm threshold filtering, TCP/UDP port filtering, intra-cell traffic filtering to prevent client-to-client snooping
Near Line of Sight Capable	Line of sight and near line of sight connectivity extends deployment flexibility in rural as well as high-density urban areas

Proxim wireless

ORiNOCO Public Safety Wi-Fi Mesh
Technical Specifications

	ORINOCO AP-4900M*	ORINOCO AP-4900MR-LR*
PRODUCT MODELS	BE70M-PS-US ORINOCO AP-4900M Tri-mode, Mesh Access Point	BE70-MR-LR-PS-US ORINOCO AP-4900MR-LR Tri-mode, Outdoor Mesh Access Point
RADIO & TRANSMISSION		
MODULATION METHOD		
802.11B OR G	OFDM; DSSS	OFDM; DSSS
802.11A	OFDM	OFDM
FREQUENCY BAND		
802.11B/G	2.412 to 2.462 GHz	2.412 to 2.462 GHz
802.11A	5.25 to 5.35 GHz (FCC UNII 1 and UNII 2); 5.725 to 5.85 GHz (FCC UNII 3 ISM)	N/A
4.9 GHZ	4.94 to 4.99 GHz (FCC Only)	4.94 to 4.99 GHz (FCC Only)
DATA RATE		
4.9 GHZ 10 MHZ CHANNELS	3, 4.5, 6, 9, 12 , 18, 24, 27 Mbps	3, 4.5, 6, 9, 12 , 18, 24, 27 Mbps
4.9 GHZ 20 MHZ CHANNELS	6, 9, 12, 18, 24, 36, 48, 54 Mbps	6, 9, 12, 18, 24, 36, 48, 54 Mbps
802.11B	1, 2, 5.5, 11 Mbps	1, 2, 5.5, 11 Mbps
802.11G	6, 9, 12, 18, 24, 36, 48, 54 Mbps	6, 9, 12, 18, 24, 36, 48, 54 Mbps
802.11A	6, 9, 12, 18, 24, 36, 48, 54 Mbps	N/A
MAX OUTPUT POWER	+18 dBm for 802.11g and 802.11a/4.9 GHz; +20 dBm for 802.11b	+20 dBm for all modulations on 4.9 GHz; +24 dBm for 802.11b/g
INTERFACES		
WIRED ETHERNET	10/100Base-T Ethernet (RJ-45)	10/100Base-T Ethernet (RJ-45)
WIRELESS	1 integrated 802.11b/g radio and 1 integrated 802.11a radio	1 integrated 802.11b/g radio and 1 integrated 4.9 GHz radio
ANTENNA CONNECTOR	Integrated diversity 2.4 and 4.9/5 GHz antennas with horizontal and vertical polarization and external antenna connectors 802.11 b/g and 802.11a/4.9 GHz	Two external Type-N Female connectors; one connector for a 2.4 GHz antenna and one connector for a 4.9 GHz antenna
PHYSICAL		
DIMENSIONS		
PACKAGED UNPACKAGED	11.375 x 9.25 x 2.75 in (288.9 x 235 x 69.9 mm) 7.8 X 4.75 X 1 in (198 x 121 x 25 mm)	14.57 x 13.7 x 8.19 in (370.1 x 348 x 208 mm) 10.5 x 10.5 x 3.25 in (267 x 267 x 83 mm)
WEIGHT		
PACKAGED UNPACKAGED	2.05 lbs (0.93 kg) 0.65 lbs (0.29 kg)	11.1 lbs (5.03 kg) 5.5 lbs (2.49 kg)
ENVIRONMENTAL		
TEMPERATURE	0° to 55°C (Operating) -20° to 85°C (Storage)	-35° to 60°C (Operating) -55° to 80°C (Storage)
HUMIDITY	Max 95% relative humidity (non-condensing)	Max 100% relative humidity (non-condensing)
WIND LOADING	N/A	125 mph
WATER & DUST PROOF	N/A	IP65
ELECTRICAL		
POWER SUPPLY	AC: 110/240 VAC, 50/60 Hz (input); 5V 3A (output)	PoE: 110/240 VAC (input); 48 VDC ± 10% (output)
(OPT) POWER SUPPLY	IEEE 802.3af Active Ethernet Support (purchased separately)	110/240 VAC light pole power tap (purchased separately)
POWER CONSUMPTION	Maximum 10 Watts	Maximum 20 Watts
LEDS	Power, Ethernet LAN Activity, Wireless B/G Activity, Wireless 802.11a Activity	Power/Ethernet LAN Link, Wireless Link/Mdr
MANAGEMENT		
LOCAL	RS-232 Serial Port; DB9 Female	RS-232 Serial Port; RJ11 Female
REMOTE	DHCP, Telnet, HTTP, TFTP, Boot P, SNMPv1/v2c/v3; ORINOCO MIB, Etherlike MIB, 802.11 MIB, Bridge MIB, MIB-II	DHCP, Telnet, HTTP, TFTP, Boot P, SNMPv1/v2c/v3; ORINOCO MIB, Etherlike MIB, 802.11 MIB, Bridge MIB, MIB-II
SECURE	SNMPv3, SSH, HTTPS	SNMPv3, SSH, HTTPS
MTBF AND WARRANTY	100,000 hours; 1-year on parts and labor	100,000 hours; 1-year on parts and labor
PACKAGE CONTENTS	• (1) AP-4900M tri-mode access point • (1) AC Power adapter and support for Active Ethernet and IEEE 802.3af (AE injector purchased separately) • (1) Cable cover and Ceiling/Wall mounting Plate • (1) Installation CD-R	• (1) AP-4900MR-LR dual-radio mesh access point • (1) Power injector and power cord • (1) RJ11 to DB9 serial connector • (1) Cable termination kit • (1) Wall/Pole Mounting bracket and hardware • (1) Installation CD-R
RELATED PRODUCTS	ORINOCO AP-4900MR-LR, AP-4900MR and AP-8000MR-LR to extend mesh network outdoors, 2.4 GHz antennas, 4.9 GHz antennas, ProximVision Network Management System, Tsunami MP.11 for backhaul between groups of mesh radios, ServPak (US/CAN Only)	ORINOCO AP-8000MR-LR 2.4/5.8 GHz mesh access points, 2.4 GHz Direct Connect Antennas (1086-OA24-DCS & 1086-OA24-DCB), 4.9 GHz Direct Connect Antenna (1086-OA43-DCB), AC Power Kit for lightpole mounted AP (1089-AC-KIT-TW), Wide Light Pole Mounting Kit (1090-LP-MNTWDL ProximVision™ NMS, Tsunami MP.11 for backhaul between groups of mesh radios, ServPak for Enhanced Support (US/CAN only)

*Available for FCC only

For detailed technical specifications, please go to **http://www.proxim.com/products/wifi/ap/**

DS_0806_ORAP4900_US

proxim wireless

Proxim Wireless Corporation
www.proxim.com

ANEXO 3 Hojas de Especificaciones BelAir Networks

BelAir NETWORKS

Data Sheet

BelAir20M Mobile Bridge

BelAir Networks wireless mesh products have always been differentiated by their ability to support vehicular speed mobility with standard wireless devices. The BelAir20M Mobile Bridge now extends this capability to address the high-performance mobile connectivity requirements of public Wi-Fi access for commuters, telematics systems monitoring train operations, point of sale applications for ticketing, and video security cameras and monitoring applications in vehicles traveling as fast as 150 mph (240 kph). The BelAir20M is based on the industry's highest performance dual 'n' radio wireless mesh nodes.

Offering true standards-based seamless mobility, the BelAir20M employs 'make before break' handover ensuring uninterrupted high-performance broadband connectivity for critical applications, including voice and video, as the vehicle moves throughout the wireless mesh network.

Vehicular Mobility

The BelAir20M, mounted in trains, buses, and other mass transit or public vehicles seamlessly integrates with the deployed BelAir wireless infrastructure to provide full and transparent mobile broadband connectivity for voice, video, and data applications at high vehicular speeds – up to 150 mph or 240 kph. Like the rest of the BelAir Networks wireless mesh product portfolio, the BelAir20M is managed as a discoverable network element in the BelView Network Management system. The BelAir20M has full meshing capabilities to trackside/ roadside applications.

Application Examples

A BelAir20M node mounted in a train or bus can provide backhaul for applications such as web access for private or public use and video monitoring within the vehicles. Voice over IP can be installed for emergency calling or workforce automation.

Dual-radio architecture

The dual-radio design of the BelAir20 provides support for concurrent 600Mbps operation using both the 2.4 and 5 GHz frequency bands. The 5 GHz frequency band is desiged to mesh with fixed outdoor 5 GHz radios available on any of the BelAir Networks products.

Features

- Dual-radio architecture
- Supports 802.11n/a/b/g
- Seamless high speed mobility for uninterrupted broadband services
- Enhanced 'make before break' handover - fastest and most reliable
- Network Management via CLI, WEB or BelView NMS
- Can be 802.3af powered

Wireless radio modules

The BelAir20 is a dual radio node. Both radio modules support the IEEE 802.11n Draft 2.0 and can be software upgraded as the specification is finalized. The standard configuration is a 2.4 GHz radio in 2x2 mode and the 5 GHz in 1x1 mode, although other configurations are possible. The BelAir20 also supports 802.11a/b/g operation for full compatibility with legacy clients.

Layer 2 Networking Capabilities

The BelAir20M has an integrated Layer 2 Switch engine that provides extensive QoS, VLAN, Network Security and Traffic Management capabilities that are necessary for transporting

mission critical, time sensitive applications such as voice and video. The BelAir200M fully supports the bridging of multiple client access devices (e.g. laptop, iPhone, etc.) to the "backhaul" radio link. Moreover, the BelAir20M maintains the status (connected/not connected) of the backhaul link, thus enabling its Ethernet port to facilitate inter-working with third-party external multi-radio router solutions (e.g. InMotion).

Network Management

The BelAir20M can be managed via a Command Line Interface (CLI), Web GUI or with BelAir Networks BelView Network Management System (NMS). Both CLI and Web GUI provide device level support, and BelView NMS provides complete network-wide support for Fault, Configuration and Performance Management. BelView NMS works on either Windows XP or SUN Solaris platforms and can also be integrated into other management systems. BelAir Networks is the leading provider of mobile broadband mesh networking solutions, delivering the industry's highest performance and most comprehensive product line. Targeted at the local government, hospitality, defense and industrial markets, BelAir Networks is deployed for public safety networks, municipal networks, port and mass transit installations, hotel and venue networks, defense applications, and plant deployments.

Networking

- 1-port 10/100/1000Base-TX (Cat.5 RJ-45)
- IEEE 802.1D MAC Bridging
- IEEE 802.1Q VLANs
- IEEE 802.1w (RSTP)
- IEEE 802.1p prioritization with 4 queues
- L2TP Tunneling for seamless mobility
- 16 SSIDs per access radio. MBSSID support for 8 virtual APs per access radio
- Support for SNTP, ICMP, HTTP, ARP, TCP, UDP, Telnet, TFTP and IP traffic

Management

- Secure local and remote access
- Command line, HTTP and HTTPS Web GUI, SNMPv1/v2/v3 and SSHv2 management interfaces
- MIBs: MIB-II, SNMPV2, 802.11, Ethernet-like, Interface Group
- Multiple user privilege levels with RADIUS authentication
- Firmware upgrade through TFTP with support for automatic rollback
- RADIUS accounting

Radios

- 2400–2483.5 MHz (for US, Canada, ETSI, Japan)
- 5150–5350 5470–5725 5725–5825 MHz (for US, Canada)
- 4900–5000 5030–5091 5150–5250 MHz (for Japan)
- 5150–5350 5470–5725 5725–5875 MHz (for ETSI)

Output power

2.4GHz
- up to 19 dBm EIRP

5GHz
- up to 30dBm EIRP

Sensitivity

2.4GHz (2RX)
- up to -92 dBm

5GHz (1RX)
- up to -89dBm

Transportation Regulatory

- EN51055
- EN50121-3-2
- EN 60950-1 and IEC 60950-1
- IEC 61373
- UL 2043

Security

- Authentication: 802.1x (RADIUS) and EAP methods
- Encryption: WEP 64 and 128 bit, TKIP / MIC per 802.1x, 802.11i AES
- MAC address access control lists
- Rogue AP detection

Approvals

- Radio: FCC part 15 and part 27, ETSI EN 300 328, EN 300 440, EN 301 893 and Industry Canada RSS 210 Issue 5
- EMC: FCC 47 CFR part 15, subpart B Class B and EN 301 489-1/-17 Class B
- Safety: ANSI/UL std no.60950-1, CSA-C22.2 std no. 60950-1, CB-60950-1
- RF safety: FCC OET Bulletin 65, Health Canada Safety code 6
- CE! Mark

Physical and Electrical

- Dimensions: (W x D x H): 210mm x 125mm x 25mm
- LED Indicators: RF-1, RF-2, LAN, PWR
- PoE Nominal Input Voltage: 48V/0.35A
- AC/DC Power adapter: Input: 100–240ACV, Output: 48V/0.8A

Environmental

- Temperature/Humidity
  - Operation -20o to 50oC
  - Storage -20o to 70o C
  - Humidity: Max 95%
- Environment Vibration: IEC 68 part, test Eo& Fh,
- Environment Shock: IEC 68-2-29, ASTM D3332
- Drop: IEC 68-2-32, or ISO 4180/2
- Altitude: IEC 68-2-40 test Z/AM, IEC 68-2-41 test Z/AMD
- Acoustic: ISO 7779, IS
- Plenum: UL2043

BelAir NETWORKS

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BDMA02020-A02

BelAir NETWORKS

Data Sheet

BelAir100LP LTE Picocell

Leveraging BelAir Networks years of experience in carrier Wi-Fi and cellular+Wi-Fi solutions, the BelAir100LP LTE Picocell is designed for mobile carriers who want to build large-scale small cell networks for future proof capacity and coverage - quickly and cost-effectively. The BelAir100LP provides a high capacity underlay or coverage extension to complement tower and rooftop-based macrocell deployments in areas of high user concentration or where the macrocell doesn't reach.

The BelAir100LP incorporates patented innovations – including switched mesh backhaul and hybrid fiber coax (HFC) integration – to address the traditional power, mounting and backhaul challenges that have impeded the adoption of small cell networks. Available in both pole and strand mount (pictured) variants, the BelAir100LP offers unmatched deployment flexibility and speed and can be installed and up and running in less than 15 minutes.

Multi-radio architecture

The BelAir100LP is a multi-radio compact base station supporting a combination of licensed LTE cellular technology along with 802.11n Wi-Fi in one rugged, carrier-grade product. The patented strand-mount architecture leverages HFC for mounting, power and backhaul supporting DOCSIS® 3.0 and Euro- DOCSIS 3.0 interfaces. Strand-mounting options include aerial plant, pedestals, cabinets or underground vaults. The pole-mount variant leverages BelAir Networks patented switched mesh backhaul to simplify deployment and reduce egress requirements while maintaining high performance. The pole-mount variant can be AC or DC powered.

Features

- Picocellular architecture maximizes capacity to improve user experience and address growth in data traffic
- Multiple mounting options – pole and wall-mount or patented strand mount via aerial, pedestal, cabinet or vault hybrid fiber coax (HFC) infrastructure
- Backhaul flexibility – patented high-performance switched mesh, fiber, Ethernet or HFC
- Powering via AC, DC or cable plant
- Seamless Cellular/Wi-Fi roaming and networkwide mobility
- Network management via CLI, WEB or SNMP using BelView NMS
- 10/100/1000 BASE-TX Ethernet interfaces
- Internal GPS antenna & receiver for timing and location
- Licensed and unlicensed access radios – LTE + dual 802.11n Wi-Fi radios with chip-based beamforming
  - Licensed: LTE
    - Frequency Bands 700, 800, 1700/2100, 1800, 1900, 2600MHz
    - Transmit Power up to 2W
    - 5–20MHz channel operation
    - FDD and TDD operation
  - Unlicensed: 802.11n Wi-Fi radio specifications:
    - Dual 2.4/5 GHz radios
    - IEEE 802.11N - 2009 compliant radio
    - Wi-Fi Alliance Certified
    - 3x3 MIMO / 3-streams per radio
    - Up to -102 dBm receive sensitivity with MRC
    - Up to 38 dBm EIRP transmit power
    - Space Time Block Coding for increased handset performance
    - Improved Maximum Ratio Combining for best in class receive sensitivity
    - Maximum Likelihood Demodulation for increased data throughput at short range
    - Low Density Parity Check for increased data throughput at all ranges
    - Internal array beam steering antennas working in conjunction with chip-based beamforming to deliver improved throughput at a greater distance

The BelAir100LP includes two IEEE 802.11n-2009 compliant 3x3 MIMO radios, each of which supports the latest processing capabilities – transmit beamforming and beam steering, space-time block coding, independent 3-streams of data, maximal ratio combining, and unmatched radio sensitivity. The BelAir100LP also features a modular platform to accommodate operators' LTE preferences

Under the radome, the rugged BelAir100LP has a combination of Wi-Fi and LTE antennas. These patented steerable antennas enable operation in high interference environments. The BelAir100LP also includes advanced algorithms and spectrum analyzer capabilities to maximize performance.

Layer 2 networking capabilities

The BelAir100LP has an integrated Layer 2 Switch engine that provides extensive QoS, VLAN, Network Security and Traffic Management capabilities that are necessary for transporting mission-critical, time sensitive applications like voice and video.

BelAirOS

Driven by the BelAirOS operating system common to the BelAir Networks portfolio, the BelAir100LP delivers:

- state-of-the-art edge policy enforcement with centralized authentication
- touchless automatic configuration
- hugely scalable monitoring and diagnostics
- end-to-end quality of service (both over the air and on the network)
- network-wide mobility
- Virtual AP capabilities that enable multiple operators to share common wireless network infrastructure for access and backhaul while offering a customized user experience through direct integration with their specific back end systems (AAA, Policy Management) on a per SSID basis

BelView Network Management

The BelAir100LP can be managed via a Command Line Interface (CLI), Web GUI or with BelView NMS. The BelAir100LP also supports TR-069. Both the CLI and WEB GUI provide device level support, while BelViewNMS provides complete network-wide support for Fault, Configuration and Performance Management. BelView NMS works on either Windows, Linux or SUN Solaris platforms and can also be integrated into other management systems. Built on a scalable client-server-data collector architecture BelView NMS can support up to 50,000 base stations.

Networking

- 1-port 10/100/1000 BASE-TX (Cat. 5 RJ-45)
- DOCSIS 3.0/EuroDOCSIS 3.0 8x4 bonded DS/US channels (achieves a downstream throughput of 260 Mbps in 8 bonded channel operation)
- IEEE 802.1D MAC bridging
- IEEE 802.1Q VLANs
- Layer 2 (802.1p) and layer 3 (DSCP) QoS
- L2TP, L2VPN with redundant tunnels
- 8 BSSIDs per Wi-Fi radio enabling 8 virtual APs per Wi-Fi radio
- Support for SNTP, ICMP, HTTP, ARP, TCP, UDP, Telnet

Management

- Secure local and remote access
- Command line, HTTP and HTTPS Web GUI, SNMPv1/v2/v3 and SSHv2 management interfaces
- MIBs: MIB-II, SNMPv2, 802.11, Ethernet-like, Interface Group
- Firmware upgrade through TFTP and FTP with dual banks and support for automatic rollback
- TR-069 support

Policy Enforcement

- Multiple user privilege levels with RADIUS authentication
- RADIUS accounting

Wi-Fi Security

- Authentication: 802.1x (RADIUS) and EAP methods, including EAP-SIM/AKA
- Encryption: WEP 64 and 128 bit, TKIP / MIC per 802.1x, 802.11i AES
- MAC address access control lists
- Rogue AP detection

Approvals

- Radio: FCC part 15.247C, part 15.407, part 90 (PSB), part 90 (ITS), part 90 subparts Y and M, EN 300-328, EN 301-893, IR2005/IR2006/IR2007, Industry Canada RSS 210 Issue 7, RSS 211 Issue 2
- EMC: FCC 47 CFR part 15, subpart B Class B, FCC 47 CFR Part 76.614, and EN 301 489-1/-17 Class B
- Safety: ANSI/UL std no.60950-1, CSA-C22.2 std no. 60950-1, CB-60950-1
- RF safety: FCC OET Bulletin 65, Health Canada Safety code 6

- Outdoor use: IP66/NEMA4X for wet and dusty conditions
- Wi-Fi Alliance certification: 802.11n, WPA, WPA2, WMM, WMM-PS

Physical and Electrical (Strandmount version)

- Size: 19.5"(L) x 10.5"(W) x 10.5"(H)
- Weight: 20lbs
- Typical power consumption: < 60W
- Power supply: 40 to 87 V ac quasi-square wave, 47 to 63 Hz, through K5 threaded interface
- Product shipped with F-adapter
- Power, radio and Ethernet LEDs

Protection circuits

- IEC 60000-4-5 level 4 surge
- GR1089 - 6 kV (3000 A) surge

Environmental

- Operating temperature: -40°C to +60°C
- Storage temperature: -40°C to +80°C
- Operating humidity: 5 to 95% non-condensing
- Shock and vibration: ETSI300-019-1-4

BelAir NETWORKS

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BDMA10120-A01

BelAir NETWORKS

Data Sheet

BelAir100M Mobile Mesh Node

BelAir Networks wireless mesh products have always been differentiated by their ability to support vehicular speed mobility with standard wireless devices. The BelAir100M Mobile Mesh Node now extends this capability to address the high-performance mobile connectivity requirements of critical Public Safety and ITS applications in vehicles traveling as fast as 150 mph (240 kph).

The BelAir100M is based on the industry's highest performance and most flexible dual and tri radio wireless mesh nodes. It provides mobile broadband support for Wi-Fi, WiMAX, 4.9 GHz Public Safety, and 5.9 GHz Intelligent Transportation Services (ITS) bands. Offering true standards-based seamless mobility, the BelAir100M employs 'make before break' handover ensuring uninterrupted high-performance broadband connectivity for critical applications, including voice and video, as the vehicle moves throughout the wireless mesh network.

Vehicular Mobility

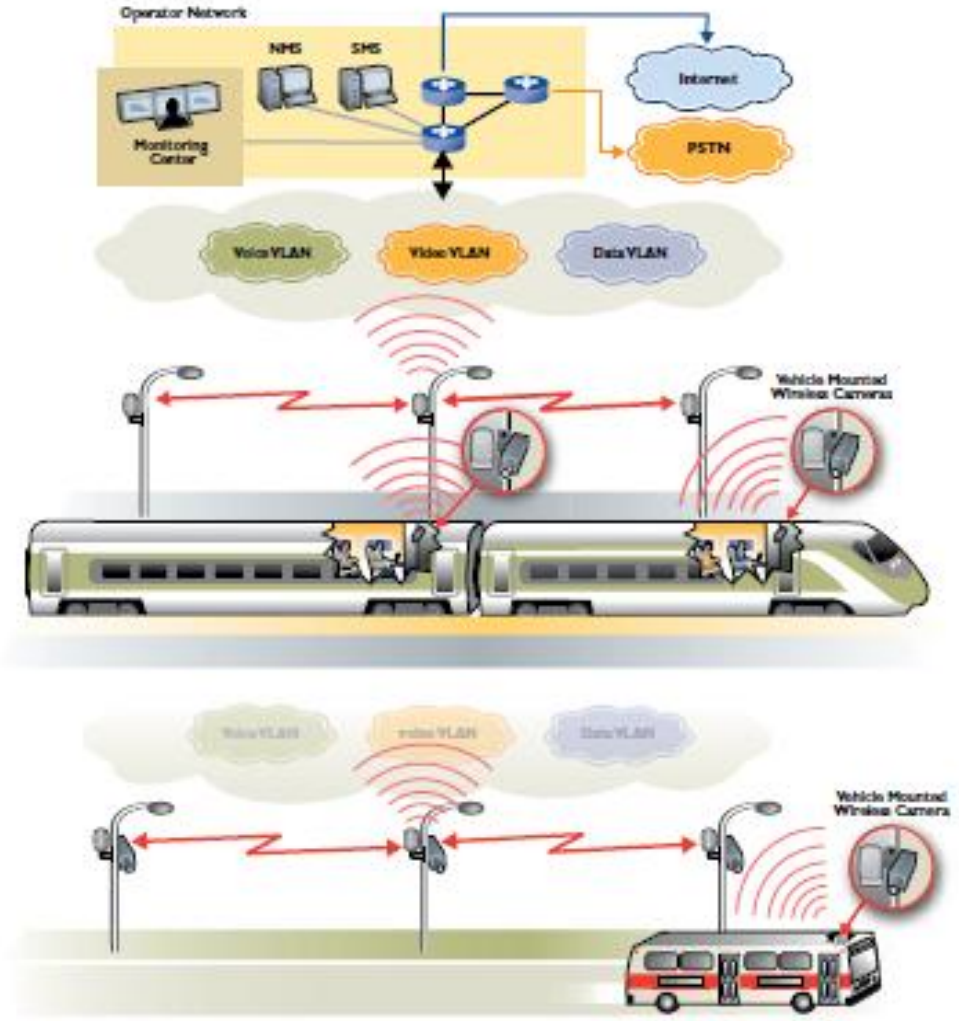
The BelAir100M, mounted in buses, trains, police cars and other mass transit or public vehicles seamlessly integrates with the deployed BelAir wireless infrastructure to provide full and transparent mobile broadband connectivity for voice, video, and data applications at high vehicular speeds – up to 150 mph or 240 kph. Like the rest of the BelAir Networks wireless mesh product portfolio, the BelAir100M is managed as a discoverable network element in the BelView Network Management system. The BelAir100M has full meshing capabilities to trackside/roadside and can connect at multiple frequency bands, offering the full redundancy essential for video monitoring and emergency connectivity applications.

Features

- Highest performance
- Modular dual or tri radio architecture
- Supports Wi-Fi, WiMAX, 4.9GHz Public Safety, and 5.9GHz ITS bands
- Seamless high speed mobility for uninterrupted broadband services
  - Enhanced 'make before break' handover – fastest and most reliable
- Network Management via CLI, Web or BelView NMS
- Electrical and Optical Ethernet interface options

Radio module options

- Access Radio Module (ARM) IEEE 802.11a/b/g, 4.9 GHz Public Safety, 5.9 GHz ITS
- Backhaul Radio Module (BRM) IEEE 802.11a pre-WiMAX, WiMAX, 4.9 GHz Public Safety, 5.9 GHz ITS
- Radio modules available in multiple licensed and unlicensed frequency bands - modular architecture enables multi-frequency support on a single node



Application Examples

A BelAir100M node mounted in a train or bus can provide backhaul for video monitoring within the vehicles. It can also be configured to provide local wireless access within the vehicle for private or public use. Voice over IP can be installed for emergency calling or workforce automation.

Tri-radio Architecture

The tri-radio design of the BelAir100M provides support for up to two Backhaul Radio Modules (BRMs) and Access Radio Modules (ARMs) plus one conventional radio module in the same wireless mesh node. The BelAir100M can be configured with a BRM and ARM for traditional wireless mesh or with dual BRMs for resilient dual band backhaul deployments.

Wireless Radio Modules

The BelAir100M can contain any combination of ARMs and BRMs, providing the ideal flexibility and capacity for mobile mesh networks. The ARMs and BRMs support a broad range of Wi-Fi (IEEE 802.11a/b/g), 4.9 GHz Public Safety and 5.9 GHz ITS applications making it the most versatile solution on the market for providing multi-service capabilities over a wireless mesh network.

Layer 2 Networking Capabilities

The BelAir100M has an integrated Layer 2 Switch engine that provides extensive QoS, VLAN, Network Security and Traffic Management capabilities that are necessary for transporting mission critical, time-sensitive applications such as voice and video.

The BelAir100M fully supports the bridging of multiple client access devices (e.g. laptop, iPhone, etc.) to the "backhaul" radio link. Moreover, the BelAir100M maintains the status (connected/not connected) of the backhaul link, thus enabling its Ethernet port to facilitate inter-working with third-party external multi-radio router solutions (e.g. InMotion).

Network Management

The BelAir100M can be managed via a Command Line Interface (CLI), Web GUI or with BelAir Networks BelView Network Management System (NMS). Both CLI and Web GUI provide device level support, and BelView NMS provides complete network-wide support for Fault, Configuration and Performance Management. BelView NMS works on either Windows XP or SUN Solaris platforms and can also be integrated into other management systems.

BelAir Networks is the leading provider of mobile broadband mesh networking solutions, delivering the industry's highest performance and most comprehensive product line. Targeted at the local government, hospitality, defense and industrial markets, BelAir Networks is deployed for public safety networks, municipal networks, port and mass transit installations, hotel and venue networks, defense applications, and plant deployments.

Networking

- 1-port 10/100BASE-TX (Cat. 5 RJ-45)
- 1-port 100BASE-FX (SMF)
- IEEE 802.1D MAC Bridging
- IEEE 802.1Q VLANs
- IEEE 802.1w (RSTP) and IEEE 802.1s (MSTP)
- IEEE 802.1p prioritization with 4 queues
- L2TP Tunneling for seamless mobility
- 16 SSIDs per access radio. MBSSID support for 8 virtual APs per access radio
- Support for SNTP, ICMP, HTTP, ARP, TCP, UDP, Telnet, TFTP and IP traffic
- Support for multi-client bridging
- Signaling of "backhaul" link status to Ethernet port

Management

- Secure local and remote access
- Command line, HTTP and HTTPS Web GUI, SNMPv1/v2/v3 and SSHv2 management interfaces
- MIBs: MIB-II, SNMPv2, 802.11, Ethernet-like, Interface Group
- Multiple user privilege levels with RADIUS authentication
- Firmware upgrade through TFTP with support for automatic rollback
- RADIUS accounting

Transportation Regulatory

- EN51055
- EN50121-3-2
- EN 60950-1 and IEC 60950-1
- IEC 61373
- UL 2043

Security

- Authentication: 802.1x (RADIUS) and EAP methods
- Encryption: WEP 64 and 128 bit, TKIP / MIC per 802.1x, 802.11i AES
- MAC address access control lists
- Rogue AP detection

Approvals

- Radio: FCC part 15 and part 27, EN 300 328, EN 300 440, EN 301 893 and Industry Canada RSS 210 Issue 5
- EMC: FCC 47 CFR part 15, subpart B Class B and EN 301 489-1/-17 Class B
- Safety: ANSI/UL std no.60950-1, CSA-C22.2 std no. 60950-1, CB-60950-1
- Laser safety: Class 1 laser product complies with 21 CFR 1040 and IEC60825
- RF safety: FCC OET Bulletin 65, Health Canada Safety code 6
- Outdoor use: IP66/NEMA4/NEMA4X for wet and dusty conditions
- CE! mark
- Mexico: NOM
- Korea: MIC2003-15
- Russia: GOST-R
- India: ETA-74/2005, ETA-78/2005
- Taiwan: LP00002, ETC094LP0425, ETC094LPD0426, ETC094LPD0426a

Physical and Electrical

- Size: 12 in. (30.5 cm) high x 7.25 in. (18 cm) wide x 6 in. (15.3 cm) deep
- Weight: 10 lbs (4.5 kg)
- Typical power consumption: 23 Watts
- Power supply: 100 to 240 V ac, 47 to 63 Hz or 24 to 110V dc
- Backup 8V battery
- Battery backup time: 40 minutes typical
- N connectors for connection to external antennas
- Power, radio and Ethernet lamps

Protection Circuits

- IEC 60000-4-5 level 4 surge
- GR1089 - 6 kV (3000 A) surge

Environmental

- Operating temperature: -40°C to +55°C
- Storage temperature: -40°C to +80°C
- Operating humidity: 5 to 95% non-condensing
- Shock and vibration: ETSI300-019-1-4

BelAir NETWORKS

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BDMA10060-A01

BelAir NETWORKS

Data Sheet

BelAir100N
Wireless Access Point

The BelAir100N AP is the industry's highest performance and most flexible dual radio concurrent wireless AP. It includes two 802.11n radios that can support both 2.4 GHz and 5 GHz, and can be AC or DC/PoE powered. In addition to Wi-Fi frequencies, the BelAir100N can also accommodate 4.9 GHz Public Safety and 5.9 GHz ITS spectrums. Building on BelAir Networks experience with the world's largest Wi-Fi networks, the BelAir100N provides unparalleled support for high capacity data, voice and video applications.

Dual radio architecture

The dual radio design of the BelAir100N supports wireless access at both 2.4 GHz and 5 GHz for broadband mobile wireless applications or a combination of access and wireless mesh or point to point backhaul. It is deployed by service providers and in private networks. The high performance radios offer a world class user experience for mobile data, mobile multimedia and fixed mobile convergence applications.

802.11n Radios

The BelAir100N integrates two IEEE 802.11a/b/g/n compliant radios, supporting 2X2 (two Transmit, two Receive) MIMO operation at 2.4 GHz and 4.9 – 5.9 GHz. Built to IEEE standard 802.11n specifications, the BelAir100N supports a maximum concurrent rate of 600 Mbps.

BelAirOS

The integrated BelAirOS operating system includes software modules that deliver scalable high speed microcellular mobility, state-of-the-art edge policy enforcement, with centralized authentication, touchless automatic configuration, hugely scalable monitoring and diagnostics and end-to-end quality of service (both over the air and on the network).

Networking Capabilities

The BelAir100N has an integrated Layer 2 switch engine that provides extensive QoS, VLAN, network security and traffic management capabilities that are necessary for transporting mission critical, time-sensitive applications like voice and video.

Features

- Modular dual radio architecture
- Supports 802.11a/b/g/n Wi-Fi
- Seamless mobility for uninterrupted service
- Network management via CLI, WEB or BelView NMS
- 10/100/1000 BASE-TX Ethernet interfaces
- 100BaseFX option
- AC or DC/PoE option

Radio modules

- Radios can operate in multiple frequency bands and can be deployed in combination to support access and/or backhaul:

2.4 GHz Radio Module
-2400 – 2483.5 MHz
4.9-5.9 GHz Radio Module (can operate in any of these bands)
- 4940 – 4990 MHz
- 5250 – 5350 MHz
- 5725 – 5850 MHz
- 5850 – 5925 MHz

Antennas

- Radios can be duplexed into pair of dual band antennas or separated into two pairs, as required
- Several internal and external antenna options are available

Network Management

The BelAir100N can be managed via a Command Line Interface (CLI), WEB GUI or with BelAir Networks BelView network management. Both CLI and WEB GUI provide device level support, while BelView provides complete network-wide support for fault, configuration and performance management. BelView works on either Windows XP or SUN Solaris platforms. The BelAir100N and BelView can also be integrated into other management systems like HP OpenView or IBM NetView.

BelAir Networks is the market share leader in Service Provider Wi-Fi solutions. The company's portfolio of indoor and outdoor wireless LAN access points, control and management systems enable service providers, government and businesses to deliver high performance, scalable and flexible managed Wi-Fi services to both enterprise and public users. BelAir Networks solutions provide a compelling return on investment and address the need for public Wi-Fi hot spots and hotzones, secure wireless LAN, cellular data offload, wireless backhaul and video surveillance. Innovative cable, telecom and mobile service providers use BelAir Networks to drive revenue and improve competitiveness.

Networking

- 1-port 10/100/1000 BASE-TX (Cat. 5 RJ-45)
- 1-port 100 BASE-FX option
- IEEE 802.1D MAC bridging
- IEEE 802.1Q VLANs
- IEEE 802.1w (RSTP) & IEEE 802.1s (MSTP)
- IEEE 802.1p prioritization with 4 queues
- L2TP and L2VPN with redundant tunnels
- 16 SSIDs per AP, 8 SSIDs per access radio. MSSID support for 8 virtual APs per access radio
- Support for SNTP, ICMP, HTTP, ARP, TCP, UDP, Telnet,

Management

- Secure local and remote access
- Command line, HTTP and HTTPS Web GUI, SNMPv1/v2/v3 and SSHv2 management interfaces
- MIBs: MIB-II, SNMPv2, 802.11, Ethernet-like, Interface Group
- Multiple user privilege levels with RADIUS authentication
- Firmware upgrade through TFTP with support for automatic rollback
- RADIUS accounting

Security

- Authentication: 802.1x (RADIUS), EAP and UAM (WISPr) methods
- Encryption: WEP 64 and 128 bit, TKIP / MIC per 802.1x, 802.11i AES
- MAC address access control lists
- Rogue AP detection

Approvals

- Radio: FCC part 15.247C, part 15.407, part 90 (PSB), part 90 (ITS), part 90 subparts Y and M, EN 300-328, EN 301-893, IR2005/IR2006/IR2007, Industry Canada RSS 210 Issue 7, RSS 211 Issue 2
- EMC: FCC 47 CFR part 15, subpart B Class B and EN 301 489-1/-17 Class B
- Safety: ANSI/UL std no.60950-1, CSA-C22.2 std no. 60950-1, CB-60950-1
- RF safety: FCC OET Bulletin 65, Health Canada Safety code 6
- Outdoor use: IP67/NEMA4X for wet and dusty conditions
- CE! mark

Physical and Electrical

- Size: 7.5 in. (19 cm) high x 13 in. (33 cm) wide x 5.5 in. (14 cm) deep
- Weight: 12 lbs (5.5 kg)
- Typical power consumption: 24 Watts
- Power supply: 100 to 240 V AC, 47 to 63 Hz
- Power supply: -40 to -72 V DC/PoE variant also available
- Available wall or pole mounting kits with theft deterrent anti-tamper screws
- Power, radio and Ethernet lamps

Protection circuits

- IEC 60000-4-5 level 4 surge
- GR1089 - 6 kV (3000 A) surge

Environmental

- Operating temperature: -40°C to +65°C (no heaters required)
- Storage temperature: -40°C to +80°C
- Operating humidity: 5 to 95% non-condensing
- Shock and vibration: ETSI300-019-1-4

BelAir NETWORKS

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BDMA10100-A01

BelAir NETWORKS

Data Sheet

BelAir100SNE Strand-Mounted Wireless Access Point

BelAir Networks delivered the industry's first strand-mounted, cable-optimized Wi-Fi access point (AP) back in 2005. Since then, the platform has continuously evolved and 10's of thousands of BelAir Networks patented strand-mount APs have been deployed worldwide for Tier One cable operators in the world's largest Wi-Fi networks. Reflecting BelAir Networks commitment to support the latest industry standards, the BelAir100SNE incorporates dual 802.11n-2009 Wi-Fi 3x3 MIMO radios and a DOCSIS® 3.0 or Euro-DOCSIS 3.0 modem on this innovative and commercially proven platform.

The BelAir100SNE is designed for cable operators who want a proven and scalable strand-mount Wi-Fi platform that integrates seamlessly with their current network and back office systems and can be up and running live in less than 15 minutes. The BelAir100SNE leverages the BelAirOS Operating System to support network-wide mobility and quality of service (QoS), along with edge-based security and policy enforcement. With BelView network management, cable operators can manage up to 50,000 BelAir100SNE APs (or any combination of BelAir APs) in a single network. Web-based monitoring and dashboard tools and smartphone apps provide real time network and user stats. The BelAir100SNE also supports TR-069 to enable integration with the operator's existing network management system.

Dual-radio architecture

The BelAir100SNE is a dual-radio compact, self contained AP supporting both 802.11b/g/n and a 802.11a/n Wi-Fi radios in a rugged, carrier-grade product. The patented strand-mount architecture leverages the cable operators hybrid fiber coax (HFC) network for mounting, power and backhaul via DOCSIS 3.0 or Euro-DOCSIS 3.0 interfaces. Strand-mounting options include aerial plant, pedestals, cabinets or underground vaults.

Features

- Multiple mounting options – patented strand mount via aerial, pedestal, cabinet or vault hybrid fiber coax (HFC) infrastructure
- Network management via CLI, WEB or SNMP using BelView NMS
- 10/100/1000 BASE-TX Ethernet interfaces
- Internal GPS antenna & receiver for location
- Dual 2.4/5 GHz radios 802.11n Wi-Fi radios
  - IEEE 802.11n - 2009 compliant
  - Wi-Fi Alliance Certified
  - 3x3 MIMO / 3-streams per radio
  - Up to -102 dBm receive sensitivity
  - Up to 38 dBm EIRP transmit power
  - Space Time Block Coding for increased handset performance
  - Improved Maximum Ratio Combining for best in class receive sensitivity
  - Maximum Likelihood Demodulation for increased data throughput at short range
  - Low Density Parity Check for increased data throughput at all range
  - Internal array beam steering antennas working in conjunction with chip-based beamforming to deliver improved throughput at a greater distance

The BelAir100SNE includes two IEEE 802.11n-2009 compliant 3x3 MIMO radios, each of which supports the latest processing capabilities – standards-based beamforming and beam steering, space-time block coding, 3 independent streams of data, maximal ratio combining, and unmatched radio sensitivity.

Under the radome, the rugged BelAir100SNE includes both the antennas and a GPS receiver, so no additional equipment is required, and installation is quick and easy. The patented steerable antennas enable operation in high interference environments. The BelAir100SNE also includes advanced algorithms and spectrum analyzer capabilities to maximize performance.

Layer 2 networking capabilities

The BelAir100SNE has an integrated Layer 2 Switch engine that provides extensive QoS, VLAN, Network Security and Traffic Management capabilities that are necessary for transporting mission-critical, time sensitive applications like voice and video.

BelAirOS

Driven by the BelAirOS operating system common to the BelAir Networks portfolio, the BelAir100SNE delivers:

- state-of-the-art edge policy enforcement with centralized authentication and policy management
- touchless automatic configuration
- end-to-end QoS (both over the air and on the network)
- network-wide mobility
- Virtual AP capabilities that enable multiple operators to share common wireless network infrastructure for access and backhaul while offering a customized user experience through direct integration with their specific back end systems (AAA, Policy Management) on a per SSID basis

BelView Network Management

The BelAir100SNE can be managed via a Command Line Interface (CLI), Web GUI or with BelView NMS.

The BelAir100SNE also supports SNMP and TR-069. Both the CLI and WEB GUI provide device level support, while BelViewNMS provides complete network-wide support for Fault, Configuration and Performance Management. BelView NMS works on either Windows, Linux or SUN platforms and can also be integrated into other management systems.

Built on a scalable client-server-data collector architecture, BelView NMS can support up to 50,000 APs in a single network. Business intelligence tools, including smartphone dashboard apps, provide the cable operator's senior management, engineering and operations personnel with real-time visibility of both the network and users. Automated provisioning makes it fast and easy to activate and modify any par

Networking

- 1-port 10/100/1000 BASE-TX (Cat. 5 RJ-45)
- DOCSIS 3.0/EuroDOCSIS 3.0 8x4 bonded DS/US channels (achieves a downstream throughput of 260 Mbps in 8 bonded channel operation)
- IEEE 802.1D MAC bridging
- IEEE 802.1Q VLANs
- Layer 2 (802.1p) and layer 3 (DSCP) QoS
- L2TP, L2VPN and GRE with redundant tunnels and integrated web redirect
- 8 BSSIDs per Wi-Fi radio enabling 8 virtual APs per Wi-Fi radio
- Support for SNTP, ICMP, HTTP, ARP, TCP, UDP, Telnet

Management

- Secure local and remote access
- Command line, HTTP and HTTPS Web GUI, SNMPv1/v2/v3 and SSHv2 management interfaces
- MIBs: MIB-II, SNMPv2, 802.11, Ethernet-like, Interface Group
- Firmware upgrade through TFTP and FTP with dual banks and support for automatic rollback
- TR-069 support

Policy Enforcement

- Multiple user privilege levels with RADIUS authentication
- RADIUS accounting

Wi-Fi Security

- Authentication: 802.1x (RADIUS) and EAP methods, including EAP-SIM/AKA
- Encryption: WEP 64 and 128 bit, TKIP / MIC per 802.1x, 802.11i AES
- MAC address access control lists
- Rogue AP detection

Approvals

- Radio: FCC part 15.247C, part 15.407, part 90 (PSB), part 90 (ITS), part 90 subparts Y and M, EN 300-328, EN 301-893, IR2005/IR2006/IR2007, Industry Canada RSS 210 Issue 7, RSS 211 Issue 2
- EMC: FCC 47 CFR part 15, subpart B Class B, FCC 47 CFR Part 76.614, and EN 301
- 489-1/-17 Class B
- Safety: ANSI/UL std no.60950-1, CSA-C22.2 std no. 60950-1,CB-60950-1
- RF safety: FCC OET Bulletin 65, Health Canada Safety code 6
- Outdoor use: IP66/NEMA4X for wet and dusty conditions
- Wi-Fi Alliance certification: 802.11n, WPA, WPA2, WMM, WMM-PS

Physical and Electrical

- Size: 17.5"(L) x 9"(W) x 8.5"(H)
- Weight: 15 lbs.
- Typical power consumption: 28 W
- Power supply: 40 to 87 V ac quasi-square wave, 47 to 63 Hz, through KS threaded interface
- Product shipped with F-adapter
- Power, radio and Ethernet LEDs

Protection circuits

- IEC 60000-4-5 level 4 surge
- GR1089 - 6 kV (3000 A) surge

Environmental

- Operating temperature: -40°C to +60°C
- Storage temperature: -40°C to +80°C
- Operating humidity: 5 to 95% non-condensing
- Shock and vibration: ETSI300-019-1-4

BelAir NETWORKS

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BDMA10130-A01

BelAir NETWORKS

Data Sheet

BelAir100T Wireless Mesh Node

The BelAir100T Wireless Mesh Node is a cost-effective multi-radio platform offering a versatile architecture for multiple configurations of access and backhaul. Designed for municipal deployments, the BelAir100T accommodates two full-slot radios, as well as one half-slot radio and provides support for a variety of networks including Wi-Fi, WiMAX, and 4.9 GHz Public Safety. Offering true standards-based seamless mobility, the BelAir100T provides uninterrupted service to critical applications, like voice and video, as subscribers move throughout the wireless mesh network.

4.9 GHz Public Safety Support

The BelAir100T extends BelAir Networks commitment to world-class wireless mesh products for Public Safety and First Responder Networks. The 4.9 GHz radio has the ability to operate in the 5.0 MHz, 10.0 MHz and 20.0 MHz channels to provide service for a variety of devices used by law enforcement and emergency response personnel. In addition, it delivers superior transmit (17 dBm) and receive (-93dBm) performance that provides better range, rivaling that of lower frequency systems.

Three-radio architecture

The three-radio BelAir100T supports unlicensed 2.4 GHz and 5.25 to 5.85 GHz frequencies, as well as licensed 2.3 GHz, 2.5 GHz and 4.9 GHz frequencies. The access and backhaul radio modules support a broad range of frequencies, including Wi-Fi (IEEE 802.11a/b/g), WiMAX (IEEE 802.16d) and 4.9 Public Safety, making it a versatile solution for providing multi-service capabilities over a wireless mesh network.

The BelAir100T leverages BelAir's patented ARM (Access Radio Module), BRM (Backhaul Radio Module) and WiMAX (WRM) radio modules in the full-slots. The half-slot provides support for a 2.4 GHz radio module or a 4.9 GHz PSM (Public Safety Radio Module). The BelAir100T can be configured with an ARM and a BRM or WRM radio module for traditional wireless mesh, or with any combination of BRMs and WRMs for a more resilient backhaul-only deployment.

Features

- Modular three-radio architecture
- Supports Wi-Fi, WiMAX and 4.9 Public Safety
- Seamless mobility for uninterrupted service
- Network Management via CLI, WEB or BelView NMS
- 1-port 10/100BASE-TX

Radio module options

- Access Radio Module (ARM) IEEE 802.11a/b/g & 4.9 Public Safety
- Backhaul Radio Module (BRM) IEEE 802.11a pre-WiMAX & 4.9 Public Safety
- WiMAX Radio Module (WRM) IEEE 802.16d
- Radios available in multiple frequency bands
  - licensed: 2.3 GHz, 2.5 GHz and 4.9 GHz
  - unlicensed: 2.4 GHz and 5.25-5.85 GHz

Layer 2 Networking Capabilities

The BelAir100T provides extensive QoS, VLAN, Network Security and Traffic Management capabilities that are necessary for transporting mission-critical, time-sensitive applications like voice and video.

Network Management

The BelAir100T can be managed via a Command Line Interface (CLI), WEB GUI or with BelAir Networks BelView Network Management System (NMS). Both CLI and WEB GUI provide device level support, and BelView NMS provides complete network-wide support for Fault, Configuration and Performance Management. BelView NMS works on either Windows XP or SUN Solaris platforms and can also be integrated into other management systems like HP OpenView or IBM NetView.

BelAir Networks is the leading provider of mobile broadband mesh networking solutions. Cities around the world rely on BelAir to deliver industry-leading broadband performance and scalability, and carrier-class capacity and reliability. BelAir Networks teams with world-class global partners to deploy proven, cost-effective wireless broadband mesh networks.

Networking

- 1-port 10/100Base-TX
- IEEE 802.1D MAC Bridging
- IEEE 802.1Q VLANs
- IEEE 802.1p prioritization with 4 queues
- L2TP Tunneling for seamless mobility
- Rapid Spanning Tree Protocol (RSTP)
- 16 SSIDs per access radio. MBSSID support for 8 virtual APs per access radio
- Support for SNTP, ICMP, HTTP, ARP, TCP, UDP, Telnet, TFTP and IP traffic

Management

- Secure local and remote access
- Command line, HTTP and HTTPS Web GUI, SNMPv1/v2/v3 and SSHv2 management interfaces
- MIBs: MIB-II, SNMPv2, 802.11, Ethernet-like, Interface Group
- Multiple user privilege levels with RADIUS authentication
- Firmware upgrade through TFTP with support for automatic rollback
- RADIUS accounting

Security

- Authentication: 802.1x (RADIUS) and EAP methods
- Encryption: WEP 64 and 128 bit, TKIP / MIC per 802.1x, 802.11i AES
- MAC address access control lists
- Rogue AP detection

Approvals

- Radio: FCC part 15 and part 27, part 90, EN 300 328, EN 300 440, EN 301 893 and Industry Canada RSS 210 Issue 5
- EMC: FCC 47 CFR part 15, subpart B Class B and EN 301 489-1/-17 Class B
- Safety: ANSI/UL std no.60950-1, CSA-C22.2 std no. 60950-1, CB-60950-1
- RF safety: FCC OET Bulletin 65, Health Canada Safety code 6
- Outdoor use: IP56/NEMA4/NEMA4X for wet and dusty conditions
- CE mark

Physical and Electrical

- Size: 12 in. (30.5 cm) high x 7.25 in. (18 cm) wide x 6 in. (15.3 cm) deep
- Weight: 10 lbs (4.5 kg)
- Power supply: 100 to 240 V ac, 47 to 63 Hz
- Available wall or pole mounting kits with theft deterrent anti-tamper screws
- Power, radio and Ethernet lamps

Protection circuits

- IEC 60000-4-5 level 4 surge
- GR1089 - 6 kV (3000 A) surge

Environmental

- Operating temperature: -40°C to +50°C
- Storage temperature: -40°C to +80°C
- Operating humidity: 5 to 95% non-condensing
- Shock and vibration: ETSI300-019-1-4

BelAir NETWORKS

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BDMA15001-A01

BelAir NETWORKS

Data Sheet

BelAir200 Wireless Multi-service Switch Router

The BelAir200 Wireless Multi-service Switch Router is the industry's highest performance and most flexible multi-radio node offering mobile broadband over Wi-Fi, WiMAX, Cellular, and 4.9 GHz Public Safety spectrums. The BelAir200 leverages a leading-edge modular design to deliver switched backhaul capabilities for greater network performance, lower latency, and resiliency via built in self-healing features. Offering true standards-based seamless mobility, the BelAir200 ensures that subscribers do not experience service interruptions to critical applications, like voice and video, as they move throughout the wireless mesh network.

Modular architecture

The BelAir200 modular architecture provides four radio slots that can contain any combination of Backhaul Radio Modules (BRMs), WiMAX Radio Modules (WRMs) and Access Radio Modules (ARMs) in the same wireless mesh node. The ARMs, WRMs, and BRMs support a broad range of Wi-Fi (IEEE 802.11a/b/g), WiMAX (IEEE 802.16d), 4.9 Public Safety and Cellular (via a T1/E1 Circuit Emulation Module) applications.

For large scale wireless mesh networks, the industry-leading BelAir200 provides the ideal flexibility and capacity in a multi-service solution.

Layer 2/3 networking capabilities

The BelAir200 has an integrated Layer 2/3 Switch Router engine that provides extensive QoS, VLAN, Network Security and Traffic Management capabilities that are necessary for transporting mission critical, time-sensitive applications like voice and video.

Features

- Modular multi-service multi-radio architecture
- Supports Wi-Fi, WiMAX and Cellular
- Seamless mobility for uninterrupted service
- Network Management via CLI, WEB or BelView NMS
- Electrical and optical Ethernet interface options
- Circuit Emulation Module (TDM Pseudowire)

Radio module options

- Access Radio Module (ARM) IEEE 802.11a/b/g & 4.9 Public Safety
- Backhaul Radio Module (BRM) IEEE 802.11a pre-WiMAX & 4.9 Public Safety
- WiMAX Radio Module (WRM) IEEE 802.16d
- Radios available in multiple frequency bands
  - licensed: 2.3 GHz, 2.5 GHz and 4.9 GHz
  - unlicensed: 2.4 GHz and 5.25-5.85 GHz

Network Management

The BelAir200 can be managed via a Command Line Interface (CLI), WEB GUI or with BelAir Networks BelView Network Management System (NMS). Both CLI and WEB GUI provide device level support, and BelView NMS provides complete network-wide support for Fault, Configuration and Performance Management. BelView NMS works on either Windows XP or SUN Solaris platforms and can also be integrated into other management systems like HP OpenView or IBM NetView.

BelAir Networks is the leading provider of mobile broadband mesh networking solutions. Cities around the world rely on BelAir to deliver industry-leading broadband performance and scalability, and carrier-class capacity and reliability. BelAir Networks teams with world-class global partners to deploy proven, cost-effective wireless broadband mesh networks.

Networking

- 1-port 10/100BASE-TX (Cat. 5 RJ-45) Ethernet interface
- 1-port 100BASE-FX (SMF) Ethernet interface
- 4 x T1 (CEM) interface
- IEEE 802.1D MAC Bridging
- IEEE 802.1Q VLANs
- IEEE 802.1w (RSTP) and IEEE 802.1s (MSTP)
- IEEE 802.1p prioritization with 4 queues
- Ingress/Egress Rate Limiting
- IP TOS Re-write
- IP Filtering
- Flow Accounting
- 16 SSIDs per access radio. MBSSID support for 8 virtual APs per access radio
- Support for SNTP, ICMP, HTTP, ARP, TCP, UDP, Telnet, TFTP and IP traffic

Management

- Secure local and remote access
- Command line, HTTP and HTTPS Web GUI, SNMPv1/v2/v3 and SSHv2 management interfaces
- MIBs: MIB-II, SNMPv2, 802.11, Ethernet-like, Interface Group, IP Forwarding Table, OSPFv2
- Multiple user privilege levels with RADIUS authentication
- Firmware upgrade through TFTP with support for automatic rollback
- RADIUS accounting

Security

- Authentication: 802.1x (RADIUS) and EAP methods
- Encryption: WEP 64 and 128 bit, TKIP / MIC per 802.1x, 802.11i AES
- MAC address access control lists
- Rogue AP detection

Approvals

- Radio: FCC part 15 and part 27, EN 300 328, EN 300 440, EN 301 893 and Industry Canada RSS 210 Issue 5
- EMC: FCC 47 CFR part 15, subpart B Class B and EN 301 489-1/-17 Class B
- Safety: ANSI/UL std no.60950-1, CSA-C22.2 std no. 60950-1, CB-60950-1
- Laser safety: Class 1 laser product complies with 21CFR 1040 and IEC60825
- RF safety: FCC OET Bulletin 65, Health Canada Safety code 6
- Outdoor use: IP56/NEMA4/NEMA4X for wet and dusty conditions
- CE! mark
- Mexico: NOM
- Korea: MIC2003-15
- Russia: GOST-R
- India: ETA-74/2005, ETA-78/2005
- Taiwan: LP00002, ETC094LP0425, ETC094LPD0426, ETC094LPD0426a

Physical and Electrical

- Size: 11.5 in. (29.2 cm) diameter x 16 in. (40.6 cm) high
- Weight: 28 lbs (12.7 kg)
- Typical power consumption: 58 Watts
- Power supply: 100 to 240 V ac, 47 to 63 Hz
- Backup 12 V battery
- Battery backup time: 20 minutes typical
- Available wall or pole mounting kits with theft deterrent anti-tamper screws
- Power, radio and Ethernet lamps

Protection circuits

- IEC 60000-4-5 level 4 surge
- GR1089 - 6 kV (3000 A) surge

Environmental

- Operating temperature: -40°C to +50°C
- Storage temperature: -40°C to +80°C
- Operating humidity: 5 to 95% non-condensing
- Shock and vibration: ETSI300-019-1-4

BelAir NETWORKS

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BDMA20020-B02

ANEXO 4 Hojas de Especificaciones Firetide

Reliable Connectivity Anywhere™

firetide

HotPort® 6000-900 Wireless Mesh Nodes

HotPort® 6000-900 Wireless Mesh Nodes

HotPort 6000-900 mesh nodes provide reliable Ethernet connectivity over a high-performance, self-forming wireless mesh backbone—indoors, outdoors, or onboard moving vehicles. All HotPort nodes have multiple Ethernet ports for connecting network devices or other networks to the wireless mesh. HotPort 6000-900 mesh features a dual radio solution with capability of operating in the 900 MHz spectrum on one radio while concurrently operating in the 2.4 GHz, 4.9 GHz (U.S. public safety licensed band) or 5 GHz frequency ranges on the other.

Reliable Connectivity Anywhere™

Designed for seamless indoor and outdoor operation, the HotPort mesh network securely handles concurrent video, voice, and data applications, making it ideal for municipal, public safety, and industrial networks. The mesh's self-forming and self-healing properties enable rapid deployment and dependable operation. Firetide's AutoMesh™ routing protocol manages network load and traffic congestion to optimize mesh-wide performance and capacity.

Firetide's end-to-end solution includes HotPort nodes for mesh infrastructure, HotPoint® access points for wireless access, HotView™ software for a complete management system, and HotView Controller™ for mesh and client mobility.

Non-Line-of-Sight Performance

With the new HotPort 6000-900, users with non-line-of-sight locations can now deploy multi-hop, fully meshed networks and receive its benefits of redundancy and load balancing, thereby improving reliability of their networks. The product enables bandwidth intensive applications such as video surveillance and broadband access traffic and extends mesh reliability, performance and services into these difficult environments.

'Smart Adaptive' Mesh Technology

HotPort 6000-900 mesh is uniquely designed for the noisy 900 MHz spectrum and introduces Firetide's 'Smart Adaptive' mesh technology to mitigate the effects of interference that typically brings down wireless throughput and reliability in this band. Firetide's noise-aware data path and noise filtering algorithms enable mesh to handle interference from other 900 MHz devices, as well as from adjacent frequency bands taken up by cellular and 3G traffic. Tools such as the spectrum analyzer, which is integrated into the product, allow a network administrator to remotely monitor the health of the network and take actions to further optimize the network performance.

Designed for Street-level Connectivity

Wireless mesh, especially in the 900 MHz spectrum, has emerged as a viable alternative to cellular and other types of communications for applications that require street-level connectivity where buildings and foliage often present a challenge. Wireless mesh is the best choice for critical applications, since it eliminates any single points of failure and provides multiple paths to ensure reliability and integrity of data.

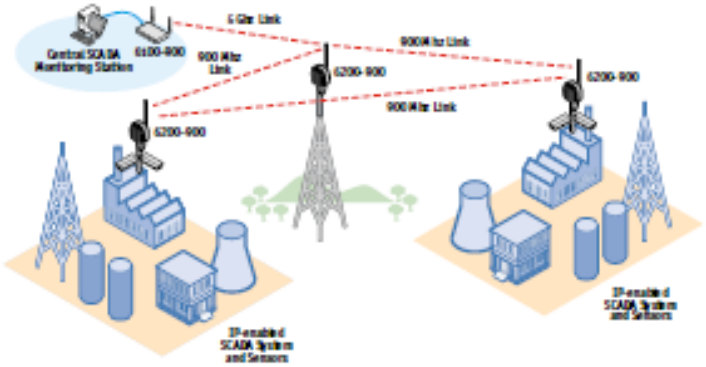
Non-line-of-sight Firetide HotPort 6000-900 mesh also meets the utilities' needs for reliable, high-bandwidth communications in remote and rugged terrains where it can increase the backhaul capacity of SCADA monitoring networks and also be used for security and surveillance.

End-to-End Security

HotPort 6000-900 mesh nodes ensure maximum security and privacy of your data. They feature WEP and WPA2 encryption between nodes and 256-bit AES encryption from ingress to egress. All Layer 3 IP data is encapsulated and accessible only to Firetide mesh nodes. HotPort nodes support VLANs, segmenting traffic with secure access control on same physical infrastructure.

HotPort 6100-900 Indoor Mesh Node

HotPort 6200-900 Outdoor Mesh Node



Public utilities network back haul using Firetide HotPort 6000-900

HotPort® 6000-900 Wireless Mesh Nodes

Specifications

Models
- HotPort 6100-900—Dual-radio Indoor Mesh Node
- HotPort 6200-900—Dual-radio Outdoor Mesh Node

Mesh Protocol
- Firetide AutoMesh™ Protocol

Security and Encryption
- 40 bit, 104 bit WEP keys
- 128 bit, 256 bit AES keys (WPA2, end-to-end data)
- MAC address filtering
- Digitally signed firmware files
- Digital certificates on nodes

Traffic Prioritization
- Quality of Service (DoS 802.1p)

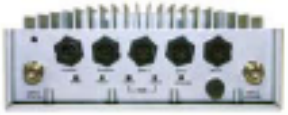
Wireless Interface
- IEEE 802.11a/b/g/h ad hoc
- Transmit power up to 400 mW for 2.4/5 Ghz radio & 630 mW for 900 Mhz radio
- Frequency ranges
  - 902 – 928 Mhz
  - 2.412 – 2.483 GHz
  - 4.94 – 4.99 GHz (US public safety band)
  - 5.15 – 5.25 GHz
  - 5.25 – 5.35 GHz
  - 5.470 – 5.725 GHz
  - 5.725 – 5.825 GHz
- Receive sensitivity (typical)
  - 900 Mhz, DSSS
    - 1 Mbps: -94 dBm
    - 11 Mbps: -89 dBm
  - 900 Mhz, OFDM
    - 6 Mbps: -91 dBm
    - 54 Mbps: -71 dBm
  - 2.4 GHz, DSSS
    - 1 Mbps: -95 dBm
    - 11 Mbps: -88 dBm
  - 2.4 GHz, OFDM
    - 6 Mbps: -90 dBm
    - 54 Mbps: -73 dBm
  - 5 GHz
    - 6 Mbps: -90 dBm
    - 54 Mbps: -73 dBm
- Dynamic Frequency Selection (DFS)
- Transmit Power Control (TPC)

Mesh Management Software
- HotView Pro™ mesh management software (separate purchase required)

Mobility Controller Software
- Firetide Mobility Controller client and infrastructure software (bundled with HotView Pro)

Regulatory Agency Certifications
- Contact your Firetide dealer for product availability and certifications for your country
- RoHS and WEEE compliant

Warranty
- Hardware: one year limited warranty
- Software: 90 days limited warranty



Outdoor HotPort 6200-900 connectors

Indoor HotPort 6100-900 connectors

Outdoor Model—6200-900

Network Ports
- Three 10/100 Mbps Ethernet ports with weatherproof connectors, LED activity indicator
- IEEE 802.3, 802.3u compliant
- CSMA/CD 10/100 autosense
- Ports 2, 3 PSE Power over Ethernet per 802.3af

Enclosure
- Cast aluminum NEMA-4X/IP66 enclosure
- Two N-type antenna connectors
- One weatherproof power connector
- Three weatherproof Ethernet connectors
- System LEDs (power, status, mesh)
- Weight: 12 lbs (5.4 Kg) with bracket and sunshield
- Dimensions: 12" X 10.5" X 5.75" (30.5 cm X 27 cm X 15 cm) including sunshield; 12" X 8.5" X 4.875" (30.5 cm X 22 cm X 12 cm) excluding sunshield

Power
- AC Input: 90-240 VAC, 50-60 Hz, 0.9 A
- DC Input: 15 VDC ±15%, 3 A
- Ports 2 and 3: IEEE 802.3af compliant PoE (PSE), 13.5 W max

Environmental Specifications
- Operating temperature: -40°C to +60°C
- Storage temperature: -40°C to +85°C
- Humidity (non-condensing): 10% to 90%
- Storage humidity (non-condensing): 5% to 95%
- Maximum altitude 15,000 feet (4600 meters)

Included Accessories
- Antennas: a pair of 2.4 GHz and 5 GHz, 5 dBi, omni directional and a pair of 900 Mhz, 3 dBi Omni directional
- (Included for network staging only)
- Bracket for pole and wall mounting
- External AC power cord (non-North America power cord is separate orderable item)
- Removable sun shield
- One weathertuned Ethernet transition cable with watertight RJ-45 coupling

Optional Accessories
- Outdoor weathertuned Ethernet cables, for use with HotPoint® access points
- Luminaire photocell socket power
- Single detachable, high gain, spectrum-specific, omni directional and directional antennas (see Antenna Guide)

Indoor Model—6100-900

Network Ports
- Four 10/100 Mbps Ethernet ports with LEDs
- IEEE 802.3, 802.3u compliant
- CSMA/CD 10/100 autosense

Enclosure
- System LEDs (power, status, mesh)
- Ethernet port LEDs (link, status, activity)
- Connectors: two antenna, one power, four Ethernet (RJ-45)
- Reset button (recessed)
- Security slot for physical locking device
- Weight: 2 lb 14 oz (1.3 kg)
- Dimensions: 9.375" X 6" X 2" (24 cm X 15 cm X 5 cm)
- Plenum-rated UL2043

Power
- DC Input: 15 VDC ±15%, 1.8 A
- External power supply: 100-240VAC, 50/60 Hz

Environmental Specifications
- Operating temperature: 0°C to +60°C
- Storage temperature: -20°C to +70°C
- Humidity (non-condensing): 10% to 90%
- Storage humidity (non-condensing): 5% to 95%
- Maximum altitude 15,000 feet (4600 meters)

Included Accessories
- AC power adapter with cord (non-North America power cord is separate orderable item)
- Antennas: one pair, 2.4 GHz and 5 GHz, 5 dBi, omni directional and one pair 900 Mhz 3 dBi omni directional

Optional Accessories
- Wall or cubicle-mount bracket
- Indoor HotPort 6000 connectors
- Outdoor HotPort 6000 connectors

Other Firetide Products

Access Points
HotPoint Indoor & Outdoor Access Points

CPE
HotClient Indoor & Outdoor Customer Premises Equipment

Software
HotView & HotView Pro Network Management Software, Firetide Mobility and WLAN Controller

Accessories
Antennas, Mounting Kits, Cables, etc.

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HotPort® 6000 Wireless Mesh Nodes for Infrastructure Mobility Applications

HotPort® 6000 Wireless Mesh Nodes

HotPort 6000 mesh nodes provide reliable Ethernet connectivity over a high-performance, self-forming wireless mesh backbone – indoors, outdoors, or onboard moving vehicles. All HotPort nodes have multiple Ethernet ports for connecting network devices or other networks to the wireless mesh. HotPort 6000 mesh nodes provide up to 70 Mbps throughput and operate at 2.4 GHz, 4.9 GHz (U.S. public safety licensed band), or 5 GHz. HotPort 6000 nodes are equipped with dual radios operating at 400 mW.

Please note that as of June 2010, HotPort 6000 functionality for fixed applications is supported within the HotPort 7000 product line. HotPort 6000 mesh nodes continue to be available for infrastructure mobility applications until Q4 2010.

HotPort 6000 Indoor Mesh Node

HotPort 6000 Outdoor Mesh Node

Reliable Connectivity for Infrastructure Mobility Applications

Designed for seamless indoor and outdoor operation, the HotPort mesh network securely handles concurrent video, voice, and data applications, making it ideal for municipal, public safety, and industrial networks, where infrastructure mobility is required. The mesh's self-forming and self-healing properties enable rapid deployment and dependable operation while allowing roaming of mesh nodes across mesh networks. Firetide's AutoMesh routing protocol manages network load and traffic congestion to optimize mesh-wide performance and capacity.

Dual-radio Performance

To maximize performance, dual-radio HotPort 6000 nodes support two radio modes. In the "bonded" mode, both radios are combined to operate as a single unit that provides double the bandwidth of a single radio equivalent. This is ideal for bandwidth-intensive application such as video surveillance, resulting in crystal clear video images. Dual-radio mesh nodes are recommended for infrastructure mobility applications.

Advanced Mesh Mobility

Firetide Mobility Controller software is required for high speed infrastructure mobility and enables enabling reliable connectivity for Wi-Fi access on public transportation or video surveillance from moving vehicles.

End-to-End Security

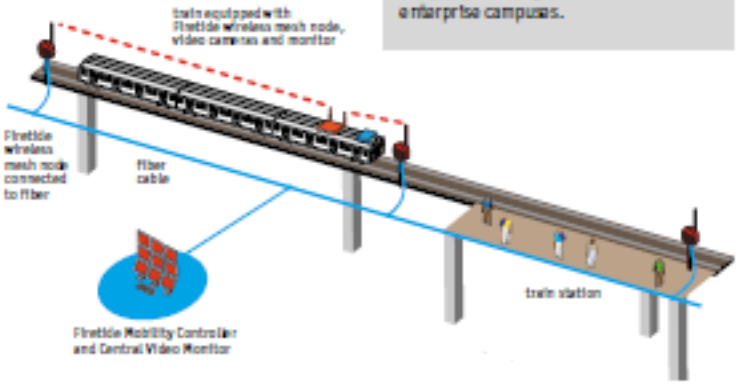
HotPort 6000 mesh nodes ensure maximum security and privacy of your data. They feature WEP and WPA2 encryption between nodes and AES encryption from ingress to egress. All Layer 3 IP data is encapsulated and accessible only to Firetide mesh nodes. HotPort nodes support VLANs, segmenting traffic with secure access control on same physical infrastructure.

Key Applications

Security and public safety: High-performance surveillance video with optimal frame rates and image resolution from moving police vehicles.

Transportation and mass transit: Reliable Wi-Fi access with high speed mobility for passengers; data connectivity; real-time video to ensure passenger and operator safety.

Industrial: Video, data and voice communications to and from moving vehicles in open pit mining, industrial facilities, enterprise campuses.



HotPort® 6000 Wireless Mesh Nodes for Infrastructure Mobility Applications

Specifications

Models
- HotPort 6102–Dual-radio Indoor Mesh Node
- HotPort 6202–Dual-radio Outdoor Mesh Node

Mesh Protocol
- Firetide AutoMesh Protocol

Security and Encryption
- 40 bit, 104 bit WEP keys
- 128 bit, 256 bit AES keys (WPA2, end-to-end data)
- MAC address filtering
- Digitally signed firmware files
- Digital certificates on nodes

Traffic Prioritization
- Quality of Service (QoS 802.1p)

Wireless Interface
- IEEE 802.11a/b/g/h ad hoc
- Transmit power up to 400 mW
- Frequency ranges
  - 2.412 – 2.483 GHz
  - 4.94 – 4.99 GHz (US public safety band)
  - 5.15 – 5.25 GHz
  - 5.25 – 5.35 GHz
  - 5.470 – 5.725 GHz
  - 5.725 – 5.825 GHz
- Receive sensitivity (typical)
  - 2.4 GHz, DSSS
    - 1 Mbps: -95 dBm
    - 11 Mbps: -88 dBm
  - 2.4 GHz, OFDM
    - 6 Mbps: -90 dBm
    - 54 Mbps: -73 dBm
  - 5 GHz
    - 6 Mbps: -90 dBm
    - 54 Mbps: -73 dBm
- Dynamic Frequency Selection (DFS)
- Transmit Power Control (TPC)

Mesh Management Software
- HotView Pro mesh management software (required)

Mobility Controller Software
- Firetide Mobility Controller infrastructure mobility software (required)

Regulatory Agency Certifications
- Contact your Firetide dealer for product availability and certifications for your country.
- RoHS and WEEE compliant

Warranty
- Hardware: one year limited warranty
- Software: 90 days limited warranty

Outdoor HotPort 6000 connectors

Indoor HotPort 6000 connectors

Outdoor Model

Network Ports
- Three 10/100 Mbps Ethernet ports with weatherproof connectors, LED activity indicator
- IEEE 802.3, 802.3u compliant
- CSMA/CD 10/100 autosense
- Ports 2, 3 PSE Power over Ethernet per 802.3af

Enclosure
- Cast aluminum NEMA-4X/IP66 enclosure
- Two N-type antenna connectors
- One weatherproof power connector
- Three weatherproof Ethernet connectors
- System LEDs (power, status, mesh)
- Weight: 12 lbs (5.4 Kg) with bracket and sunshield
- Dimensions: 12" X 10.5" X 5.75" (30.5 cm X 27 cm X 15 cm) including sunshield; 12" X 8.5" X 4.875" (30.5 cm X 22 cm X 12 cm) excluding sunshield

Power
- AC Input: 90-240 VAC, 50-60 Hz, 0.9 A
- DC Input: 15 VDC ±15%, 3 A
- Ports 2 and 3: IEEE 802.3af compliant PoE (PSE), 13.5 W max

Environmental Specifications
- Operating temperature: -40°C to +60°C
- Storage temperature: -40°C to +85°C
- Humidity (non-condensing): 10% to 90%
- Storage humidity (non-condensing): 5% to 95%
- Maximum altitude 15,000 feet (4600 meters)

Included Accessories
- Antennas: two pairs, 2.4 GHz and 5 GHz, 5 dBi, omni directional (included for network staging only)
- Bracket for pole and wall mounting
- External AC power cord (non-North America power cord is separate orderable item)
- Removable sun shield
- One weathertred Ethernet transition cable with watertight RJ-45 coupling

Optional Accessories
- Outdoor weathertred Ethernet cables, for use with HotPoint access points
- Luminaire photocell socket power
- Single detachable, high gain, spectrum-specific, omni directional and directional antennas (see Antenna Guide)

Indoor Model

Network Ports
- Four 10/100 Mbps Ethernet ports with LEDs
- IEEE 802.3, 802.3u compliant
- CSMA/CD 10/100 autosense

Enclosure
- System LEDs (power, status, mesh)
- Ethernet port LEDs (link, status, activity)
- Connectors: two antenna, one power, four Ethernet (RJ-45)
- Reset button (recessed)
- Security slot for physical locking device
- Weight: 2 lb 14 oz (1.3 kg)
- Dimensions: 9.375" X 6" X 2" (24 cm X 15 cm X 5 cm)
- Plenum-rated UL2043

Power
- DC Input: 15 VDC ±15%, 1.8 A
- External power supply: 100-240 VAC, 50/60 Hz

Environmental Specifications
- Operating temperature: 0°C to +60°C
- Storage temperature: -20°C to +70°C
- Humidity (non-condensing): 10% to 90%
- Storage humidity (non-condensing): 5% to 95%
- Maximum altitude 15,000 feet (4600 meters)

Included Accessories
- AC power adapter with cord (non-North America power cord is separate orderable item)
- Antennas: two pairs, 2.4 GHz and 5 GHz, 5 dBi, omni directional

Optional Accessories
- Wall or cubicle-mount bracket

Other Firetide Products

Access Points
HotPoint Indoor & Outdoor Access Points

CPE
HotClient Indoor & Outdoor Customer Premises Equipment

Software
HotView Pro, Firetide Mobility Controller, FiretideWLAN Controller

Accessories
Antennas, Mounting Kits, Cables, etc.

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HotPort® 7000 (7010/7020) Wireless Mesh Nodes

Viable Alternative to Fiber

Infrastructure mesh technology from Firetide provides municipal, industrial and enterprise users with the bandwidth needed to expand the reach of their existing networks, while adding a variety of fixed and mobile applications: city-wide video surveillance, traffic management and intelligent transportation systems, Wi-Fi access for mobile city workers and wireless broadband for underserved areas.

Convenient Upgrade Paths

HotPort® 7000 mesh nodes ship as 802.11a/b/g/n dual-radio capable hardware, with enhanced functionality enabled through software licenses. Projects that do not require 802.11n MIMO (multiple input, multiple output) capacity or dual-radio capability can start with 802.11a/b/g-enabled single-radio configuration. Dual-radio functionality can easily be enabled through a software license at an additional cost. Similarly, a separate software license can enable MIMO functionality for operation in 40 MHz channels, and to take advantage of 802.11n technology to achieve throughput of up to 300 Mbps outdoors and 400 Mbps indoors.

HotPort 7000 Indoor Mesh Node

HotPort 7000 Outdoor Mesh Node

Easier Deployments & Network Management

Unlike wired networks, where deployment is cumbersome, the self-forming nature of the Firetide mesh network ensures rapid deployment of large-scale networks. The HotPort 7000 mesh features integrated spectrum analysis, network capacity planning and antenna alignment tools for easier deployments and network management.

Higher Reliability

The HotPort 7000 nodes form a multi-point to multi-point ad hoc wireless mesh network with no single point of failure. Unlike a wired network, where a cut in the cable could take several days to resolve, the Firetide mesh routes the traffic immediately on an alternate link ensuring continuous service and network availability.

Dual-radio Performance

To maximize performance, dual-radio HotPort 7000 nodes support two radio modes. In the "bonded" mode, both radios are combined to operate as a single unit that provides double the bandwidth of a single radio equivalent. In the "linear" mode, both radios operate independently enabling sustained bandwidth levels over an unlimited number of hops. This enables long linear topologies, such as when networking a railway line, and provides a sustained level of service to every node, which is also critical for large municipal networks.

Quality of Service

Firetide's patented AutoMesh™ flow based routing protocol supports advanced load balancing and congestion control mechanisms for optimal routing within the mesh network. The HotPort 7000 mesh infrastructure also provides extensive VLAN capabilities critical for deploying a multi-service network on a large scale.

Metro-scale Deployments

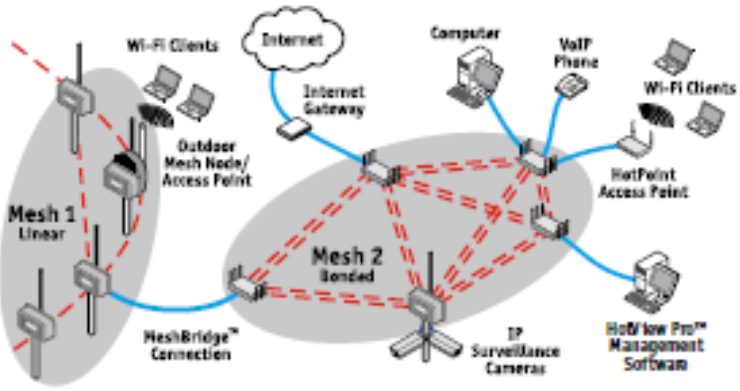
Firetide's network easily scales up to several hundreds of mesh nodes for city-wide deployment. Advanced features like MeshBridge™ and Gigabit EthernetDirect™ support mesh connectivity across multiple locations.

Multicast & Security

Firetide infrastructure provides reliable multicast capabilities critical for large-scale public safety and broadband access networks. Firetide mesh provides advanced security, including 802.11i support, dual-layer of FIPS140-2 certifiable 256-bit AES encryption, digital certificates on network elements, digitally signed firmware files, MAC based access control lists and VLAN based access control lists.

Flexible Configuration

Indoor and outdoor HotPort 7000 nodes feature dual or single configurable radios in the 2.4, 4.9 (U.S. public safety licensed band) and 5 GHz frequency ranges. HotPort 7000 mesh can utilize channel widths of 5, 10, 20 and 40 MHz (MIMO only), with 5 and 10 MHz channel widths only available on the 4.9 GHz band.



HotPort® 7000 (7010/7020) Wireless Mesh Nodes

Specifications

Models
- HotPort 7010—Indoor Mesh Node*
- HotPort 7020—Outdoor Mesh Node*
- *Purchase of software license(s) required for dual-radio and/or 802.11n MIMO functionality*

Mesh Protocol
- Firetide AutoMesh™ Protocol

Security and Encryption
- 40 bit, 104 bit WEP keys
- 128 bit, 256 bit AES keys (WPA2, end-to-end data)
- MAC address filtering
- Digitally signed firmware files
- Digital certificates on nodes

Traffic Prioritization
- Quality of Service (QoS 802.1p)

Wireless Interface
- IEEE 802.11a/b/g/h/n ad hoc; 3X3 MIMO with 2 streams*
- *Purchase of software license required for 802.11n MIMO functionality*
- 3X3 MIMO with 2 streams
- Transmit power up to 400 mW per stream
- Frequency ranges
  - 2.412 – 2.483 GHz
  - 4.94 – 4.99 GHz (US public safety band)
  - 5.15 – 5.25 GHz (Indoor use only)
  - 5.25 – 5.35 GHz
  - 5.470 – 5.725 GHz
  - 5.725 – 5.850 GHz
- Receive sensitivity (typical)
  - 2.4 GHz, DSSS
    - 1 Mbps: -95 dBm
    - 11 Mbps: -88 dBm
  - 2.4 GHz, OFDM
    - 6 Mbps: -90 dBm
    - 54 Mbps: -73 dBm
  - 5 GHz, OFDM
    - 6 Mbps: -90 dBm
    - 54 Mbps: -73 dBm
- Ability to configure 5, 10, 20 and 40 Mhz (MIMO only) channel bandwidth
- Dynamic Frequency Selection (DFS)
- Transmit Power Control (TPC)

Mesh Management Software
- HotView Pro™ mesh management software (required)

Regulatory Agency Certifications
- Contact your Firetide dealer for product availability and certifications for your country
- RoHS and WEEE compliant

Warranty
- Hardware: one year limited warranty
- Software: 90 days limited warranty

HotPort 7000 Outdoor Connectors

HotPort 7000 Indoor Connectors

Outdoor Model—7020

Network Ports
- Three GigE 10/100/1000 Mbps Ethernet ports with weatherproof connectors, LED activity indicator
- IEEE 802.3, 802.3u compliant
- CSMA/CD 10/100 autosense
- Ports 2, 3 PSE Power over Ethernet per 802.3af

Enclosure
- Cast aluminum NEMA-4X/IP66 enclosure
- Six type-N female antenna connectors
- Two weatherproof power connectors: AC and DC
- Three weatherproof Ethernet connectors
- System LEDs (power, status, mesh)
- Weight: 12 lbs (5.4 kg) with bracket and sunshield
- Dimensions: 11.6" X 8.1" X 4.1"

Power
- AC Input: 100–240 VAC, 50–60 Hz, 0.9 A
- DC Input: 12 VDC ±15%, 4 A powering 2 PoE devices; 1.7 A without PoE
- Ports 2 and 3: IEEE 802.3af compliant PoE (PSE) consumption

Environmental Specifications
- Operating temperature: -40°C to +60°C
- Storage temperature: -40°C to +85°C
- Humidity (non-condensing): 10% to 90%
- Storage humidity (non-condensing): 5% to 95%
- Maximum altitude 15,000 feet (4600 meters)

Included Accessories
- Antennas: Six 2.4 GHz and six 5 GHz, 5 dBi, indoor-rated omni directional (included for network staging only)
- Bracket for pole and wall mounting
- External AC power cord (non-North America power cord is separate orderable item)
- Removable sunshield
- Three weathertred Ethernet connectors for watertight RJ-45 coupling

Optional Accessories
- Outdoor weathertued Ethernet transition cables for use with HotPoint® access points
- Omni, directional & panel antennas (Please see Antenna Guide)

Indoor Model—7010

Network Ports
- Four GigE 10/100/1000 Mbps Ethernet ports with LEDs
- IEEE 802.3, 802.3u compliant
- CSMA/CD 10/100 autosense

Enclosure
- System LEDs (power, status, mesh)
- Ethernet port LEDs (link, status, activity)
- Connectors: Six RPSMA female antenna, one power, four Ethernet (RJ-45)
- Reset button (recessed)
- Weight: 2 lb 14 oz (1.3 kg)
- Dimensions 9.4" X 5.9" X 1.6"

Power
- DC Input: 12 VDC, 2.5 A
- Port 1: IEEE 802.3at compliant PoE (PD)
- External power supply: 100–240 VAC, 50/60 Hz

Environmental Specifications
- Operating temperature: 0°C to +60°C
- Storage temperature: -20°C to +70°C
- Humidity (non-condensing): 10% to 90%
- Storage humidity (non-condensing): 5% to 95%
- Maximum altitude 15,000 feet (4600 meters)

Included Accessories
- AC power adapter with cord (non-North America power cord is separate orderable item)
- Antennas: Six 2.4 GHz and six 5 GHz, 5 dBi, omni directional

Optional Accessories
- Wall or cubicle-mount bracket

Other Firetide Products

Access Points
HotPoint Indoor & Outdoor Access Points

CPE
HotClient Indoor & Outdoor Customer Premises Equipment

Software
HotView Pro Network Management Software, FiretideMobility Controller, Firetide WLAN Controller

Accessories
Antennas, Mounting Kits, Cables, etc.

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ANEXO 5 Hojas de Especificaciones Tropos

Tropos 1310
Distribution Automation Mesh Router

The Tropos 1310 is a compact, easy to install, IP mesh router optimized for DA applications. It allows utilities to economically deliver high performance, low latency communications to power distribution assets such as recloser controllers, capacitor bank controllers and voltage regulators. Centrally managed by Tropos Control, the Tropos 1310 extends the performance and coverage of a Tropos distribution area network (DAN) by adding mesh routing to DA assets.

FEATURES AND BENEFITS

- Mesh network node functionality at 2.4GHz
- IPSec tunneling
- Ethernet or serial device (DNP3) connectivity
- DC powered from most device controllers
- Simple installation and commissioning
- Tropos Control Management

For product specifications, please contact Tropos.

Economical Solution for Distribution Automation Applications

Utilities are adding communications to thousands of distribution automation devices. These devices require highly reliable and secure communications in order to reduce the length and extent of power outages, switch and route power, and perform Volt / VAR management. The Tropos GridCom 2.0 architecture provides a communications foundation for a wide variety of smart grid applications. It delivers backhaul communications for advanced metering (AMI), and high-bandwidth, low latency communications for distribution automation, demand response, substation monitoring and mobile workforce support. The Tropos 1310 broadens the Tropos mesh router product family, providing an economical path for utilities to deliver distribution automation applications.

Fully Integrated into Tropos Mesh Networks

The Tropos 1310 is an IP mesh router operating at 2.4GHz. It provides the following essential communications functions for distribution automation assets in a Tropos mesh network:

- Ethernet and Serial device connectivity: Supports DA devices using serial (DNP3 protocol) or Ethernet devices using DNP/IP
- Wireless device connectivity: Acts as a Wi-Fi access point for end point devices that support 802.11b/g/n communications
- Reliable network connectivity: Delivers mesh network connectivity to other nodes and gateways in a Tropos mesh network resulting in a highly reliable, redundant architecture
- Secure end-to-end communications – Supports multiple IPSec tunnels with AES encryption for secure data communications from the router to the utility operations centers

Tropos Control Network Management

The Tropos 1310 is centrally managed by Tropos' industry leading wireless network management, monitoring and control application, Tropos Control. Tropos Control allows the network operator to monitor network performance in real-time and perform complex tasks such as network configuration and software upgrades. The Tropos 1310 fully integrates with the Tropos Distribution Area Network and is centrally managed by Tropos Control.

tel 408.331.6800 • fax 408.331.6801 • www.tropos.com • sales@tropos.com

Tropos 3320/3310 Indoor Mesh Router

The 3320 Indoor Mesh Router provides a turnkey solution for extending Tropos outdoor mesh networks into indoor environments. Ideal for extending municipal, utility, enterprise, industrial, or military outdoor mesh networks into indoor offices or other facilities, the unit features a next-generation high-sensitivity radio design for superior stability and throughput.

Capable of simultaneous support for multiple applications, the 3320 Indoor Mesh Router includes an onboard Ethernet port for hard-wired connection of peripheral devices such as security cameras for video surveillance. Single or multiple 3320 Indoor Mesh Routers are easily deployed in a wide variety of indoor settings, and the compact, elegant form factor provides support for any 802.11a/b/g/n client device.

FEATURES AND BENEFITS

Software

- Support for 802.11n features delivers significant performance enhancements
- Available in single (2.4 GHz) or dual-radio (2.4/5 GHz) configurations
- Advanced auto-configuration capabilities streamline system deployment

Software

- Decentralized architecture optimizes throughput and ensures scalability
- Dynamic selection of optimal end-to-end paths boosts performance
- Tunes network performance and capacity by optimizing signal strength on a per-connection basis

TROPOS networks

Simple Installation and Configuration

The 3320 Indoor Mesh Router is simple to deploy, bringing existing outdoor service inside to provide robust wireless broadband connectivity without cabling or difficult system configuration. Users simply power up the router and auto-configuration takes place via Tropos Predictive Wireless Routing Protocol (PWRP™), a patented algorithm that dynamically configures and optimizes mesh connections.

Government buildings, libraries, utility substation control rooms, warehouses, and satellite offices of all types can be quickly and easily brought online. Users will benefit from full client support for laptops, wireless-enabled desktops, tablets, handhelds, IP scanners, video security equipment, and more.

The router is available in two versions:

- **3320 Indoor Mesh Router** — Dual-band unit with one 2.4 GHz, 802.11n and one 5 GHz 802.11a radio. Designed to support higher-capacity indoor networks, the unit supports mesh communications with other routers and client connectivity on both bands for superior performance, resiliency, and capacity. Designed to leverage existing outdoor network investments, the 3320 enables the indoor network to be scaled to meet demands through deployment of additional 3320 or 3310 Indoor Mesh routers.
- **3310 Indoor Mesh Router** — Single-band unit with one 2.4 GHz 802.11n radio. Designed for indoor networks with lighter traffic loads that do not require 802.11a support, the unit is ideal for leveraging existing outdoor network investments. The 3310 also enables the indoor network to be scaled through deployment of additional 3310 Indoor Mesh routers.

Resilient, High-Performance Networks From Tropos – the Wireless IP Broadband Market Leader

As the leader in IP broadband mesh networking solutions, Tropos is the right choice for organizations interested in deploying a robust infrastructure capable of supporting both outdoor and indoor environments. Designed to enhance operational efficiencies, Tropos technology provides the backbone for the top-performing outdoor wireless IP networks across the globe. For further information, visit us on the Web at www.tropos.com.

Wireless

- IEEE 802.11b/g/n radio
  - Frequency band: 2.4-2.483 GHz
  - Modulation: 802.11g/n - OFDM (64-QAM, 16-QAM, QPSK, BPSK); 802.11b - DSSS (DBPSK, DQPSK, CCK)
  - Media Access Protocol: CSMA/CA with ACK
  - TX Power: ETSI/EU 5-20 dBm (EIRP) set in 1 dB units; FCC/IC 20-35 dBm (EIRP) set in 1 dB units
  - Multi-Antenna System: 1-TX x 3-RX
  - Support for 802.11n MRC
  - Three 4 dBi omnidirectional antennas
  - RX Sensitivity:

-97 dBm @ 1 Mbps	-95 dBm @ 18 Mbps
-94 dBm @ 5.5 Mbps	-92 dBm @ 24 Mbps
-92 dBm @ 11 Mbps	-89 dBm @ 36 Mbps
-96 dBm @ 6 Mbps	-85 dBm @ 48 Mbps
-96 dBm @ 12 Mbps	-84 dBm @ 54 Mbps

- IEEE 802.11a radio
  - Frequency band: 5.725 - 5.850 GHz (FCC/IC) 5.470 - 5.725 GHz with DFS (ETSI/EU)
  - Modulation: 802.11a/n - OFDM (64-QAM, 16-QAM, QPSK, BPSK)
  - Media Access Protocol: CSMA/CA with ACK
  - TX Power: ETSI/EU 15-30 dBm (EIRP) set in 1 dB units; FCC/IC 19-34 dBm (EIRP) set in 1 dB units
  - 4 dBi Omnidirectional antenna
  - RX Sensitivity:

-94 dBm @ 6 Mbps	-86 dBm @ 24 Mbps
-93 dBm @ 9 Mbps	-83 dBm @ 36 Mbps
-92 dBm @ 12 Mbps	-78 dBm @ 48 Mbps
-89 dBm @ 18 Mbps	-76 dBm @ 54 Mbps

Networking

- Full 802.11b/g, 802.11a, 802.11n Client Compatibility
- IEEE 802.3u 10/100BaseT Ethernet Ports
- IPv4; IPv6-ready
- BOP
- 802.1q VLAN Support (ESSID and IP based tagging)
- Support for static and dynamic addressing for wireless and wired clients
- Onboard DHCP Server and Relay
- Plug and Play Wired Client Interface
- Session-Persistent Mobility across Subnets
- Location Based Services
- Layer 2 Emulation (L2E)
- NAT

Quality of Service

- 802.11e WMM
- 802.1p/q with 4 queues per VLAN and ESSID
- 802.1p and DSCP
- VoIP and VoWiFi Support
  - Heuristics-based Voice Classification
  - Call Admission Control
  - TSpec Classification
  - Seamless Mobility
  - Call Reporting
- Rate Limiting (Airtime and Throughput Based)

Management

- RADIUS Accounting
- Local and Remote Management Tools via HTTPS
- Router Access Control
- Identity-Based Authentication (4 levels)
- Configuration Save and Restore
- Software Upgrades with Rollback
- Command Line Interface (CLI) via SSH
- SNMP (standard MIBs and Tropos MIB)
- Wireless, Network and Client Monitoring and Statistics

Security

- Authentication: WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAP-TTLS, EAP-SIM, PEAP)
- Encryption: Open, WEP, AES-CCM, TKIP
- Hardware assisted encryption
- AES encryption of mesh and control traffic
- Multiple BSSIDs & ESSIDs (ESSID suppression)
- Full VPN compatibility (VPN filtering)
- Password and Certificate-based HTTPS and SSH Remote Access
- Packet Filtering & Forwarding
- Peer-to-Peer Blocking
- Client Access Control Lists
- Router Access Control
- Evil Twin Detection and Reporting
- Denial of Service Attack Detection
- Tamper-Evident Seal
- FIPS 140-2 Level 2 compliant

Environmental Specifications

- Operating temperature range: -40°C to 55°C
- Storage temperature range: -40°C to 85°C
- Weather rating: IP11
- Shock & vibration: ETSI 300-19-2-4 spec T41.E class 4M3
- Transportation: ISTA 2A

Package Contents

- Tropos 3320/3310 Outdoor Mesh Router
- Mounting bracket
- Quick Start Guide
- Antennas

Warranty

- One (1) year on parts and labor; return to point of purchase
- Optional standard and premium support packages available

Approvals

- FCC CFR 47 Part 15, Class B Subpart C
- Industry Canada RSS 210
- EN 301 489-17
- EN 300 328
- EN 301 893
- EN 60950
- IEC 950
- UL 60950-1
- CSA 22.2 No. 60950-1
- UL 579/IEC 60529 IP67 rated for outdoor use
- UL 1449/IEC 60664-1
- CE

Hardware Specifications

- Auto-sensing 802.3u 10/100BASE-T Ethernet
- Power input: PoE (20-60 VDC); 100-277 VAC with external accessory
- Power consumption: 10 W typical
- Power-on and network status lamp: Green/Red/Blue
- Dimensions (w/o antennas): 8.5" (21.6 cm) x 7" (17.8 cm) x 3" (7.6 cm)
- Weight: 2.2 lbs (1 kg) max., with mounting brackets

Protection Circuits

- Antenna Protection Integrated
- Electrical Protection:
  - EN61000-4-4 Level 2 Electrical Fast Transient Burst Immunity
  - EN61000-4-3 Level 2 EMC Field Immunity
  - EN61000-4-2 Level 2 (contact), Level 3 (air) ESD Immunity

Ordering Information

Part Number: 33201000 for FCC and Canada
Tropos 3320 Indoor Mesh router, FCC TX; 2.4 & 5.8 GHz; Four 4 dBi omni antennas, mounting brackets

Part Number: 33101000 for FCC and Canada
Tropos 3310 Indoor Mesh router, FCC TX; 2.4 GHz; three 4 dBi omni antennas, mounting brackets

tel 408.331.6800 • fax 408.331.6801 • www.tropos.com • sales@tropos.com

Tropos 4310
Mobile Mesh Router

The 4310 Mobile Mesh Router interoperates seamlessly with Tropos fixed routers to deliver a robust, high-performance wireless connectivity solution for mobile workers. At vehicular speeds, the Mobile Router supports voice, video, and data connectivity and extends the Tropos fixed network to provide access for handhelds, laptops, and other endpoint devices.

FEATURES AND BENEFITS

Software

- Routing algorithms optimized for mobility provide connectivity at vehicular speeds
- Maximizes performance to automatically find optimum end-to-end paths across the network
- Graceful handoffs prevent service disruptions to latency-sensitive voice, video, and VPN connections
- Sub-second handoffs across multiple available wireless channels
- Creation of standalone mobile networks in areas where coverage is unavailable

Platform

- Intelligent 2.4 GHz mobile node supports 802.11b/g mesh and client connectivity
- Best-in-class link budget for superior RF propagation
- Vehicle-mounted with integrated high-power radio
- FIPS 140-2 compliant

TROPOS networks

An easily-deployed solution for increasing the productivity of mobile workforces, the Tropos 4310 Mobile Mesh Router enables any vehicle to become a mobile node. Typical applications include extending coverage within cities and across regions to support mobile field workers. This includes utility crews, first responders, building inspectors and animal control – all of whom benefit by having high-speed access to information and being able to file reports from the field. When deployed in military vehicles or industrial environments such as ports or mining operations, the mobile router improves operational efficiencies and enhances communications..

Tropos Mobile Routers also support the creation of tactical mesh zones, an empowering solution for emergency response teams or military tactical teams. Multiple vehicles equipped with mobile routers can mesh with one another to create a standalone peer-to-peer network capable of increasing tactical effectiveness through enhanced communication. Even if the response team is operating in a rural region that does not have access to the fixed Tropos network, the team member vehicles still benefit from enhanced communication capabilities to coordinate their efforts.

When stationary, the mobile-node equipped vehicle uses its high-power and high-sensitivity 2.4 GHz radio to provide connectivity to authorized handheld and laptop users within a three-mile radius (depending on the environment).

PWRP

The cornerstone of the Tropos Mesh OS is the patented Predictive Wireless Routing Protocol (PWRP™), which continually analyzes the quality of active and inactive mesh links to dynamically configure the ideal combination of paths to optimize network performance. Upon deployment, the routers automatically discover one another, and quickly determine the optimal route to the gateways that inject capacity into the network. Optimal links are chosen on the basis of throughput, packet success, signal-to-noise ratios, and other key criteria.

PWRP performs a range of key tasks across the wireless network:

- Streamlines deployments and preserves performance by dynamically configuring and optimizing mesh connections
- Improves overall throughput by selecting optimal routing paths
- Enhances network resiliency by providing graceful rerouting of traffic in the event of RF interference, backhaul failures, or other disruptions in the wireless mesh
- Supports client mobility without the need for special client hardware, software, or network reconfigurations
- Enables the network to be scaled to thousands of nodes covering the largest geographical areas in the industry

Tropos Mesh OS

The Tropos Mesh OS is the cornerstone of the decentralized Tropos System Architecture. A common software platform that runs on each router across the network, the Tropos Mesh OS leverages the router's on-board intelligence to monitor and maximize performance. Unlike controller-based architectures that suffer bandwidth losses as control traffic is passed back and forth between network nodes and the central site, the distributed Tropos MetroMesh System Architecture uses efficient on-board processing at the device level to minimize network congestion and adapt on a real-time, packet-by-packet scale. This distributed approach optimizes performance and throughput by minimizing control traffic, delivers a highly scalable solution, and helps provide a quality user experience for network clients.

Advanced Network Management Platform Delivers Optimized Edge-to-Edge Visibility

Tropos Control is a standards-based network management system designed to achieve peak performance and reliability. Designed around an intuitive Web-based interface, the software facilitates the remote management of Tropos Mesh networks, and is ideal for dynamically deploying and configuring networks ranging in size from tens to thousands of Tropos Mesh routers. Tropos Control minimizes planning, deployment, and operating costs, and increases the efficiency of management personnel by performing complex tasks such as global provisioning and software updates across the network in a single session.

- Streamlines tasks such as monitoring network health, statistical network performance analysis, and performance optimization
- Provides macro-level visibility as well as granular real-time and historical detail on usage, link quality, capacity, and network reliability
- Network Health dashboard provides at-a-glance views of network traffic, performance, and alarms with links to instantly drill down to relevant statistical information
- Wireless-aware provisioning for guaranteed configuration changes and software updates over dynamically changing links
- Detailed historical database of RF environmental data, network performance, and client connectivity enables fast root-cause diagnosis
- Assists network managers to plan future expansions and optimization strategies based on analysis of network trends and detailed historical information

Resilient, High-Performance Networks From Tropos – the Wireless IP Broadband Market Leader

As the leader in wireless IP broadband mesh networking solutions, Tropos is the right choice for organizations interested in deploying a robust infrastructure capable of withstanding the harshest outdoor environments. Designed to contain costs and enhance productivity, Tropos technology provides the backbone for top-performing outdoor wireless IP networks across the globe. As the industry continues to evolve, Tropos is poised to extend its market leadership through the introduction of innovative products, and functionality. For further information, visit us on the web at www.tropos.com.

Wireless
- IEEE 802.11b/g
- Frequency band: 2.4-2.483 GHz
- Modulation: 802.11g - OFDM (64-QAM, 16-QAM, QPSK, BPSK) 802.11b - DSSS (DBPSK, DQPSK, CCK)
- TX Power: 36dBm (EIRP)
- Media Access Protocol: CSMA/CA with ACK
- RX Sensitivity:

-100dBm @ 1 Mbps	-92dBm @ 12 Mbps
-95dBm @ 2 Mbps	-89dBm @ 18 Mbps
-93dBm @ 5.5 Mbps	-86dBm @ 24 Mbps
-91dBm @ 11 Mbps	-83dBm @ 36 Mbps
-94dBm @ 6 Mbps	-78dBm @ 48 Mbps
-93dBm @ 9 Mbps	-76dBm @ 54 Mbps

- Transmit and receive diversity

Networking
- TCP and VPN session persistent roaming across subnets
- Mobile tactical mesh operating mode
- Full 802.11b/g client compatibility
- IPv4; IPv6-ready
- 802.1q VLAN support
- Support for static and dynamic addressing for wireless and wired clients
- Layer 2 and Layer 3 support
- DHCP Server and Relay
- NAT support
- Plug & Play Wired client support
- Two (2) 10/100 Base-T Ethernet ports (Management and CPE connection)
- 802.11e WMM QoS support
- 802.1p/q with 4 queues per VLAN and ESSID
- Two (2) Type-A USB ports
- Console port (for factory use) and Serial port

Management
- RADIUS Accounting
- Secure Local and Remote Management Tools via HTTPS
- Configuration Save and Restore
- Software Upgrades with Rollback
- Command Line Interface (CLI) via SSH
- SNMP (standard MIBs and Tropos MIB)
- Wireless, Network and Client Monitoring, Statistics and Wireless capture capabilities

Security
- Authentication: WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAPTTLS, EAP-SIM, PEAP)
- Encryption: Open, WEP, AES-CCM, TKIP
- Hardware assisted encryption
- AES encryption of mesh and control traffic
- Multiple BSSIDs & ESSIDs (ESSID suppression)
- Full VPN compatibility (VPN 9 listing)
- Password and Certificate-based HTTPS and SSH Remote Access
- Packet Filtering & Forwarding
- Client Access Control Lists
- Router Access Control
- Evil Twin Detection and Reporting
- Denial of Service Attack Detection
- Tamper-Evident Seals
- FIPS 140-2 compliant

Environmental Specifications
- Operating temperature range: -40°C to 70°C
- Storage temperature range: -40°C to 85°C
- Shock & vibration: MIL-STD-202F, Method 204C
- Humidity range: 10-95% non-condensing
- IP Level 21

Optional Accessories
- Antenna kit: one (1) 7.4dBi flexible spring base omni-directional antenna, mobile mount bulkhead or magnetic mount N-connector, 12' of low-loss antenna cable
- Antenna kit: one (1) 5.0dBi omni-directional antenna, mobile mount bulkhead or magnetic mount N-connector, 12' of low-loss antenna cable
- GPS receiver with external puck antenna

Mounting Options
- Vehicle mounted in protected area such as trunk or cargo space:
  - Vertical or horizontal mounting orientation

Approvals
- FCC CFR 47 Part 15, Class B
- Industry Canada RSS 210
- UL 60950-1
- CSA 22.1 No. 950
- EN 60950
- IEC 950

Hardware Specifications
- Autosensing 10/100 BaseT Ethernet
- Power input: 10.0 to 32.0VDC
- Power consumption: 8W typical
- Polarity protection
- Low voltage disconnect protection
- Automotive over-voltage protection, SAE J1211
- Automotive mini-blade fuse and socket, externally accessible
- Network status lamp
- Remote network status indicator
- Dimensions: 13.1 in (33.3 cm) wide x 7.91 in (20.1 cm) deep x 3.85 in (9.8 cm) high
- Weight: 9 lbs (4.35 kg) max., with mounting bracket

Protection Circuits
- Antenna Protection: ≤ 0.5µJ for 3kA @ 8/20µS Waveform
- Electrical Protection:
  - EN61000-4-5 Level 4 AC Surge Immunity
- Data Protection:
  - EN61000-4-2 Level 4 ESD Immunity

Warranty
- One (1) year on parts and labor; return to point of purchase
- Optional standard and premium support packages available

Package Contents
- Tropos 4310
- Mounting bracket and accessories
- Hardware Installation and Quick Start Guides

Ordering Information
Part Number: 43102100
Tropos 4310 mobile router, variable power; N-connectors, bracketry

Part Number: AN074090
One (1) vehicle mounted 7.4dBi omni antenna and cable kit, bulkhead mount

Part Number: AN074091
One (1) vehicle mounted 7.4dBi omni antenna and cable kit, magnetic mount

Part Number: AN050090
One (1) vehicle mounted 5.0dBi omni antenna and cable kit, bulkhead mount

Part Number: AN050091
One (1) vehicle mounted 5.0dBi omni antenna and cable kit, magnetic mount

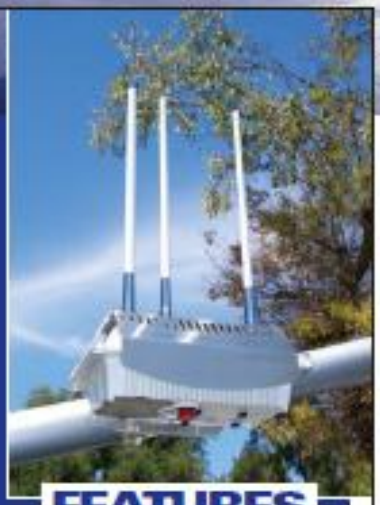
For additional configuration options please contact your Tropos Representative

TROPOS networks

tel 408.331.6800 • fax 408.331.6801 • www.tropos.com • sales@tropos.com

Tropos 5320
Outdoor Mesh Router

TROPOS networks
GREENER, SAFER, SMARTER



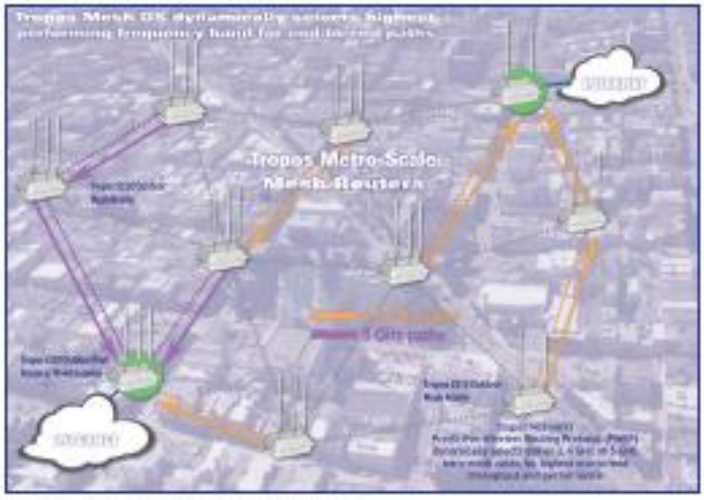
The Tropos® System Architecture delivers the maximum scalability, high capacity, reliability, and security demanded by customers. Tropos Architecture combines the innovative and patented Tropos Mesh OS, the industry's most sophisticated metro-scale mesh routing intelligence, with Tropos operation and optimization tools, which provide centralized visibility, analysis and control, and purpose-built Tropos routers with peerless 802.11 radio performance. Tropos' complete solution enables city-wide fixed and mobile multi-megabit connectivity for IP-based voice, video and data applications.

The Tropos Mesh OS, including the Predictive Wireless Routing Protocol (PWRP®) is the industry's most scalable mesh routing algorithm. The Tropos 5320 outdoor mesh router is a dual-radio router that uses 802.11a and 802.11b/g links to form the mesh and uses 802.11b/g to provide client coverage and connectivity. Utilizing the embedded PWRP, the Tropos 5320 creates a self-organizing and self-healing wireless mesh that intelligently selects the optimum end-to-end data path through the mesh. Because the Tropos Mesh OS never requires more than 5% of available bandwidth, networks can be scaled to many thousand nodes without client throughput or network capacity degradation. Tropos Mesh OS dynamically uses 5 GHz links to improve performance while not unnecessarily increasing the router density or sacrificing reliability. In this way, the Tropos 5320 and Tropos Mesh OS combine to leverage the benefits of using additional spectrum to increase capacity while eliminating the pitfalls of the 5 GHz, line-of-sight, spectrum.

The Tropos 5320 maximizes return on the investment, as the software, management and hardware combine to enable the operation of multiple independent networks on a single metro-scale mesh infrastructure. Individual departments can operate independently on the network, segregating information access applicaations, and access levels.

Tropos routers require only power and can be deployed anywhere it is available. Each router provides wireless connectivity to standard 802.11b/g clients and extends the coverage area of the metro-scale mesh network.

The ruggedized and weatherized Tropos 5320 is NRTL certified for outdoor installation. It can be mounted on external structures such as buildings or lampposts in less than 15 minutes by a trade-level worker with one tool. Outdoor Tropos Mesh routers run on a wide range of power options and are available with an optional, factory-installed battery backup system.



FEATURES

Tropos Mesh OS
- Patented Layer 3 mesh routing intelligence
- PWRP dynamically employs links across multiple frequency bands for high throughput
- Supports multiple virtual networks on a single wireless infrastructure
- High-speed, session-persistent roaming
- Dynamic channel assignment, automatic power control and data rate selection provide efficient use of RF spectrum
- SABRE policy-based routing carries traffic for different applications on different spectrum while supporting dynamic fault tolerance

Secure Management
- User-defined traffic filters
- 802.1x/802.11i
- MAC address access control lists
- AES encryption of mesh data and control traffic

Platform
- High-performance 54 Mbps Wi-Fi
- Best-in-class link budget for superior RF propagation
- Ruggedized and weatherized for extreme outdoor conditions
- FIPS 140-2 certified

Tropos 5320
Outdoor Mesh Router

TROPOS networks
GREENER, SAFER, SMARTER

TECHNICAL SPECIFICATIONS

Wireless

- IEEE 802.11b/g
- Frequency band: 2.4-2.483 GHz
- Modulation: 802.11g - OFDM (64-QAM, 16-QAM, QPSK, BPSK)
  802.11b - DSSS (DBPSK, DQPSK, CCK)
- TX Power: ETSI/EU 20dBm (EIRP)
  FCC/IC 36dBm (EIRP)
- 7.4dBi Omnidirectional antennas
- Optional 6.8dBi omni-directional or 12dBi sector antenna(s)
- Media Access Protocol: CSMA/CA with ACK
- RX Sensitivity:

-100dBm @ 1 Mbps	-89dBm @ 18 Mbps
-95dBm @ 5.5 Mbps	-86dBm @ 24 Mbps
-91dBm @ 11 Mbps	-83dBm @ 36 Mbps
-94dBm @ 6 Mbps	-78dBm @ 48 Mbps
-92dBm @ 12 Mbps	-76dBm @ 54 Mbps

- Transmit and Receive diversity

- IEEE 802.11a
- Frequency band: 5.725 - 5.850 GHz (FCC/IC)
  5.470 - 5.725 GHz (ETSI/EU)
- Modulation: 802.11a - OFDM (64-QAM, 16-QAM)
- TX Power: ETSI/EU 29dBm (EIRP)
  FCC/IC 43dBm (EIRP) point-to-point
  36dBm (EIRP) point-to-multipoint, sector
  33dBm (EIRP) point-to-multipoint, omni
- 9.1dBi Omnidirectional antenna
- Optional 13.0dBi sector (or) 19dBi patch antenna
- Media Access Protocol: CSMA/CA with ACK
- RX Sensitivity:

-94dBm @ 6 Mbps	-86dBm @ 24 Mbps
-93dBm @ 9 Mbps	-83dBm @ 36 Mbps
-92dBm @ 12 Mbps	-78dBm @ 48 Mbps
-89dBm @ 18 Mbps	-76dBm @ 54 Mbps

Networking

- TCP and VPN session persistent roaming
- Full 802.11b/g client compatibility
- NAT support
- Layer 2 and Layer 3 support
- DHCP Server and Relay
- Sub-interface support
- Ethernet port

Management

- HTTPS to on-board configuration management tools
- Secure local and remote configuration via HTTPS
- SNMP V2c
- Tropos MIB
- Browser-based management tool
- Simple configuration save and restore
- Network & client monitoring and statistical capture features

Security

- Authentication: 802.11i, 802.1x (including EAP-TLS/TTLS/SIM/PEAP
- Encryption: Open, WEP, TKIP, AES
- AES encryption of mesh and control traffic
- Multiple BSSIDs & ESSIDs (ESSID suppression)
- Full VPN compatibility (VPN filtering—rejects non-VPN traffic)
- MAC address access control lists
- HTTPS only to on-board management tools
- Packet filtering
- FIPS 140-2 certified

Environmental Specifications

- Operating temperature range: -40°C to 55°C
- Storage temperature range: -40°C to 85°C
- Weather rating: IP67 weathertight
- Wind survivability: >165 mph
- Wind loading (165 mph): <300 Newtons
- ASTM B117 Salt Fog rust resistance compliant
- Shock & vibration: ETSI 300-19-2-4 spec T41.E class 4M3
- Transportation: ISTA 2A

Optional Battery Back-Up

- Factory installed Li-Ion battery
- Back-up power 2 - 6 hours typical

Package Contents

- Tropos 5320
- 7.4dBi omni-directional antennas (2), 802.11b/g
- 9.1dBi omni-directional antenna (1), 802.11a
- Mounting bracket and accessories
- Hardware Installation and Quick Start Guides

Warranty

- One (1) year on parts and labor; return to point of purchase
- Optional standard and premium support packages available

Optional Accessories

- Power Cables
  - Street light NEMA photo-electric control power tap 100-480 VAC, 2 wire 4 ft. power cable
  - Street light NEMA photo-electric control power tap 100-480 VAC, 2 wire 20 ft. power cable
  - Electrical power cord, US/Canada 120 VAC, 15 A, 3 prong 6 ft. or 30 ft.
- CAT5 building entrance data protection; network protection unit
- 19dBi patch antenna, 802.11a

Approvals

- FCC CFR 47 Part 15, Class B
- Industry Canada RSS 210
- EN 301 489-17
- EN 300 328
- EN 301 893
- EN 60 950
- IEC 950
- UL 60950-1
- CSA 22.2 No. 60950-1
- UL 579/IEC 60529 IP67 rated for outdoor use
- UL 1449/IEC 60 664-1
- CE

Hardware Specifications

- Autosensing 10/100BaseT Ethernet
- Power Input: 100-480VAC 50/60Hz single and split-phase ANSI/IEEE C62.41 category C3 integrated branch circuit protection
- AC power consumption: 18 W typical
- Power over Ethernet power sourcing capability: 12Vdc, 24Vdc, 48Vdc @ 30W output
- Power-on and network status lamp: Green/Red
- Dimensions (w/o mounting brackets or antennas): 13.00 in (33.02 cm) wide x 8.00 in (20.32 cm) deep x 5.3 in (13.50 cm) high
- Weight: 16 lbs (7.20 kg) max., with mounting brackets

Protection Circuits

- Antenna Protection: ≤ 0.5μJ for 6kV/3kA @ 8/20μS Waveform
- Electrical Protection:
  - ANSI/IEEE C62.41, UL 1449-2nd ed., 10kA @ 8/20 μS Wave form, 36kA per phase, L-L, L-N, L-PE
  - EN61000-4-5 Level 1 & 2 AC Surge Immunity
  - EN61000-4-4 Level 2 Electrical Fast Transient Burst Immunity
  - EN61000-4-3 Level 2 EMC Field Immunity
  - EN61000-4-2 Level 2 (contact), Level 3 (air) ESD Immunity

Ordering Information:

Part Number: [illegible]
Tropos 5320 router, ETSI/EU TX, two 7.4dBi & one 9.1dBi omni antennas, bracketry
Part Number: [illegible]
Tropos 5320 router, ETSI/EU TX, battery backup, two 7.4dBi & one 9.1dBi omni antennas, bracketry
Part Number: [illegible]
Tropos 5320 router, FCC/IC TX, two 7.4dBi & one 9.1dBi omni antennas, bracketry
Part Number: [illegible]
Tropos 5320 router/FCC/IC TX, battery backup two 7.4dBi & one 9.1dBi omni antennas, bracketry
Part Number: FIPS 1402-5320
Software license, hardware labels for FIPS 140-2

For additional configuration options please contact your Tropos Representative

TROPOS networks
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DS-122809

Tropos 6320/6310 Mesh Router

The 6320 Outdoor Mesh Router is designed to provide a cost-effective, easy to deploy, high-performance networking solution for outdoor environments. Lightweight and compact, the 6320 router delivers significant performance increases through support for the 802.11n standard, a next-generation high-sensitivity radio design, and the incorporation of new patented features into the industry-leading Tropos Mesh Operating System.

FEATURES AND BENEFITS

Software

- Decentralized architecture optimizes throughput in real-time and ensures scalability
- Dynamic selection of optimal end-to-end path delivers the highest performance
- Network performance and capacity maximized by automatic optimization of power and rate on per-connection and per-packet basis

Platform

- Support for 802.11n features delivers significant performance enhancements
- Cost-effective, compact, lightweight design streamlines site sourcing and deployment
- Available in single (2.4 GHz) or dual-radio (2.4/5 GHz) configurations

TROPOS networks

A cost-effective solution for a wide variety of applications, the Tropos 6320 router is well-suited for municipalities, utilities, enterprise, industrial, and military entities. The 6320 router provides a reliable communications foundation for utility meter reading, intelligent transportation systems, public safety, and video surveillance, and is designed to support multiple applications simultaneously. Each router can either serve as a gateway interface for capacity injection into the network, or as a node to extend or reinforce network connectivity.

The small, lightweight form factor is ideal for deployments where aesthetics and weight are part of the mounting asset equation. Configured with multiple antennas, the 6320 router is fitted with two Ethernet ports. These ports can be used for a variety of purposes, including capacity injection from a wired or point-to-point wireless broadband link; for attachment of client devices such as a video camera or Advanced Meter Reading/Advanced Metering Infrastructure (AMR/AMI) collector, or to receive power over Ethernet. The router is available in two versions:

- **6320 Outdoor Mesh Router** - Dual-band unit with one 2.4 GHz and one 5 GHz radio. Designed for creating or expanding higher-capacity multi-use networks, the 6320 supports meshing and client connectivity on both bands for superior performance, resiliency, and capacity. A scalable solution that protects hardware investments, the 6320 enables the network to be expanded to support the highest-capacity configurations through deployment of additional Tropos routers.
- **6310 Outdoor Mesh Router** - Single-band unit with one 2.4 GHz radio. Designed for networks with lighter traffic loads, such as collector monitoring for utilities, or for fill-in connectivity in larger systems. A scalable solution that protects hardware investments, 6310-based networks are fully interoperable with dual-band routers - and can be easily expanded to the highest-capacity configurations through deployment of additional of Tropos routers.

802.11n Features Deliver Network-Wide Performance Enhancements

Both models are designed to utilize the powerful capabilities of the 802.11n standard, which delivers performance increases in coverage, capacity, and reliability. This breakthrough technology improves receive link signal strength and client connectivity not just for 802.11n clients, but for 802.11b/g clients as well. Client connection reliability is enhanced by combining multiple signals from multiple antennas, instead of relying on signals received from a single antenna. The result is increased throughput, higher network capacity, and reduced latency across the network.

Tropos Mesh OS

The Tropos Mesh OS is the cornerstone of the decentralized Tropos System Architecture. A common software platform that runs on each router across the network, the Tropos Mesh OS leverages the router's on-board intelligence to monitor and maximize performance. Unlike controller-based architectures that suffer bandwidth losses as control traffic is passed back and forth between network nodes and the central site, the distributed Tropos System Architecture uses efficient on-board processing at the device level to minimize network congestion and adapt on a real-time, packet-by-packet scale. This distributed approach optimizes performance and throughput by minimizing control traffic, delivers a highly scalable solution, and helps provide a quality user experience for network clients.

PWRP

The cornerstone of the Tropos Mesh OS is the patented Predictive Wireless Routing Protocol (PWRP™), which continually analyzes the quality of active and inactive mesh links to dynamically configure the ideal combination of paths to optimize network performance. Upon deployment, the routers automatically discover one another, and quickly determine the optimal route to the gateways that inject capacity into the network. Optimal links are chosen on the basis of throughput, packet success, signal-to-noise ratios, and other key criteria.

PWRP performs a range of key tasks across the wireless network:

- Streamlines deployments and preserves performance by dynamically configuring and optimizing mesh connections
- Improves overall throughput by selecting optimal routing paths
- Enhances network resiliency by providing graceful rerouting of traffic in the event of RF interference, backhaul failures, or other disruptions in the wireless mesh
- Supports client mobility without the need for special client hardware, software, or network reconfigurations
- Enables the network to be scaled to thousands of nodes covering the largest geographical areas in the industry

PowerCurve

A distributed algorithm that leverages the Tropos PWRP communication protocol, PowerCurve maximizes network performance and capacity by automatically optimizing power and rate parameters on a per-connection and per-packet basis. This advanced, distributed algorithm continually adjusts transmit power to maximize the number of wireless links that can operate concurrently. Unlike alternative approaches where transmit power is configured as a static setting, PowerCurve tightly couples power and bit rate control. This enables the router to make continuous and dynamic adjustments that can enhance throughput and provide a better user experience.

PowerCurve delivers the following key benefits:

- Dynamically monitors and adjusts power and rate per-packet, per-link, to deliver maximum capacity
- Enhances network reliability, capacity, and scalability beyond the capabilities of controller-based architectures
- Streamlines network planning, deployment, and optimization

Airtime Congestion Control

Airtime Congestion Control (ACC) technology enables networks to be operated closer to their capacity limits by detecting signs of congestion and dynamically adjusting airtime resource allocation to clients. ACC is unlike traditional rate limiting in two important ways. First, instead of limiting traffic during congestion-free periods, ACC activates only when performance-impacting congestion is detected and returns to a monitoring state afterward. Second, it is mesh- and wireless-aware, distributing airtime resources equally among clients during a congestion event rather than applying fixed throughput caps. By allowing networks to carry heavy traffic loads without crossing over into a saturated state, ACC actually increases usable capacity.

- Deterministic allocation of airtime resources enables networks to run at higher capacity without congestion
- Monitors airtime availability to deliver more efficient network utilization than systems relying on limiting traffic levels
- Provides fair network access to all users, enabling Tropos to surpass traditional broadband wireless network capacity

Smart Channel

Designed to optimize performance in both single- and dual-radio networks, this distributed algorithm continually samples all available channels to analyze link performance and interference trends. The channel decision logic is integrated into the PWRP routing algorithms so that end-to-end path qualities are assessed on alternate channels. In dual-radio systems, fine-grained channel plans are implemented within individual clusters to optimize each cell for client coverage and spectral reuse.

- Provides continuous monitoring of all channels to detect intermittent noise sources
- Non-disruptive to user traffic and sessions
- Avoids interference and enhances network capacity and reliability

Advanced Network Management Platform Delivers Optimized Edge-to-Edge Visibility

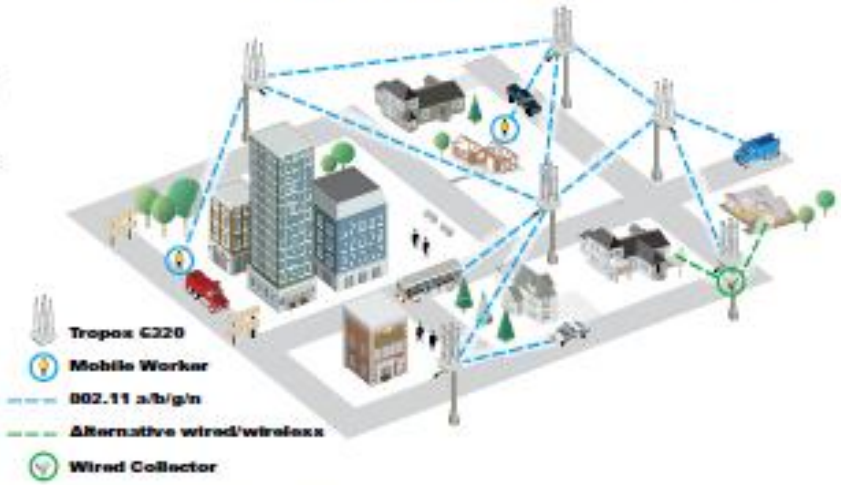
Tropos Control is a standards-based network management system designed to achieve peak performance and reliability. Designed around an intuitive Web-based interface, the software facilitates the remote management of Tropos Mesh networks, and is ideal for dynamically deploying and configuring networks ranging in size from tens to thousands of Tropos routers. Tropos Control minimizes planning, deployment, and operating costs, and increases the efficiency of management personnel by performing complex tasks such as global provisioning and software updates across the network in a single session.

- Streamlines tasks such as monitoring network health, statistical network performance analysis, and performance optimization
- Provides macro-level visibility as well as granular real-time and historical detail on usage, link quality, capacity, and network reliability
- Network Health dashboard provides at-a-glance views of network traffic, performance, and alarms with links to instantly drill down to relevant statistical information
- Wireless-aware provisioning for guaranteed configuration changes and software updates over dynamically changing links
- Detailed historical database of RF environmental data, network performance, and client connectivity enables fast root-cause diagnosis
- Assists network managers to plan future expansions and optimization strategies based on analysis of network trends and detailed historical information

Resilient, High-Performance Networks From Tropos – the Wireless IP Broadband Market Leader

As the leader in wireless IP broadband mesh networking solutions, Tropos is the right choice for organizations interested in deploying a robust infrastructure capable of withstanding the harshest outdoor environments. Designed to contain costs and enhance productivity, Tropos technology provides the backbone for top-performing outdoor wireless IP networks across the globe. As the industry continues to evolve, Tropos is poised to extend its market leadership through the introduction of innovative products and functionality. For further information visit us on the web at www.tropos.com.

Tropos fixed and mobile routers can be used for securely operating a wide range of services



Wireless
- IEEE 802.11b/g/n radio
  - Frequency band: 2.4-2.483 GHz
  - Modulation: 802.11g/n - OFDM (64-QAM, 16-QAM, QPSK, BPSK); 802.11b - DSSS (DBPSK, DQPSK, CCK)
  - Media Access Protocol: CSMA/CA with ACK
  - TX Power: ETSI/EU 5-20 dBm (EIRP) set in 1 dB units; FCC/IC 20-35 dBm (EIRP) set in 1 dB units
  - Multi-Antenna System: 1-TX x 3-RX
  - Support for 802.11n MRC
  - 6 dBi integrated omnidirectional antennas
  - RX Sensitivity:

-97 dBm @ 1 Mbps	-95 dBm @ 18 Mbps
-94 dBm @ 5.5 Mbps	-92 dBm @ 24 Mbps
-92 dBm @ 11 Mbps	-89 dBm @ 36 Mbps
-96 dBm @ 6 Mbps	-85 dBm @ 48 Mbps
-96 dBm @ 12 Mbps	-84 dBm @ 54 Mbps

- IEEE 802.11a radio
  - Frequency band: 5.725 - 5.850 GHz (FCC/IC) 5.470 - 5.725 GHz with DFS (ETSI/EU)
  - Modulation: 802.11a/n - OFDM (64-QAM, 16-QAM, QPSK, BPSK)
  - Media Access Protocol: CSMA/CA with ACK
  - TX Power: ETSI/EU 15-30 dBm (EIRP) set in 1 dB units; FCC/IC 19-34 dBm (EIRP) set in 1 dB units
  - 8 dBi Omnidirectional antenna
  - RX Sensitivity:

-94 dBm @ 6 Mbps	-86 dBm @ 24 Mbps
-93 dBm @ 9 Mbps	-83 dBm @ 36 Mbps
-92 dBm @ 12 Mbps	-78 dBm @ 48 Mbps
-89 dBm @ 18 Mbps	-76 dBm @ 54 Mbps

Networking
- Full 802.11b/g, 802.11a, 802.11n Client Compatibility
- IEEE 802.3u 10/100BaseT Ethernet Ports
- IPv4; IPv6-ready
- BGP
- 802.1q VLAN Support (ESSID and IP based tagging)
- Support for static and dynamic addressing for wireless and wired clients
- Onboard DHCP Server and Relay
- Plug and Play Wired Client Interface
- Session-Persistent Mobility across Subnets
- Location Based Services
- Layer 2 Emulation (L2E)
- NAT

Quality of Service
- 802.11e WMM
- 802.1p/q with 4 queues per VLAN and ESSID
- 802.1p and DSCP
- VoIP and VoWiFi Support
  - Heuristics-based Voice Classification
  - Call Admission Control
  - TSpec Classification
  - Seamless Mobility
  - Call Reporting
- Rate Limiting (Airtime and Throughput Based)

Management
- RADIUS Accounting
- Local and Remote Management Tools via HTTPS
- Router Access Control
- Identity-Based Authentication (4 levels)
- Configuration Save and Restore
- Software Upgrades with Rollback
- Command Line Interface (CLI) via SSH
- SNMP (standard MIBs and Tropos MIB)
- Wireless, Network and Client Monitoring and Statistics

Security
- Authentication: WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAP-TTLS, EAP-SIM, PEAP)
- Encryption: Open, WEP, AES-CCM, TKIP
- Hardware assisted encryption
- AES encryption of mesh and control traffic
- Multiple BSSIDs & ESSIDs (ESSID suppression)
- Full VPN compatibility (VPN filtering)
- Password and Certificate-based HTTPS and SSH Remote Access
- Packet Filtering & Forwarding
- Peer-to-Peer Blocking
- Client Access Control Lists
- Router Access Control
- Evil Twin Detection and Reporting
- Denial of Service Attack Detection
- Tamper-Evident Seal
- FIPS 140-2 Level 2 certified

Environmental Specifications
- Operating temperature range: -40°C to 55°C
- Storage temperature range: -40°C to 85°C
- Weather rating: IP67
- Wind survivability: >165 mph
- Wind loading (165 mph): <210 Newtons
- ASTM B117 Salt Fog rust resistance compliant
- Shock & vibration: ETSI 300-19-2-4 spec T41.E class 4M3
- Transportation: ISTA 2A

Package Contents
- Tropos 6320 Outdoor Mesh Router
- Mounting bracket and accessories
- Quick Start Guide
- Weatherized data cable housing

Warranty
- One (1) year on parts and labor; return to point of purchase
- Optional standard and premium support packages available

Optional Accessories
- Data & POE Outdoor CAT5 STP Cables: 4 or 8 ft
- Street light NEMA photo-electric control power tap 100-277 VAC
- CAT5 data cable building entrance protection; network protection unit

Approvals
- FCC CFR 47 Part 15, Class B Subpart C
- Industry Canada RSS 210
- EN 301 489-17
- EN 300 328
- EN 301 893
- EN 60950
- IEC 950
- UL 60950-1
- CSA 22.2 No. 60950-1
- UL 579/IEC 60529 IP67 rated for outdoor use
- UL 1449/IEC 60664-1
- CE

Hardware Specifications
- Auto-sensing 802.3u 10/100BASE-T Ethernet
- Power input: PoE (20-60 VDC); 100-277 VAC with external accessory
- Power consumption: 10 W typical
- Power-on and network status lamp: Green/Red/Blue
- Dimensions (w/o mounting brackets or antennas): 8.75" (22.2 cm) x 7.25" (18.4 cm) x 2.5" (6.4 cm); with antennas 14" (35.6 cm)
- Weight: 5 lbs (2.3 kg) max., with mounting brackets

Protection Circuits
- Antenna Protection Integrated
- Electrical Protection:
  - EN61000-4-4 Level 2 Electrical Fast Transient Burst Immunity
  - EN61000-4-3 Level 2 EMC Field Immunity
  - EN61000-4-2 Level 2 (contact), Level 3 (air) ESD Immunity

Ordering Information
Part Number: 63203030 for FCC and Canada
Tropos 6320 Outdoor Mesh router, FCC TX; 2.4 & 5.8 GHz; three 6 dBi & one 8 dBi omni antennas, bracketry

Part Number: 63202531 for ETSI markets
Tropos 6320 Outdoor Mesh router, ETSI TX; 2.4 & 5.4 GHz; three 6 dBi & one 8 dBi omni antennas, bracketry

Part Number: 63103030 for FCC and Canada
Tropos 6310 Outdoor Mesh router, FCC TX; 2.4 GHz; three 6 dBi omni antennas, bracketry

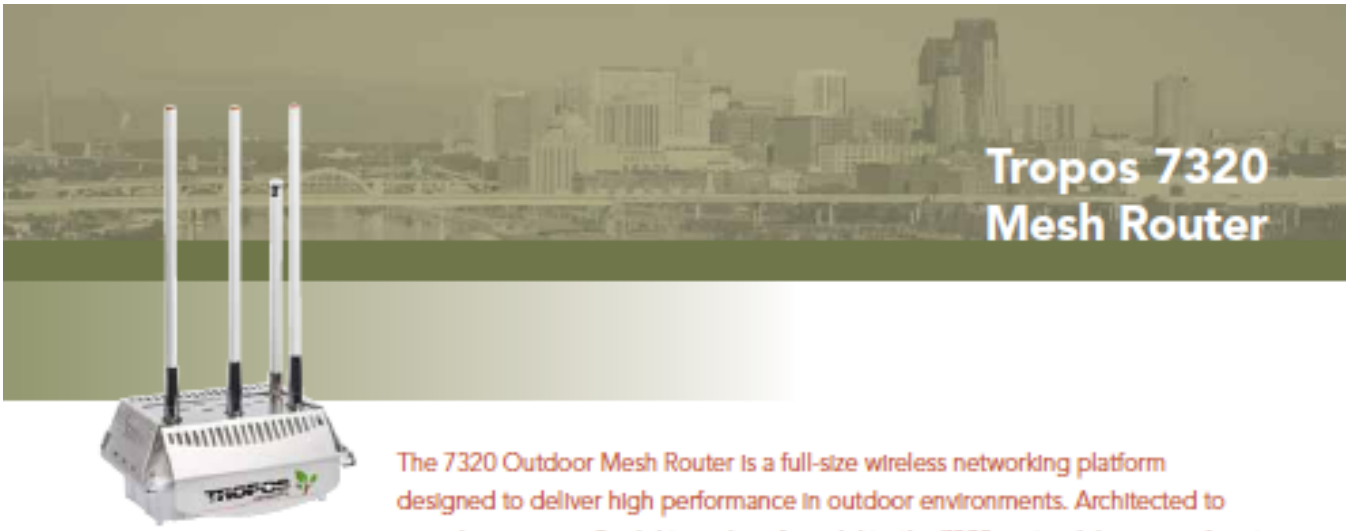
Part Number: 63102531 for ETSI markets
Tropos 6310 Outdoor Mesh router, ETSI TX; 2.4 GHz; three 6 dBi omni antennas, bracketry

Part Number: FIPS 1402-6310
Software license, hardware labels for FIPS 140-2

Part Number: FIPS 1402-6320
Software license, hardware labels for FIPS 140-2

TROPOS networks

tel 408.331.6800 • fax 408.331.6801 • www.tropos.com • sales@tropos.com



Tropos 7320 Mesh Router

The 7320 Outdoor Mesh Router is a full-size wireless networking platform designed to deliver high performance in outdoor environments. Architected to provide maximum flexibility and configurability, the 7320 router delivers significant performance increases through support for the 802.11n standard, a next-generation high-sensitivity radio design, and the incorporation of patented new features into the industry-leading Tropos Mesh Operating System.

FEATURES AND BENEFITS

Software

- Decentralized architecture optimizes throughput in real-time and ensures scalability
- Dynamic selection of optimal end-to-end path delivers the highest performance
- Network performance and capacity maximized by automatic optimization of power and rate on per-connection and per-packet basis

Platform

- Support for 802.11n features deliver significant performance enhancements
- Flexible, modular form factor can be customized with user-selected antennas
- Supports the industry's widest array of power input options
- Ideal for providing source PoE to co-located devices

TROPOS networks

A high-capacity solution capable of simultaneous support for multiple network applications, the Tropos 7320 router is designed to meet the demanding needs of municipalities and utilities, as well as enterprise, industrial, and military entities. The platform provides a reliable communications foundation for deploying concurrent implementations of public safety, intelligent transportation systems, video surveillance, and utility metering systems. The 7320 Tropos router can either serve as a gateway interface for capacity injection into the network, or as a node to extend or reinforce network connectivity.

Designed for creating or expanding higher-capacity networks, the 7320 router is a dual-band unit with one 2.4 GHz and one 5 GHz radio that supports meshing and client connectivity at both frequencies. The platform provides superior performance and resiliency, and enables the network to be scaled to the highest-capacity configurations through deployment of additional Tropos routers.

The high-capacity unit is fitted with two Ethernet ports that can be used for a variety of purposes:

- Gateway configurations where device connectivity is needed for capacity injection into the network
- Attachment of client devices requiring power over Ethernet (PoE), such as cellular point-to-point wireless products used for capacity injection; video cameras; or Advanced Meter Reading/Advanced Metering Infrastructure (AMR/AMI) collectors

The 7320 router is preconfigured with multiple omnidirectional antennas for high-performance 802.11n connectivity. For increased flexibility, the omnidirectional antennas can easily be replaced with optional high-gain sector or patch antennas for enhanced coverage.

802.11n Features Deliver Network-Wide Performance Enhancements

The 7320 mesh router is designed to utilize the powerful capabilities of the 802.11n standard, which delivers performance increases in coverage, capacity, and reliability. This breakthrough technology improves receive link signal strength and client connectivity not just for 802.11n clients, but for 802.11b/g clients as well. Client connection reliability is enhanced by combining multiple signals from multiple antennas, instead of relying on signals received from a single antenna. The result is increased throughput, higher network capacity, and reduced latency across the network.

Tropos Mesh OS

The Tropos Mesh OS is the cornerstone of the decentralized Tropos System Architecture. A common software platform that runs on each router across the network, the Tropos Mesh OS leverages the router's on-board intelligence to monitor and maximize performance. Unlike controller-based architectures that suffer bandwidth losses as control traffic is passed back and forth between network nodes and the central site, the distributed Tropos System Architecture uses efficient on-board processing at the device level to minimize network congestion and adapt on a real-time, packet-by-packet scale. This distributed approach optimizes performance and throughput by minimizing control traffic, delivers a highly scalable solution, and helps provide a quality user experience for network clients.

PWRP

The cornerstone of the Tropos Mesh OS is the patented Predictive Wireless Routing Protocol (PWRP™), which continually analyzes the quality of active and inactive mesh links to dynamically configure the ideal combination of paths to optimize network performance. Upon deployment, the routers automatically discover one another, and quickly determine the optimal route to the gateways that inject capacity into the network. Optimal links are chosen on the basis of throughput, packet success, signal-to-noise ratios, and other key criteria.

PWRP performs a range of key tasks across the wireless network:

- Streamlines deployments and preserves performance by dynamically configuring and optimizing mesh connections
- Improves overall throughput by selecting optimal routing paths
- Enhances network resiliency by providing graceful rerouting of traffic in the event of RF interference, backhaul failures, or other disruptions in the wireless mesh
- Supports client mobility without the need for special client hardware, software, or network reconfigurations
- Enables the network to be scaled to thousands of nodes covering the largest geographical areas in the industry

PowerCurve

A distributed algorithm that leverages the Tropos PWRP communication protocol, PowerCurve maximizes network performance and capacity by automatically optimizing power and rate parameters on a per-connection and per-packet basis. This advanced, distributed algorithm continually adjusts transmit power to maximize the number of wireless links that can operate concurrently. Unlike alternative approaches where transmit power is configured as a static setting, PowerCurve tightly couples power and bit rate control. This enables the router to make continuous and dynamic adjustments that can enhance throughput and provide a better user experience.

PowerCurve delivers the following key benefits:

- Dynamically monitors and adjusts power and rate per-packet, per-link, to deliver maximum capacity
- Enhances network reliability, capacity, and scalability beyond the capabilities of controller-based architectures
- Streamlines network planning, deployment, and optimization

Airtime Congestion Control

Airtime Congestion Control (ACC) technology enables networks to be operated closer to their capacity limits by detecting signs of congestion and dynamically adjusting airtime resource allocation to clients. ACC is unlike traditional rate limiting in two important ways. First, instead of limiting traffic during congestion-free periods, ACC activates only when performance-impacting congestion is detected and returns to a monitoring state afterward. Second, it is mesh- and wireless-aware, distributing airtime resources equally among clients during a congestion event rather than applying fixed throughput caps. By allowing networks to carry heavy traffic loads without crossing over into a saturated state, ACC actually increases usable capacity.

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Tropos fixed and mobile routers can be used for securely operating a wide range of services

Wireless

- IEEE 802.11b/g/n radio
  - Frequency band: 2.4-2.483 GHz
  - Modulation: 802.11g/n - OFDM (64-QAM, 16-QAM, QPSK, BPSK); 802.11b - DSSS (DBPSK, DQPSK, CCK)
  - TX Power: ETSI/EU 5-20 dBm (EIRP) set in 1 dB units; FCC/IC 21-36 dBm (EIRP) set in 1 dB units
  - 7.4 dBi Omnidirectional antennas
  - Optional 6.0 dBi omni-directional or 12 dBi sector antenna(s)
  - Media Access Protocol: CSMA/CA with ACK
  - RX Sensitivity:

-97 dBm @ 1 Mbps	-95 dBm @ 18 Mbps
-94 dBm @ 5.5 Mbps	-92 dBm @ 24 Mbps
-92 dBm @ 11 Mbps	-89 dBm @ 36 Mbps
-96 dBm @ 6 Mbps	-85 dBm @ 48 Mbps
-96 dBm @ 12 Mbps	-84 dBm @ 54 Mbps

  - Multi-Antenna System: 1-TX x 3-RX
  - Support for 802.11n MRC
- IEEE 802.11a radio
  - Frequency band: 5.725 - 5.850 GHz (FCC/IC) 5.470 - 5.725 GHz with DFS (ETSI/EU)
  - Modulation: 802.11a/n - OFDM (64-QAM, 16-QAM)
  - TX Power: ETSI/EU 15-30 dBm (EIRP) factory-set in 1 dB units; FCC/IC 20-35 dBm (EIRP) factory-set in 1 dB units
  - 9.1dBi Omnidirectional antenna
  - Optional 17 dBi sector (or) 19 dBi panel antenna
  - Media Access Protocol: CSMA/CA with ACK
  - RX Sensitivity:

-94 dBm @ 6 Mbps	-86 dBm @ 24 Mbps
-93 dBm @ 9 Mbps	-83 dBm @ 36 Mbps
-92 dBm @ 12 Mbps	-78 dBm @ 48 Mbps
-89 dBm @ 18 Mbps	-76 dBm @ 54 Mbps

Networking

- Full 802.11b/g, 802.11a, 802.11n Client Compatibility
- IEEE 802.3u 10/100 Base TT Ethernet Ports
- IPv4; IPv6-ready
- BGP
- 802.1q VLAN Support (ESSID and IP based tagging)
- Support for static and dynamic addressing for wireless and wired clients
- Onboard DHCP Server and Relay
- Plug and Play Wired Client Interface
- Session-Persistent Mobility across Subnets
- Location Based Services
- Layer 2 Emulation (L2E)
- NAT

Quality of Service

- 802.11e WMM
- 802.1p/q with 4 queues per VLAN and ESSID
- 802.1p and DSCP
- VoIP and VoWiFi Support
  - Heuristics-based Voice Classification
  - Call Admission Control
  - TSpec Classification
  - Seamless Mobility
  - Call Reporting
- Rate Limiting (Airtime and Throughput Based)

Management

- RADIUS Accounting
- Local and Remote Management Tools via HTTPS
- Router Access Control
- Identity-Based Authentication (4 levels)
- Configuration Save and Restore
- Software Upgrades with Rollback
- Command Line Interface (CLI) via SSH
- SNMP (standard MIBs and Tropos MIB)
- Wireless, Network and Client Monitoring and Statistics

Security

- Authentication: WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAP-TTLS, EAP-SIM, PEAP)
- Encryption: Open, WEP, TKIP, AES-CCM
- Hardware assisted encryption
- AES encryption of mesh and control traffic
- Multiple BSSIDs & ESSIDs (ESSID suppression)
- Full VPN compatibility (VPN filtering)
- Password and Certificate based HTTPS and SSH based Remote Access
- Packet Filtering & Forwarding
- Peer-to-Peer Blocking
- Client Access Control Lists
- Router Access Control
- Evil Twin Detection and Reporting
- Denial of Service Attack Detection
- Tamper-Evident Seal
- FIPS 140-2 Level 2 Certified

Environmental Specifications

- Operating temperature range: -40°C to 55°C
- Storage temperature range: -40°C to 85°C
- Weather rating: IP67
- Wind survivability: >165 mph
- Wind loading (165 mph): <300 Newtons
- ASTM B117 Salt Fog rust resistance compliant
- Shock & vibration: ETSI 300-19-2-4 spec T41.E class 4M3
- Transportation: ISTA 2A

Optional Battery Back-up

- Factory installed Li-Ion battery
- Back-up power 2 - 6 hours typical

Package Contents

- Tropos 7320 Outdoor Mesh Router
- 7.4 dBi omni-directional antennas (3), 802.11b/g
- 9.1 dBi omni-directional antenna (1), 802.11a
- Mounting bracket and accessories
- Hardware Installation and Quick Start Guides

Warranty

- One (1) year on parts and labor; return to point of purchase
- Optional standard and premium support packages available

Optional Accessories

- Power Cables
  - Street light NEMA photo-electric control power tap 100-480 VAC, 2 wire 4 ft. power cable
  - Street light NEMA photo-electric control power tap 100-480 VAC, 2 wire 20 ft. power cable
  - Electrical power cord, US/Canada 120 VAC, 15 A, 3 prong 6 ft. or 30 ft.
- CAT5 building entrance data protection; network protection unit
- 19 dBi panel antenna, 802.11a
- 17 dBi sector antenna, 802.11a
- 12 dBi sector antenna, 802.11b/g
- 6 dBi omni antenna, 802.11b/g

Approvals

- FCC CFR 47 Part 15, Class B
- Industry Canada RSS 210
- EN 301 489-17
- EN 300 328
- EN 301 893
- EN 60950
- IEC 950
- UL 60950-1
- CSA 22.2 No. 60950-1
- UL 579/IEC 60529 IP67 rated for outdoor use
- UL 1449/IEC 60664-1
- CE

Hardware Specifications

- Autosensing 10/100BaseT Ethernet
- Power input: 100-480VAC 50/60Hz single and split-phase ANSI/IEEE C62.41 category C3 integrated branch circuit protection
- AC power consumption: 18 W typical
- Power over Ethernet power sourcing capability: 12Vdc, 24Vdc, 48Vdc @ 30 W output
- Power-on and network status lamp: Green/Red
- Dimensions (w/o mounting brackets or antennas): 13.00 in (33.02 cm) wide x 8.00 in (20.32 cm) deep x 5.3 in (13.50 cm) high
- Weight: 16 lbs (7.20 kg) max., with mounting brackets

Protection Circuits

- Antenna Protection: < 0.5µJ for 6kV/3kA @ 8/20µS Waveform
- Electrical Protection:
  - ANSI/IEEE C62.41, UL 1449-2nd ed., 10kA @ 8/20 µS Wave form, 36kA per phase, L-L, L-N, L-PE
  - EN61000-4-5 Level 1 & 2 AC Surge Immunity
  - EN61000-4-4 Level 2 Electrical Fast Transient Burst Immunity
  - EN61000-4-3 Level 2 EMC Field Immunity
  - EN61000-4-2 Level 2 (contact), Level 3 (air) ESD Immunity

Ordering Information

Part Number: 73203030 for FCC and Canada FCC/IC TX, three 7.4dBi & one 9.1 dBi omni antennas, bracketry

Part Number: 73203130 for FCC and Canada FCC/IC TX, battery backup, three 7.4 dBi & one 9.1 dBi omni antennas, bracketry

Part Number: 73202531 for ETSI markets ETSI/EU TX, three 7.4 dBi & one 9.1 dBi omni antennas, bracketry

Part Number: 73202631 for ETSI markets ETSI/EU TX, battery backup, three 7.4 dBi & one 9.1 dBi omni antennas, bracketry

Part Number: FIPS 1402-7320
Software license, hardware labels for FIPS 140-2

tel 408.331.6800 • fax 408.331.6801 • www.tropos.com • sales@tropos.com

ANEXO 6 Hojas de Especificaciones Strix

Strix SYSTEMS

Network Without Wires™

Access/One® 2400 Outdoor Wireless System

High Bandwidth – Low Cost Alternative to Cabled Solutions

Using multi-radio, multi-frequency wireless mesh infrastructure from Strix Systems provides higher throughput and a cost effective alternative approach to terrestrial-based wired networks. No matter what type of customer or vertical market, Strix can exponentially reduce CapEx and OpEx, which is critical to today's growing demands for network connectivity, retrofit or new expansion, and migration to new applications for enhanced services and efficiencies.

Higher Capacity and Performance

The Access/One® 2400 Outdoor Wireless System provides high throughput over multiple hops and is built for capacity. It supports multiple radio frequencies (2.4 GHz, 4.9 GHz, 5 GHz) concurrently from each unit and is uniquely designed for simultaneous support of multiple applications, VLAN segmented networks, real-time and low latency voice, and high resolution video applications and services.

Layer 2 Switching Architecture

Strix's foundational architecture from its inception has clearly distinct advantages over other wireless solutions. It is a true dedicated multi-radio Layer 2 switching wireless mesh backbone providing near full duplex RX and TX and it also combines multiple dedicated radios for client access all simultaneously from each unit. This provides exponentially greater sustainable throughput and lower latency over multiple hops compared to other mesh solutions that employ a store and forward single radio for backhaul, which results in high latency and 50% or greater degradation of available bandwidth.

Easier Large Scale Deployments & Network Management

The Access/One 2400 automatically self forms, self configures and self heals forming an instantaneous and highly redundant wireless mesh network infrastructure and helps lower deployment and operational expenditures. Its proven multi-radio and Layer 2 switching architecture enables unlimited scalability and rapid deployment of thousands of mesh nodes. Centralized provisioning and monitoring allow instant availability.

Failover & Reliability

The Access/One 2400 enables network communication with each other and performs intelligent tasks and analysis, ensuring that the network's performance is always at its peak. But if problems do arise, the system has the intelligent ability to "tune" and "heal" itself instead of breaking down. There's no single point of failure. Each unit is fully aware of its neighbor and, in the event of an adjacent unit's failure, over-load, or network cable cut of a wire terminated unit, it will redirect traffic. Customers can now benefit from a wireless system that satisfies network-wide reliability.

High Speed Mobility

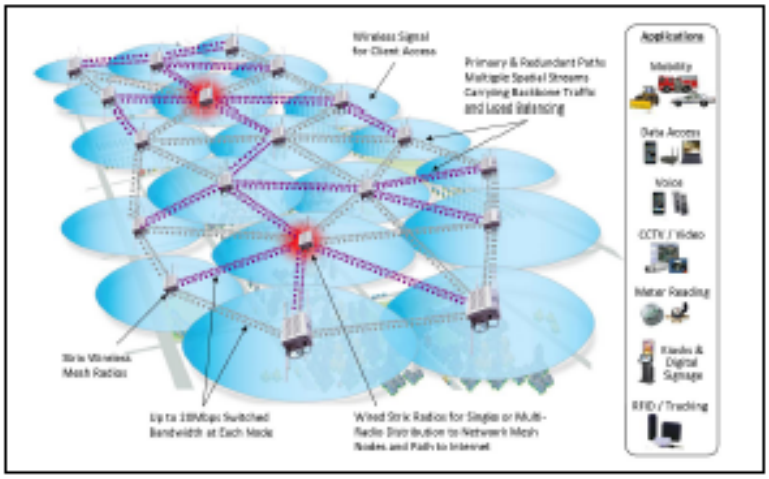
Strix Access/One solutions are capable of supporting high speed vehicular and railway mobile roaming up to 160+ mph. The multi-radio Layer 2 switching architecture and highly tunable mobile parameters enable blistering fast mobile roaming and session persistence when used with the Strix MWS100 mobile unit. Any 802.11 compliant device is supported allowing roaming between multiple network technologies (e.g. 2.4 GHz, 4.9 GHz public safety, CDMA, 3G, EVDO, etc.).

Security & Optimization

The Access/One 2400 offers the industry's highest level of security authentication and encryption available and mesh-wide Layer 2 traffic isolation. It also offers enhanced optimization parameters: QoS traffic provisioning, multicast traffic efficiency handling, weak client handling, mobility roaming, power save queuing, antenna alignment, and throughput testing.

Applications

Fixed and mobile, video surveillance, VoIP, mobile, SCADA, AMR, Smart Grid, traffic control, intelligent transport, Wi-Fi access, rural broadband, telemetry, etc.



Network Without Wires™

Technical Specifications

Models

- OWS2400-10 – 2 x A/G/J/H/4.9
- OWS2400-20 – 4 x A/G/J/H/4.9
- OWS2400-30 – 6 x A/G/J/H/4.9

Mesh Protocol

- Strix Dynamic Mesh Architecture™
- Scalable Mesh Fast Re-Route™
- High Performance Modular Architecture™

Security & Encryption

- Authentication
  - 802.1x support, RADIUS – Up to 2 RADIUS servers per BSSID
  - RADIUS Client Functionality
  - EAP-MD5, TLS, TTLS, PEAP
  - WPA, WPA2, PSK
  - Access Control Lists
  - Strix Access/One
- Encryption:
  - Backhaul: AES CCM
  - Client: AES, TKIP and WEP
  - 64, 128, 152, 256 bit
  - Password Encryption
- Trusted Inventory Authentication
- Trusted IP Management Access
- RADIUS Management User Accounts
- Mesh-wide Layer 2 Traffic Isolation
- Rogue Device Detection
- SSID Suppression

Traffic Prioritization & QoS

- Class of Service 802.1p
- 802.1q VLAN Queuing
- DiffServ

Software Features

- 16 BSSIDs per radio
- 250 VLANs per radio, Up to 4096 tags
- Single or Multi-VLANs per BSSID
- Multi-Radios for dedicated mesh backhaul and client access
- Load Balancing and Auto Failover
- Session-Persistent Mobility
- Location Based Services
- Multicast Efficiency Handling
- Dynamic Auto Channel Select
- Weak Client Trigger Handling
- Railway Self Provisioning
- Power Save Packet Queuing
- Clear Channel Assessment
- Integrated Performance Test Utility

Wireless Interface

- Wireless Standards
  - 802.11 A/G/J/H/4.9
- Frequency Bands:

  802.11A/H
  - 5.15 - 5.25 GHz
  - 5.25 - 5.35 GHz
  - 5.470 - 5.725 GHz
  - 5.725 - 5.850 GHz

  802.11A/4.9/J
  - 4.94 – 4.99 GHz (USA)
  - 4.92 – 5.08 GHz (Japan)

  802.11G
  - 2.4 - 2.462 GHz (Americas, FCC)
  - 2.4 - 2.472 GHz (Europe, ETSI)
  - 2.4 - 2.497 GHz (Japan, MKK)
- Receiver Sensitivity Rates (Mbps)
  - -74 dBm @ 54 Mbps
  - -91 dBm @ 11 Mbps
- Transmit Power
  - Up to 26 dBm, 400mW[1]
  - Transmit Power Control
- Modulations
  - Orthogonal Frequency Division Multiplexing (OFDM)
  - (BPSK, QPSK, 16-QAM, 64-QAM)
  - 802.11b – DSS (BPSK, QPSK, CCK)
- Dynamic Frequency Selection
- Strix products have been WiFi certified

Network Interface

- One 10/100 Mbps Ethernet port with weatherproof connectors, LED activity indicator
- 100 Mbps switched interface backplane
- IEEE 802.3, 802.3u compliant
- CSMA/CD 10/100 autosense
- DHCP, DHCP Relay, Static IP

Management Software

- Centralized Provisioning and Monitoring
- Topology and Mapping
- Inventory Management
- HTTP/HTTPS – WEB GUI configuration
- Telnet/SSH – CLI Interface
- Device Discovery and Auto Backhaul
- Remote Management
- SNMP – 802.11 and Strix MIBs
- Syslog

Electrical

- AC Input: Auto-sensing 100-240 VAC, 50/60 Hz, single and split phase, with ANSI/IEEE C62.41 category C3 integrated surge protection
- DC Input: 24 VDC, 6A maximum
- AC Power Consumption: Avg. 24W

Protection Circuits

- Electrical Protection: ANSI/IEEE C62.41, UL 1449 2nd edition; 10kA @ 8/20 µs waveform, 36kA per phase; LL, L-N, L-PE
- Data Protection: EN61000-4-2 Level 4 ESD Immunity
- EN61000-4-5 Level 4 AC Surge Immunity
- EN61000-4-4 Level 4 Elect. Fast Transient Burst Immun.
- EN61000-4-3 EMV Field Immunity

Environmental

- Operating Temperature: -40°C to +55°C
- Storage Temperature: -50°C to +85°C
- Humidity: 10% to 90% non-condensing
- Weather Rating: IP68 weather tight
- Wind Survivability: >165 mph
- Wind Load (165 mph): <1024 newtons
- Salt/Fog/Rust Resistance: Mil-STD-810F 509.4
- Shock & Vibration: ESTI 300-132-4 spec T41.E
- Class 4M3 and Mil-STD-810
- Transportation: ISTA 2A and Mil-STD-810

Physical

- 12" H x 10" W x 6" D
- Weight: 14.5lbs (6.58 Kg)
- NEMA 4X rated, IP68
- N-Type Female Connectors
- Weatherproof Power Connector
- Weatherproof Ethernet Connectors
- Wall, Pole, and Adjustable mount

Approvals

- FCC CFR47 Part 15, Class A; EN 301 489-1/-17 EN 301 328; EN 301 893
- Industry Canada RSS210
- EN60950 cTUVus Listed LT.E
- UL 579/IEC 60529 IP68
- UL 1449 2nd edition / IEC 60664-1
- VCCI Class A

Options and Accessories

- Optional Mounting Brackets
- Photo Electric Cell Power Tap

Warranty

- 13 Months Hardware and Software
- Extended Warranties Available

[1] Multiple Configurations Available
[2] Transmit power varies by country

Strix Systems, Inc.
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Newbury Park, CA 91320

1-805-768-4640 (Sales / General)
1-805-214-1104 (Support)
www.strixsystems.com

Blistering Fast Wireless Mesh™

Access/One® Network 5600 Series

Extreme Bandwidth – Low Cost Alternative to Cabled Solutions

Using up to 3x3 antennas[1], multiple spatial streams, and Multiple Input, Multiple Output (MIMO) techniques, wireless mesh infrastructure from Strix Systems provides blistering fast throughput and a cost effective alternative approach to terrestrial-based networks such as Fiber. No matter what type of customer or vertical market, Strix can exponentially reduce CapEx and OpEx, which is critical to today's growing demands for network connectivity, retrofit or new expansion, and migration to new applications for enhanced services and efficiencies.

Extreme Capacity and Performance

The Access/One® Network (A1N) 5600 outdoor wireless solution with up to 3x3 MIMO provides blistering fast throughput at up to 300 Mbps and built for extreme capacity. It supports multiple radio frequencies (2.4 GHz, 4.9 GHz, 5 GHz) concurrently from each unit and is uniquely designed for simultaneous support of multiple applications, VLAN segmented networks, real-time and low latency voice, and high resolution video applications and services.

Extreme Architecture

Strix's foundational architecture from its inception has clearly distinct advantages over other wireless solutions. It is a true dedicated multi-radio Layer 2 switching wireless mesh backbone providing near full duplex RX and TX and it also combines multiple dedicated radios for client access all simultaneously from each unit. This provides exponentially greater sustainable throughput and lower latency over multiple hops compared to other A/G/N solutions that employ a store and forward single radio for backhaul, which results in high latency and 50% or greater degradation of available bandwidth and high latency.

Easier Large Scale Deployments & Network Management

The A1N5600 automatically self forms, self configures and self heals forming an instantaneous and highly redundant wireless mesh network infrastructure and helps lower deployment and operational expenditures. Its proven multi-radio and Layer 2 switching architecture enables unlimited scalability and rapid deployment of thousands of mesh nodes. Centralized provisioning and monitoring allow instant availability.

Failover & Reliability

The A1N5600 enables network communication with each other and performs intelligent tasks and analysis, ensuring that the network's performance is always at its peak. But if problems do arise, the system has the intelligent ability to "tune" and "heal" itself instead of breaking down. There's no single point of failure. Each unit is fully aware of its neighbor and, in the event of an adjacent unit's failure, overload, or network cable cut of a wire terminated unit, it will redirect traffic. Customers can now benefit from a wireless system that satisfies network-wide reliability.

High Speed Mobility

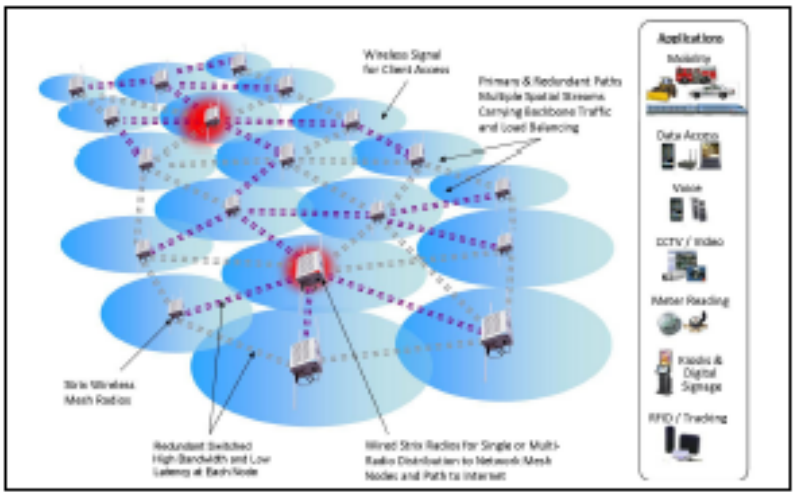
Strix Access/One solutions are capable of supporting high speed vehicular and railway mobile roaming up to 160+ mph. The multi-radio Layer 2 switching architecture and highly tunable mobile parameters enable blistering fast mobile roaming and session persistence when used with the Strix A1N5300 mobile unit. Any 802.11 compliant device is supported allowing roaming between multiple network technologies (e.g. 2.4 GHz, 4.9 GHz public safety, CDMA, 3G, EVDO, etc.).

Security & Optimization

The A1N5600 offers the industry's highest level of security available, which includes 256-bit AES encryption, FIPS 140-2 and 197 certifications and mesh-wide Layer 2 traffic isolation. It also offers enhanced optimization parameters: QoS traffic provisioning, multicast traffic efficiency handling, weak client handling, mobility roaming, power save queuing, antenna alignment, and throughput testing.

Applications

Fixed and mobile, video surveillance, VoIP, mobile, SCADA, AMR, Smart Grid, traffic control, intelligent transport, Wi-Fi access, rural broadband, telemetry, etc.



Blistering Fast Wireless Mesh™

Technical Specifications

Models

- A1N5612 – 1G/A/N/1/4.9
- A1N5622 – 2G/A/N/1/4.9
- A1N5632 – 3G/A/N/1/4.9
- A1N5642 – 4G/A/N/1/4.9
- A1N5652 – 5G/A/N/1/4.9
- A1N5662 – 6G/A/N/1/4.9

Mesh Protocol

- Strix Dynamic Mesh Architecture™
- Scalable Mesh Fast Re-Route™
- High Performance Modular Architecture™

Security & Encryption

- Authentication
  - 802.1x support, RADIUS – Up to 2 RADIUS servers per BSSID
  - RADIUS Client Functionality
  - EAP-MD5, TLS, TTLS, PEAP
  - WPA, WPA2, PSK
  - Access Control Lists
  - Strix Access/One
- Encryption:
  - Backhaul: AES CCM
  - Client: AES, TKIP and WEP
  - 64, 128, 152, 256 bit
  - Password Encryption
- Trusted Inventory Authentication
- Trusted IP Management Access
- RADIUS Management User Accounts
- Mesh-wide Layer 2 Traffic Isolation
- Rogue Device Detection
- SSID Suppression

Traffic Prioritization & QoS

- 802.11e WMM
- Class of Service 802.1p
- 802.1q VLAN Queuing
- DiffServ

Software Features

- 16 BSSIDs per radio
- 250 VLANs per radio, Up to 4096 tags
- Single or Multi-VLANs per BSSID
- Multi-Radios for dedicated mesh backhaul and client access
- Load Balancing and Auto Failover
- Session-Persistent Mobility
- Location Based Services
- Multicast Efficiency Handling
- Dynamic Auto Channel Select
- Weak Client Trigger Handling
- Railway Self Provisioning
- Power Save Packet Queuing
- Clear Channel Assessment
- Integrated Performance Test Utility

Wireless Interface

- Wireless Standards – A/G/N/1/4.9
- Up to 3x3 MIMO
- Frequency Bands:
  - 802.11G/N
    - 2.4 - 2.462 GHz (Americas, FCC)
    - 2.4 - 2.472 GHz (Europe, ETSI)
    - 2.4 - 2.497 GHz (Japan, MKK)
  - 802.11A/N
    - 5.15 - 5.25 GHz
    - 5.25 - 5.35 GHz
    - 5.470 - 5.725 GHz
    - 5.725 - 5.850 GHz
  - 802.11A/J/4.9
    - 4.94 – 4.99 GHz (USA)
    - 4.92 – 5.08 GHz (Japan)
- Receiver Sensitivity Rates (Mbps)
  - -64 dBm @ Up to 300 Mbps
  - -76 dBm @ 54 Mbps
  - -91 dBm @ 11 Mbps
  - -93 dbm @ 6 Mbps
- Transmit Power
  - Up to 27 dBm
  - Transmit Power Control by 1 dB
- Modulations
  - Orthogonal Frequency Division Multiplexing (OFDM)
  - BPSK, QPSK, 16-QAM, 64-QAM
  - 802.11b – DSS (BPSK, QPSK, CCK)
- Supported Channel Widths
  - 5, 10, 20, and 40 MHz
- Dynamic Frequency Selection

Network Interface

- Up to 4 GigE 10/100/1000 Mbps Ethernet ports with weatherproof connectors
- GigE switched interface backplane
- IEEE 802.3, 802.3u compliant
- CSMA/CD 10/100 autosense
- High Power PoE Input
- POE Output 802.3af, 802.3at
- DHCP, DHCP Relay and Static IP

Management Software

- Centralized Provisioning and Monitoring
- Topology and Mapping
- Inventory Management
- HTTP/HTTPS – WEB GUI configuration
- Telnet/SSH – CLI Interface
- Device Discovery and Auto Backhaul
- Remote Management
- SNMP – 802.11 and Strix MIBs
- Syslog

Electrical

- AC Input: Auto-sensing 100-240 VAC, 50/60 Hz, single and split phase, with ANSI/IEEE C62.41 category C3 integrated surge protection
- DC Input: 12 V – 48 VDC, 6A maximum
- AC Power Consumption: Avg. 24 W

Protection Circuits

- Electrical Protection: ANSI/IEEE C62.41, UL 1449 2nd edition; 10kA @ 8/20 µs waveform, 36kA per phase; L-L, L-N, L-PE
- Data Protection: EN61000-4-2 Level 4 ESD Immunity
- EN61000-4-5 level 4 AC Surge Immunity
- EN61000-4-4 level 4 Elect. Fast Transient Burst Immun..
- EN61000-4-3 EMV Field Immunity

Environmental

- Operating Temperature: -40°C to +55°C
- Storage Temperature: -50°C to +85°C
- Humidity: 10% to 90% non-condensing
- Weather Rating: IP68 weather tight
- Wind Survivability: > 165 mph
- Wind Load (165 mph): <1024 newtons
- Salt/fog/dust Resistance: Mil-STD-810F 509.4
- Shock & Vibration: ETSI 300-192-4 spec T41.E
- Class 4M3 and Mil-STD-810
- Transportation: ISTA 2A and Mil-STD-810

Physical

- 12" high x 10" wide x 6" deep
- Weight: 10 lbs
- NEMA 4X rated, IP68
- N-Type Female Connectors
- Weatherproof Power Connector
- Weatherproof Ethernet Connectors
- Wall, Pole, and Adjustable mount

Approvals

- FCC CFR47 Part 15, Class A; EN 301 489-1/-17 EN 301 328; EN 301 893
- Industry Canada RSS210
- EN60950 cTUVus Listed I.T.E
- UL 579/IEC 60529 IP68
- UL 1449 2nd edition / IEC 60664-1
- VCCI Class A

Options and Accessories

- Optional Mounting Brackets
- Photo Electric Cell Power Tap

Warranty

- 13 Months Hardware and Software
- Extended Warranties Available

[1] Multiple Configurations Available
[2] Transmit power varies by country

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MWS-100 HSX10

HIGH PERFORMANCE INTEGRATED WIRELESS SYSTEM

Strix Systems introduces the Integrated wireless MWS-100 HSX10 to its award winning Access/One family of wireless indoor, outdoor, mobile and video surveillance products. Enclosed in a weatherized, air and watertight outdoor enclosure, Utilizing Strix DMA™, the Access/One MWS-100 HSX10 dual radio mesh system uses advanced algorithms to deliver high performance intelligent radio algorithms that dynamically adjust to the environment for superior multi-frequency, multi-channel, multi radio technology that delivers multi-megabit and low latency performance.

Designed to address key markets, Strix MWS-100 HSX10 is easily deployable, automatically and instantly self-configuring, and provides superior performance, security and flexibility. City and municipal public safety deployments as well as mobile/RV parks, marinas, outdoor malls, fixed and temporary event venues, outdoor enterprise, industrial and strategic locations, for applications ranging from general access/ hot spots, mobile data, video surveillance, VoIP and backhaul transport for SCADA and AMR. Efficiently increasing the reach of the networks in a robust and a cost effective way.

MWS-100 HSX10 is the most secure mesh networking system available, with the tools to authenticate users, encrypt wireless traffic, and monitor network activity all provided as standard features. Integrates well with the OWS to expand networks effeciently and in a cost effective manner.

Strix MWS-100 HSX10 offers unique set of finely tuned features including robust high performance 802.11a, 802.11g & high power licensed 4.9 GHz (DSRC-C) for a combination of high density user access and high-speed backhaul to Strix Access/One Outdoor Wireless Mesh Networks. Strix MWS-100 HSX10 also supports industry-standard security algorithms for secured backhaul and client connectivity, multiple SSIDS and VLANs as well as end-to-end Quality of Service. Extended operating temperature ranges and flexible mounting options make Strix MWS-100 HSX10 suitable for all types of deployment scenarios. The MWS-100 HSX10 scales efficiently and economically while maximizing coverage areas affordably. It greatly reduces deployment, operating costs bringing down the Total Cost of Ownership.

Features

Wireless

- High-performance, dual-radio mesh architecture.
- Low latency and high throughput across multiple wireless hops.
- Full duplex mesh.

System

- All nodes auto-discover and self-configure.
- Self-tuning and self-healing mesh for network optimization.
- User definable QoS with voice, video and data prioritization.
- Up to 16 BSSIDs per radio.
- Multiple SSIDs (per network and per node) and VLAN tagging, with configurable security parameters on a per-SSID basis.
- Session persistence for roaming, path optimization or failover.
- Manager/One® Web interface provides a full suite of intuitive management tools at the network, node, and radio levels.
- Additional remote management options include SNMP, CLI over Telnet or SSH, HTTP/HTTPS, DHCP, and BOOTP.
- Seamless interoperability with the Strix Access/One® Indoor Wireless System (IWS) and Edge Wireless System (EWS).

Security

- Supports all industry standard security protocols.
- RADIUS, EAP-MD5, EAP-TLS, PEAP-TTLS authentication.
- 802.11i with AES, WEP and TKIP encryption.
- MAC address Access Control Lists on a per SSID basis.
- Full VPN support.
- Layer 2 Traffic Privacy

www.strixsystems.com

Strix Systems, Inc.
810 Lawrence Drive, Suite 124
Newbury Park, CA 91320

Tel: 805.499.8435
Web Site: www.strixsystems.com

Technical

Wireless

- Wireless Standards: IEEE 802.11a/g
- Frequency Bands:

  802.11a
  - 5.15 - 5.25 GHz
  - 5.25 - 5.35 GHz
  - 5.470 - 5.725 GHz (capable)
  - 5.725 - 5.850 GHz

  802.11g
  - 2.4 - 2.462 GHz (Americas, FCC)
  - 2.4 - 2.472 GHz (Europe, ETSI)
  - 2.4 - 2.497 GHz (Japan, MKK)

  U.S. Public Safety
  - 4.940 - 4.990 GHz (FCC DSRC-C)

- Data Rates (Mbps):
  - 6, 9, 12, 18, 24, 36, 48, 54 (802.11a/g/4.9)
- Wireless Medium:

  802.11a/g/4.9 – OFDM
- Modulation:

  802.11a/4.9 – BPSK, QPSK, 16 QAM, 64 QAM
  802.11g – DBPSK, DQPSK, CCK
- Operating Channels:

  802.11a
  - 13 (Americas, FCC) 8 indoor, 5 outdoor
  - 13+ (Europe, ETSI), 13 (Japan, MKK)

  802.11g
  - 11 (Americas, FCC)
  - 13 (Europe, ETSI), 13 (Japan, MKK)

  U.S. Public Safety
  - 2 (4.955 GHz, 4.975 GHz)
- Transmit Power (802.11a/g/4.9): 26 dBm
- Transmit and Receive Diversity
- Receiver Sensitivity:

802.11g:	802.11a/4.9:
-98 dBm @ 1 Mbps	-93 dBm @ 6 Mbps
-94 dBm @ 5.5 Mbps	-90 dBm @ 12 Mbps
-91 dBm @ 11 Mbps	-84 dBm @ 24 Mbps
-93 dBm @ 6 Mbps	-81 dBm @ 36 Mbps
-91 dBm @ 12 Mbps	-76 dBm @ 48 Mbps
-85 dBm @ 24 Mbps	-74 dBm @ 54 Mbps
-82 dBm @ 36 Mbps	
-77 dBm @ 48 Mbps	
-75 dBm @ 54 Mbps	

- LO (crystal) Frequency Stability:

  +/-20PPM

Electrical

- Power Input: Auto-sensing 120/240 VAC, 50/60 Hz, single and split phase, with ANSI/IEEE C62.41 category C3 integrated surge protection
- Power Consumption: 18W typical, 20W maximum
- DC Input: 12 - 48V,
- High Powered PoE

Environmental

- Operating Temperature: -40°C to +55°C
- Storage Temperature: -50°C to +85°C
- Humidity: 10% to 90% non-condensing
- Weather Rating: IP67 weather tight
- Wind Survivability: >165 mph
- Wind Loading (165 mph): <1024 newtons

Physical

- 7.25" H x 8.25"W x 2.25"D (without accessories)
- Weight: 2.4lbs (1.08 Kg)
- NEMA 4X outdoor enclosure rated IP67
- Wall mount and pole mount brackets included

Security

- Authentication: 802.1x support, including RADIUS client, EAP-MD5, EAP-TLS, PEAP-TTLS, WPA/WPA2 and WPA-PSK/WPA2-PSK
- Encryption: IEEE 802.11i with AES, TKIP, WEP and AES encrypted backhaul.
- General: Layer 2 Traffic Privacy

Remote Management

- Web, CLI and SNMP interfaces
- Supports DHCP, Telnet, SSH, HTTP, HTTPs, and FTP
- SNMP: MIB II, 802.11 MIB, and Strix private MIBs

Approvals

- FCC CFR47 Part 15, Class A; EN 301 489-1/-17 EN 301 328; EN 301 893
- Industry Canada RSS210
- EN60950 cTUVus Listed I.T.E
- UL 579/IEC 60529 IP67, rated for outdoor use
- UL 1449 2nd edition / IEC 60664-1
- VCCI Class A

Optional Accessories

- Adjustable Mounting Bracket
- Street light NEMA photo-electric power taps

Warranty

- One year Hardware and Software included
- Optional extended Warranties

Ordering Information

Please Contact your Distributor

MWS 100 SERIES

Features

Wireless

- The Industry's Highest-Power, Lowest Cost Mesh Network Edge Mobile Wireless Node.
- High Speed Mobility. State-Of-The-Art Network Persistence, Robust Delivery of Voice, Video and Data.
- Defined Quality Of Service (QoS)
- Low Latency and High Throughput Across Multiple Wireless Hops.
- Dynamic Channel Assignment, Automatic Power Control, Data Rate Selection for Optimum RF Spectrum Efficiency.

System

- Plug-N-Play simplicity, auto-discover and self-configuration.
- 802.11a or 4.9 GHz DSRC-C (high power) for public safety applications.
- 802.11g radio for client access.
- Takes advantage of Strix mesh network Full-Duplex capabilities.
- Strix Access/One Edge™ extends QoS from Strix mesh networks.
- Seamless Interoperability with Strix Access/One family of products.

Management

- Remote Management via CLI, HTTP and SNMP.
- Remote Firmware Updates.
- Client Monitor and Wireless Neighbor List.
- Event Logging and Statistics.
- Layer-2 NAT Monitor.
- Signal Strength History.

Security

- Support for security/encryption standards including: WPA-PSK, WPA2-PSK, WEP, TKIP, AES.
- MAC Address Access Control Lists .
- Supports all L2 and L3 VPNs.

www.strixsystems.com

INDUSTRYS HIGHEST PERFORMANCE MOBILE WIRELESS MESH EXTENSION

Strix Systems Access/One® Mobile Wireless System (MWS) 100, powered by Strix Access/One Edge™, is the industry's highest performance mobile extension for in-vehicle wired or wireless client connectivity to public safety, railway, municipal, strategic or tactical Strix wireless broadband mesh networks. The MWS 100 is small, sleek, durable and portable, designed for any vehicle type, enabling the longest reach and instant mesh hand-off compared to any other mobile wireless devices. Delivering seamless mobility for public safety, emergency medical, fire, industrial, mobile enterprise and many other applications, the MWS offers superior multi-megabit, multi-RF, multi-channel capabilities unique in the industry. Strix adds the latest in Strix Access/One Edge technology into this compact unit with Quality of Service (QoS) for voice, video and data provided by the Strix mesh network and industry-standard security algorithms for secured client connectivity. The MWS 100 offers a four-fold increase in power, penetration and performance for a robust network experience enabling the highest speed connection for wired or wireless laptops, PDA's and other approved 4.9 GHz devices. Utilizing dual-diversity antenna technology, intelligent radio algorithms and intelligent Access/One Edge capabilities, the MWS maximizes signal strength and performance, detecting alternate nodes as it traverses the larger wireless mesh network, optimizing channel selections and instantaneously establishing best network path criteria. As mobile network paths are selected, mesh links are secured while the mobile mesh node continues the process of optimal path determination. All Strix Access/One devices enable interference mitigation, provide network resiliency, and offer built-in troubleshooting tools and remote upgradeability to support the most demanding environments.

Strix Systems, Inc.
2350 Mission College Blvd.,
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1-877-STRIXSYS (787-4979) Toll Free
Web Site: www.strixsystems.com

Strix Networks Without Wires SYSTEMS

Technical Specifications

Wireless

- Wireless Standards: IEEE 802.11a/b/g
- Frequency Bands:

  802.11a/4.9 GHz radio is DSRC-C mask compliant

  802.11g 2.4 - 2.497 GHz

  (Availability of specific bands is dependent on region model number)
- Data Rates (Mbps):

  6, 9, 12, 18, 24, 36, 48, 54
- Transmit Power:

  802.11a: 26 dBm

  4.9 GHz: 30 dBm

  802.11b/g: 26 dBm
- Receiver Sensitivity:

802.11g:	802.11a/4.9:
-98 dBm @ 1 Mbps	-93 dBm @ 6 Mbps
-94 dBm @ 5.5 Mbps	-90 dBm @ 12 Mbps
-91 dBm @ 11 Mbps	-84 dBm @ 24 Mbps
-93 dBm @ 6 Mbps	-81 dBm @ 36 Mbps
-91 dBm @ 12 Mbps	-76 dBm @ 48 Mbps
-85 dBm @ 24 Mbps	-74 dBm @ 54 Mbps
-82 dBm @ 36 Mbps	
-77 dBm @ 48 Mbps	
-75 dBm @ 54 Mbps	

- LO (crystal) Frequency Stability:

  +/-20PPM

Ethernet LAN

- 10/100Base-T (auto-sensing)

LAN Indicators

- Power and Signal

Electrical

- External Power Supply Input:

  12 - 48 VDC +/- 10%
- Vehicle-rated surge suppression

  10.8 VDC cutoff
- Ethernet with PoE
- 10W max power consumption

Physical

- Dimension: 9.5"(24cm)L x 6"(16cm)W x 2" (5cm)H
- Weight: 1.5 Lb (0.6 g)
- Temperature: -40°F (-40°C) to 131°F (+55°C)
- Humidity: 95% Non-condensing

Operating Modes

- 802.11a/4.9 STA, 802.11b/g AP
- Cross-subnet mobility
- VLAN mapping for client traffic
- L2 NAT / Client bridge between radios and Ethernet port

Security

- Wi-Fi Protected Access (WPA-PSK)
- Wi-Fi Protected Access 2 (WPA2-PSK)
- Wireless Equivalency Protocol (WEP)
- Temporal Key Integrity Protocol (TKIP)
- Advanced Encryption Standard (AES)
- MAC Address Access Control Lists

Remote Management

- CLI, HTTP, SNMP
- Local management over Ethernet
- Remote management over network management VLAN
- Remote firmware upgrade

Troubleshooting

- Client monitor, wireless neighbor list
- Event logging and statistics
- L2 NAT monitor
- Signal strength history

Warranty

- One year warranty on parts

Ordering Information

MWS100-NA
Configured for operation in North America

MWS100-EU
Configured for operation in E.U. countries

MWS100-RW
Configured for operation in R.W. countries

EWS 150 SERIES

THE INDUSTRY'S HIGHEST POWER MESH EXTENSION

Strix Systems Access/One® Network Edge Wireless System (EWS) 150, powered by Strix DMA™, is the industry's highest powered mesh network extension for the longest reach of any indoor wireless mesh network CPE. A perfect fit for carriers, municipalities, public safety agencies and enterprises, the compact EWS 150 builds on Strix customer successes. Multi-megabit, multi-RF, multi-channel mesh extension is unique in the industry supporting a broad range of voice, video and data applications delivering the highest performance and seemless mobility. Strix adds the latest in Strix DMA™ technology into this compact unit with Quality of Service (QoS) provided by Strix mesh network and Wi-Fi Protected Access (WPA/WPA2) for secured client connectivity. While wireless-enabled laptops and other wireless devices don't provide adequate power to communicate with outdoor mesh networks, the EWS 150 offers a four-to-forty-fold increase in power, penetration and performance for the most excellent network experience. By improving signal strength, the mesh network is quickly detected, optimal channels selected and the client connection secured. All Strix Access/One are self configuring, enable interference mitigation, provide network resiliency, and offer built-in troubleshooting tools and remote upgradeability for the most demanding environments. The EWS 150 is available for world-wide deployment and is the best choice when you demand the highest performance.

Features

Wireless

- The industry's highest-power, lowest cost mesh extension.
- Optimal throughput for Voice, Video And Data.
- Defined Quality Of Service (QoS)
- Low latency and high throughput across multiple wireless hops.
- Dynamic channel assignment, automatic power control and data rate selection for greatest RF spectrum efficiency.
- Dual Diversity to achieve highest performance and greatest WiFi resilience.

System

- Plug-n-play simplicity, auto-discover and self-configuration.
- Seamless interoperability with the Strix Access/One® Indoor Wireless System (IWS) and Outdoor Wireless System (OWS).
- Takes advantage of mesh Full-Duplex capabilities.
- VLANS over a single SSID and Ethernet
- Self-tuning and self-healing mesh for network optimization.
- 802.11b/g with Long-range connectivity to 54Mbps.

Management

- Remote management via CLI, HTTP and SNMP
- Management of VLANS and Bandwidth Controls
- Remote firmware updates to Strix Access/One Edge Wireless capabilities.
- Client Monitor and wireless neighbor list
- Event Logging and Statistics
- Layer-2 NAT Monitor
- Signal Strength History

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Strix SYSTEMS

Technical Specifications

Wireless

- Wireless Standards: IEEE 802.11b/g
- Frequency Bands:

  802.11g
  - 2.4 - 2.497 GHz
  (Availability of specific bands is dependent on region model number)
- Data Rates (Mbps):
  - 6, 9, 12, 18, 24, 36, 48, 54 (802.11b/g)
- Transmit Power:

  802.11b/g: 26 dBm
- Receiver Sensitivity:

  802.11g
  6 Mbps @ -91 dBm
  54 Mbps @ -72 dBm
  802.11b
  1 Mbps @ -93 dBm
  11 Mbps @ -85 dBm
- LO (crystal) Frequency Stability:

  +/-20PPM

Ethernet LAN

- 10/100Base-T (auto-sensing)

LAN Indicators

- Power and Signal

Electrical

- External Power Supply Input:

  EWS150G-NA
  100/120 VAC, 47 - 63 Hz

  EWS150G-RW
  100/240 VAC, 47 - 63 Hz

  EWS150G-EU
  100/240 VAC, 47 - 63 Hz
- External Power Supply Output:

  12 VDC, 1 Amp

Physical

- Dimension: 158.75mm x 127mm x 50.8mm(LxWxH)
- Weight: 700g
- Temperature: 0°C to 40°C(Operating), -20°C to 70°C(storing)
- Humidity: 95% Non-condensing

Operating Modes

- 802.11b/g STA
- L2 Network Address Translation (NAT)

Security

- Wired Equivalent Privacy (WEP)
- Unique per-user key
- MAC address filtering (ACL)

Remote Management

- CLI, HTTP, SNMP
- Local management over Ethernet
- Remote management over network management VLAN
- Remote firmware upgrade

Troubleshooting

- Client monitor, wireless neighbor list
- Event logging and statistics
- L2 NAT monitor
- Signal strength history

Warranty

- One year warranty on parts

Note

Same universal power supply for all models.

Ordering Information

EWS150G-NA
Configured for operation in North America

EWS150G-RW
Configured for operation in R.W. countries

EWS150G-EU
Configured for operation in E.U. countries

ANEXO 7 Hojas de Especificaciones Netkrom

ISPAIR Multi-band Base Station 500 Series

Four radios and multiple operation modes and frequencies in one !

ISPAIR Multi-band Base Station 500 series is an Outdoor Radio Access Point with four High Power wireless ports at 2.3-2.5/4.9/5GHz, 802.11a/b/g standard-compliant, future WiMAX and 802.11n, ISPAIR Multi-band Base Station 500 series is the ideal solution for Wireless ISP, large Mesh networks, long range HotSpot, Public Safety Networks and Multipoint applications needing high-performance outdoor Wi-Fi and WiMAX equipments in a fast-growing market and at low cost.

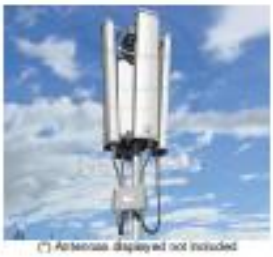
ISPAIR Multi-band Base Station 500 series can have four 90 deg sector panel antenna or three 120 deg sector panel antenna and one backhaul link, the ISPAIR Multi-band Base Station 500 series delivers Internet and VoIP service to your laptop, Wi-Fi phone or network clients - LAN at large distances, you can use this Base Station to provide NLoS - Non Line of Sight and LoS - Line of Sight applications, high data rates and superior throughput for data intensive that allow multiple sites to share a single, high-speed connection to the Internet or VoIP telephony networks. The most feature-rich firmware and OS software allow you to apply most advanced RF and networks functions as advanced IP Routing, QoS - quality of service, Firewall, DHCP Server, NAT, Bandwidth Shaping, HotSpot and other technologies to create a smart and easy controllable network.

ISPAIR Multi-band Base Station 500 series can work as an access point, WDS, Client and repeater, or as a combination of these. Each radio has separately adjustable power output, with its own frequency and channel, SSID and encryption settings, that allow you to cover long distances in Multipoint applications up to 20 miles or 32 Km. All of these characteristics transform this Base Station into the most powerful, complete and advanced of the world.

With prominent 216Mbps of capacity (54 Mbps each radio) data transfer rate in regular mode or 432Mbps (108Mb Mbps each radio) data transfer rate on turbo mode and up to 1 Watt output power, you can forget about the word "interference". The ISPAIR Multi-band Base Station 500 series is the next generation of wireless equipments. **Step together in the future with us!.**

Features:

- Intel XScale technology CPU power for high-speed connection.
- Four Radios and Multiple Frequency in one (Choose the Frequency You Need!).
- Work as Access Point, WDS, Client and Repeater in Bridge or Router mode.
- Ultra High power RF Ports up to 1 Watt, for long distance.
- Long Distance parameters and Output power regulation (selected by software).
- Perfect design and characteristics for Industrial outdoor use (waterproof).
- Complete compatibility with any IEEE network and future Wimax
- Advanced Network functions (IP Routing, Hotspot, Firewall, DHCP, NAT, etc)
- Bandwidth Management and QoS
- Free Netkrom NMS - Network Management System
- Carrier Class Radio for extreme environment -60 to 230C



(*) Antennas displayed not included

Applications:

Specifications :

HARDWARE

Processor	Intel® IXP425 XScale® 533 MHz
Memory Flash	16 MB
Console Port	One Serial DB9 standard
RF Port	Four RF Mini-PCI modules
Power Connections	802.3af Power over Ethernet 9-48v DC
Weight	4.5 Lb. or 2 Kg. (Radio, Bracket and accessories)
Mount	Pole or tower mounting brackets

Memory	64 MB
Ethernet Port	Two Ethernet 10/100 Mbps
Console Port	One Serial DB9 standard
RF Connector	Four N-Female type
Enclosure	Industrial Die-Cast Thermal Aluminum, NEMA-6 / IP-67
Dimensions	8.3 x 6 x 2 in (21 x15 x 5cm.)
Operating Temperature	Enclosure Seal -60C to 230C

SOFTWARE

RF Operational Modes

Access Point (bridge or router function)
WDS (bridge function)
Repeater (bridge function)
AP Client (bridge or router function)
Station (bridge or router function)

Security Features

Access Control List
WEP 64/128
WPA1/WPA2 with TKIP & AES ciphers

Advanced Wireless Features

Tx Power and Tx Rate
Antenna Selection
ACK Timeout
WMM - Wireless QoS
Mac Address Spoofing
Hide SSID and Stealth Mode
Best Channel Selection and Country Code Selection
DFS/TPC (Dynamic Frequency Selection / Transmit Power Control)
Compression, Bursting, Fast Frames
802.11h Full Support
Antenna Alignment (Site Survey / Link Quality / Signal Level)

QoS - Bandwidth Management

Committed Information Rate (CIR)
Peak Information Rate (PIR)
Committed Burst Size (CBS)
Excess Burst Size (EBS)
Based in :
- Input/Output Interface
- Source IP/Subnet
- Source Port(s)
- Source Mac
- Destination IP/Subnet
- Destination Port(s)
- Destination Mac
- Protocol (FTP, ICMP, TCP, etc)
- Application (Peer to Peer, EDonkey, Kazza, IRC, etc)

Network Advanced Features

Transparent Bridging
Layer 2 (Mac Address) Forwarding
Layer 3 (IP Address) Forwarding
Static Routing
RIP v2
DHCP Server and Client
PPPoE Client/PPTP Client
Vlan (802.1Q) Support
Advance Statistics
Graphical User Interface
Monitor Utils (Ping and Trace Route)

Hot Spot Features

WAN, LAN, DHCP, Firewall - NAT
QoS - Bandwidth Management
Wireless Radius Client
UAM Authentication, Mac Address Authentication
Walled Garden
Advertisement Sites
Log in Page Customization
Users Info, Radius Statistics

Firewall - NAT

Input/Output Interface
Source IP/Subnet
Port(s)
Source Mac
Destination IP/Subnet
Protocol (ICMP, TCP, etc)
Connection State(New, Established, etc)

Administration Tools

SNMP Agent
NTP Agent
HTTP Server
SSH

RF MODULES

Model	ISP-BS500GH	ISP-BS500AGUHP	ISP-BS500AH
Frequencies	2400-2497MHz (*) 2300 ~ 2500 MHz (*) (*) programmable for different country regulations)	**2.4GHz Band:** 2400-2497MHz (*) 2300 ~ 2500 MHz (*) **4.9GHz Band:** 4940~4990MHz (public Safety Band) **5GHz Band:** 5150-5850MHz (*) (*) programmable for different country regulations)	**4.9GHz Band:** 4940~4990MHz (public Safety Band) **5GHz Band:** 5150-5850MHz (*) (*) programmable for different country regulations)
Standard Compliance	IEEE 802.11b/g	IEEE 802.11a/b/g and Public Safety Band	IEEE 802.11a and Public Safety Band
Access Method	TDD (CSMA/CA)		
Channel Bandwidth	5, 10, 20 or 40 MHz (Selected by Software)		
Modulation technique	DSSS (DBPSK, DQPSK, CCK) OFDM (BPSK,QPSK, 16-QAM, 64-QAM)	**2.4GHz band:** DSSS (DBPSK, DQPSK, CCK) OFDM (BPSK,QPSK, 16-QAM, 64-QAM) **4.9GHz Band:** OFDM (BPSK,QPSK, 16-QAM, 64-QAM) **5GHz Band:** OFDM (BPSK,QPSK, 16-QAM, 64-QAM)	OFDM (BPSK,QPSK, 16-QAM, 64-QAM)
Output Power	30dBm@6-24Mbps 26dBm@54Mbps	**2.4GHz Band:** 30dBm@6-24Mbps 26dBm@54Mbps **4.9/5GHz Band:** 26dBm@6-24Mbps 22dBm@54Mbps	26dBm@6-24Mbps 26dBm@36Mbps 24dBm@54Mbps
Receiving Sensitivity	-97dBm@1Mbps -94dBm@6Mbps -74dBm@54Mbps	**2.4GHz Band:** -95dBm@1Mbps -92dBm@6Mbps -74dBm@54Mbps **4.9/5GHz Band:** -92dBm@6Mbps -74dBm@54Mbps	-94dBm@6Mbps -86dBm@24Mbps -74dBm@54Mbps
EMC Certificate	FCC Part 15/UL ETSI 300/328/CE		

Ordering Information:

- **ISP-BS500GH** — ISPAIR Tri-Band 2.3-2.5 802.11b/g Sectoral Base Station Ultra High Power AP with 4-RF Port Radio 1Watt and PoE
- **ISP-BS500AGUHP** — ISPAIR Tri-Band 2.3-2.5/4.9/5GHz 802.11a/b/g Sectoral Base Station Ultra High Power AP with 4-RF Port Radio 1 Watt@2.4GHz / 400mw@5Ghz and PoE
- **ISP-BS500AH** — ISPAIR 4.9 to 6.1Ghz 802.11a Sectoral Base Station Ultra High Power AP with 4-RF Port Radio 600mW and PoE

WE PROTECT YOUR INVESTMENT: 802.11n and WIMAX upgreadable

As a company focused exclusively on Wireless data transmission, NETKROM is committed to long-term product planning, backwards compatibility and the integration of new technologies that will allow it to support traditional enterprise markets. The NETKROM Base Station is upgradable to WIMAX and recently approved 300/600Mbps 802.11n standard.

Netkrom

MULTIBAND

Backhaul/AP Dual Radio

Two Radios, multipe standard and frequencies in one!

RoHS Compliant

Covers frequency range:

Output Power:

The Multi-band Backhaul/AP Dual Radio now covers from 180MHz up to 6.1GHz, including the popular unlicensed bands (2.4/5GHz 802.11a/b/g/n Standard). With prominent 54/108 Mbps data transfer rate (up to 70 Mbps real throughput), Ultra Wideband coverage and up to 1 Watt output power, you can forget about the word "interference". The Multi-band Backhaul/AP Dual Radio is the next generation of wireless radio equipments.

Step together in the future with us!.

The Multi-band Backhaul/AP Dual Radio comes with 2 Radio Slots to select between several Mini PCI modules the frequency you need, high output power and firmware with advanced software characteristics based on Linux OS allowing to cover long distances up to 200 miles or 320 Km. All of these characteristics transform this radio into the most complete and advanced of the world.

HIGH PPS PERFORMANCE:

- **Packet Aggregation.** Allows for many small, inefficient packets to be sent in a single, larger radio packet
- **Powerful CPU.** In many PTP systems a slow CPU is the limiting factor in PPS performance

High PPS, required for voice and video applications

HIGH THROUGHPUT OVER DISTANCE:

Features:

- Multiple unlicensed and licensed bands from 180MHz to 6.1GHz (Choose the Frequency You Need!)
- Data transfer rate up to 108 Mbps
- Work as Base Station, HotSpot AP, Mesh AP, Wireless Client, Backhaul and Repeater
- High power modules up to 1 Watt for long distance links up to 200 miles or 320 Km.
- Long distance parameters and output power regulation
- High CPU power for high-speed connection
- Perfect design and characteristics for industrial outdoor use (waterproof)
- Mitigation Algorithm to avoid RF interference.
- Bandwidth Management (upload and download)
- Complete compatibility with any IEEE network and WiMAX
- Advanced network functions (IP Routing, Firewall, DHCP, NAT, Bandwidth Management, QoS, etc)
- Advanced security features WEP (64, 128 bit), WPA 1& WPA2 and AES
- Free Netkrom NMS - Network Management System
- Carrier class radio for extreme environment -40 to 230C
- Robust and Efficient MAC Layer
- High packets per Second Performance
- High TX Power and RX Sensitivity
- Data and signal correction via FEC
- System Gain: > 150dB

Different band and purpose applications

Frequency	Purpose	Compliance	Technology
160-280MHz	Metering/Telemetry NLOS	VHF Band	OFDM; 802.11 Based
760-780MHz	Broadband Wireless NLOS	Public Safety Band	OFDM; 802.11 Based
907-922MHz	Broadband Wireless NLOS	FCC ISM Band	OFDM; 802.11 Based
2.3-2.4GHz	Broadband Wireless	Wimax Licensed Band	OFDM; 802.11 Based
2.4-2.5GHz	WLAN/Broadband Wireless	FCC/ETSI ISM Band	OFDM/802.11b/g/n Based
2.5-2.7GHz	Broadband Wireless	Wimax Licensed Band	OFDM; 802.11 Based
2.7-2.9GHz	Broadband Wireless	Wimax Licensed Band	OFDM; 802.11 Based
3.4-3.7GHz	Broadband Wireless	Wimax Licensed Band	OFDM; 802.11 Based
3.65-3.7GHz	Broadband Wireless	FCC Part90Y Unlicensed Band	OFDM; 802.11 Based
4.475-4.725GHz	Military and Government	Licensed Band	OFDM; 802.11 Based
4.94-4.99GHz	Public Safety	Public Safety Band	OFDM; 802.11 Based
5.25-5.825GHz	WLAN/Broadband Wireless	FCC/ETSI ISM Band	OFDM/802.11 a/n Based
4.9-6.1GHz	Microwave Link	Licensed/Unlicensed Band	OFDM; 802.11 Based


Netkrom
Applications
1 Telco/Carrier/WISP Backhaul
2 Video Surveillance
3 Interbuilding
4 Long Range Coverage Hotspot
5 Long Range/WISP/Broadband Wireless
1 Telco/Carrier/WISP Backhaul
BTS
Backhaul
(IP/E1/T1)
BSC Site
BTS
Public Events
Transit
Monitoring
2 Video
Surveillance
Public Safety
3 Interbuilding
WI FI
ZONE
4 Long Range
Coverage Hotspot
Shopping Center
Hotels, Airport, etc.
Factory
Standard
Subscribers
Ultra Long range
Subscribers
Rural School
Rural Residents
Standard Coverage
Extended Coverage
5 Long Range/WISP/
Broadband Wireless

Specifications

HARDWARE

Processor:	Intel IXP425 533 MHz	433 MHz Geode
Memory Flash:	16 MB	1 GB
Memory:	64 MB	128 MB
Ethernet Port:	Two Ethernet 10/100 Mbps	One Ethernet 10/100 Mbps
RF Port Slot:	Two RF Mini-PCI Modules	
RF Connector Type:	Two N-Female	
Console Port:	One Serial DB9 standard	
Power Connections:	802.3af Power over Ethernet 48v DC with surge protector	Passive Power over Ethernet 18 vDC with surge protector
Operating Temperature:	Enclosure Seal -60C to 230C	
Enclosure:	Industrial Die-Cast Thermal Aluminum, NEMA-6/IP-67	
Dimensions:	8.3 x6 x 2 in (21 x15 x5 cm.)	
Weight:	4.5 lb. or 2 Kg. (Radio, Bracket and accessories)	
Mount:	Pole or tower mounting brackets	

SOFTWARE

RF Operational Modes:
Access Point (bridge or router function)
WDS (bridge function)
Repeater (bridge function)
AP Client (bridge or router function)
Station (bridge or router function)
RF (1 +1)

Advance Wireless Features:
Tx Power and Tx Rate
Antenna selection
ACK Timeout
WMM-Wireless QoS
Mac Address Spoofing
Hide SSID and Stealth Mode
Best Channel Selection and Country Code Selection
DFS/TPC (Dinamyc Frequency Selection/Transmit Power Control)
Compression, Bursting, Fast Frames
802.11h Full support
Antenna Alignment (Site Survey, Link Quality Signal Level)
Interference lower than 3dBm

Network Advance Features:
Transparent Bridging
Layer 2 (MAC Address) Forwarding
Layer 3 (IP Address) Forwarding
Static Routing
Dynamic Routing RIP v1/v2
DHCP Server and Client
PPPoE Client/PPTP Client
Vlan (802.1Q) Support
Advance Statistics
Graphical User Interface
Monitor Utils (Ping and Trace Route)

Security Features:
Access Control List
WEP 64/128/256
WPA1/WPA2 with TKIP & AES ciphers, IEPS-197

Firewall NAT:
Input/Output interface
Source IP/Subnet
Port(s)
Source Mac
Destination IP/Subnet
Protocol (ICMP, TCP, etc)
Connection State (New, Established, etc)

QoS- Bandwidth Management:
Committed Information Rate (CIR)
Peak Information Rate (PIR)
Committed Burst Size (CBS)
Excess Burst Size (EBS)
Based in: -Input/Output Interface
-Source IP/Subnet
-Source Port(s)
-Source Mac
-Destination IP/Subnet
-Destination Port(s)
-Destination Mac
-Protocol (FTP, ICMP, TCP, etc)
-Application (Peer to Peer, E Donkey, Kazza, IRC, etc)

Hot Spot Features:
WAN, LAN, DHCP, Firewall - NAT
QoS - Banwidth Management
Wireless Radius Client
UAM Authentication, Mac Address Authentication
Walled Garden
Advertisement Sites
Login Page Customization
Users Info, Radius Statistics

Administration Tools:
SNMP Agent
NTP Agent
HTTP Server
SSH

WE PROTECT YOUR INVESTMENT: WIMAX and 801.11n Support

As a company focused exclusively on Wireless data transmission, Netkrom is committed to long-term product planning, backwards compatibility and the integration of new technologies that will allow it to support traditional enterprise markets. The Netkrom WiMAX/Mesh/Wi-Fi Multi-band Series support now WiMax and is upgradeable to recently approved 300/600 Mbps 802.11n standard..

RF MODULES (Unlicensed Band)

Model	MB-900HP+	MB-M5AGUHP	MB-M5GHP	MB-M5GUHP	MB-M5AHP	MB-M5AUHP
Frequencies	900 - 928MHz	2400-2497MHz (*) 5150-5850MHz (*) (*) programmable for different country regulations)	2400-2497MHz (*) Extended Band: 2312-2500MHz (*) programmable for different country regulations)		5150-5850MHz (*) Extended Band: 4920-6100MHz (*) programmable for different country regulations)	
Standard Compliance	OFDM 802.11 Based	IEEE 802.11a/b/g	IEEE 802.11b/g		IEEE 802.11a	
Access Method	Time Division Duplex (TDD) with CSMA/CA					
Channel Bandwidth	5, 10, or 20 MHz (Selected by Software)	5, 10, 20 or 40 MHz (Selected bySoftware)				
Modulation technique	DSSS/OFDM (BPSK, QPSK, 16-QAM, 64-QAM)				OFDM (BPSK, QPSK, 16-QAM, 64-QAM)	
Output Power	28dBm@1-24Mbps 26dBm@36Mbps 24dBm@54Mbps	**2.4GHz Band:** 30dBm@1-24Mbps 26dBm@54Mbps **5GHz Band:** 26dBm@6-24Mbps 22dBm@54Mbps	26dBm@1-24Mbps 24dBm@36Mbps 24dBm@54Mbps	30dBm@1-24Mbps 28dBm@36Mbps 25dBm@54Mbps	26dBm@6-24Mbps 24dBm@36Mbps 20dBm@54Mbps	28dBm@6-24Mbps 26dBm@36Mbps 23dBm@54Mbps
Receiving Sensitivity	-92dBm@1Mbps -86dBm@24Mbps -72dBm@54Mbps	**2.4GHz Band:** -92dBm@1Mbps -74dBm@54Mbps **5GHz Band:** -93dBm@6Mbps -74dBm@54Mbps	-93dBm@1-6Mbps -72dBm@54Mbps	-96dBm@1-6Mbps -72dBm@54Mbps	-93dBm@6Mbps -72dBm@54Mbps	-94dBm@6Mbps -88dBm@24Mbps -74dBm@54Mbps
EMC Certificate	FCC Part 15/UL and ETSI 300/328/CE					

RF MODULES (Licensed Band)

Model	MB-M180HP	MB-M700HP	MB-M2SHP	MB-M27HP	MB-M35HP	MB-M37HP	MB-M44HP	MB-MW35HP
Frequencies	180-188MHz	760-780MHz	2.5-2.7GHz	2.7-2.9GHz	3400-3700MHz	3650-3700MHz	4.475-4.725GHz	3400-3600MHz
Standard Compliance	OFDM 802.11 Based							WiMAX 802.16-2004
Access Method	Time Division Duplex (TDD) with CSMA/CA							TDD & HFDD
Channel Bandwidth	5, 10, 20 or 40 MHz (Selected by Software)							3.5MHz or 7MHz
Modulation technique	DSSS/OFDM (BPSK,QPSK, 16-QAM, 64-QAM)							OFDM (BPSK,QPSK, 16-QAM, 64-QAM)
Output Power	28dBm@ 6-24Mbps 26dBm@ 36Mbps 23dBm@ 54Mbps	28dBm@1-24Mbps 26dBm@36Mbps 24dBm@54Mbps	25dBm@6-24Mbps 21dBm@36Mbps 18dBm@54Mbps	25dBm@6-24Mbps 21dBm@36Mbps 18dBm@54Mbps	25dBm@6-24Mbps 21dBm@36Mbps 18dBm@54Mbps	25dBm@6-24Mbps 21dBm@36Mbps 18dBm@54Mbps	24dBm@6-24Mbps 22dBm@36Mbps 18dBm@54Mbps	23dBm
Receiving Sensitivity	-92dBm@6Mbps -86dBm@24Mbps -73dBm@54Mbps	-92dBm@1Mbps -86dBm@24Mbps -73dBm@54Mbps	-92dBm@6Mbps -86dBm@24Mbps -73dBm@54Mbps	-92dBm@6Mbps -86dBm@24Mbps -73dBm@54Mbps	-92dBm@6Mbps -86dBm@36Mbps -73dBm@54Mbps	-92dBm@6Mbps -86dBm@24Mbps -73dBm@54Mbps	-92dBm@6Mbps -86dBm@24Mbps -73dBm@54Mbps	-92dBm@BPSK -86dBm@16-QAM -78dBm@64-QAM
EMC Certificate	FCC Part 15/UL and ETSI 300/328/CE							

Ordering Information:

- ***MB-ROMB V3*** Multi-band Backhaul/AP Dual Radio - 2 port radio slot AP/Bridge/Router with PoE
- ***MB-ROMB V4*** Multi-band Backhaul/AP Dual Radio - 2 port radio slot AP/Bridge/Router with PoE
- ***MB-M180HP*** 180-188MHz (NON LINE OF SIGHT) 54Mb Mini-PCI Module High power 600mW
- ***MB-M700HP*** 760-780MHz (NEAR LINE OF SIGHT) 54Mb Mini-PCI Module High power 600mW
- ***MB-M900HP+*** 900 MHz ISM Band (NEAR LINE OF SIGHT) 54Mb Mini-PCI Module High power 600mW
- ***MB-M5GHP*** 2.4GHz 802.11b/g Compatible 108Mb Mini-PCI Module High Power 400mW
- ***MB-M5GUHP*** 2.4GHz 802.11b/g Compatible 108Mb Mini-PCI Module Ultra High Power 1 Watt
- ***MB-M5AGUHP*** 2.4/5 GHz 802.11a/b/g 108 Mb Mini-PCI Module Ultra High Power 1Watt@2.4GHz/400mW@5 GHz
- ***MB-M25HP*** 2.5-2.7GHz 54Mb WiMAX Licensed Band Mini-PCI Module High power 300mW
- ***MB-M27HP*** 2.7-2.9GHz 54Mb Mini-PCI Module High power 300mW
- ***MB-M35HP*** 3.4 to 3.7 GHz 54Mb WiMAX Licensed Band Mini-PCI Module High power 300mW
- ***MB-M37HP*** 3.650 to 3.7GHz (New FCC Part 90Y Unlicensed Wireless Band) 54 Mb Mini-PCI Module High power 300mW
- ***MB-MW35HP*** 3.4 to 3.6 GHz WiMAX 802.16-2004 TDD (Licensed Band) 75 Mb Mini-PCI Module
- ***MB-M44HP*** 4.475-4.725GHz Mini-PCI Module High power 250mW
- ***MB-M5AHP*** 5GHz 802.11a 108 Mb Mini-PCI Module High Power 400mW
- ***MB-M5AUHP*** 5GHz 802.11a 108 Mb Mini-PCI Module Ultra High Power 600mW

ANEXO 8 Hojas de Especificaciones SkyPilot

SkyPilot by Trilliant

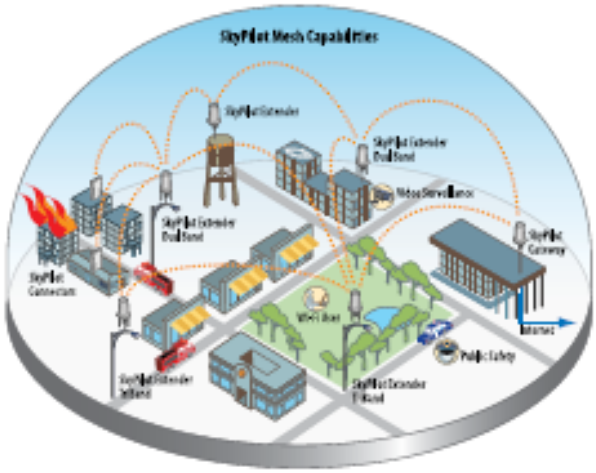
SkyPilot Gateway

Foundation of the SkyPilot Mesh Network

SkyPilot® Gateway products are carrier-class network base stations that serve as network takeout points and root nodes of the SkyPilot network, a low-latency, high-bandwidth radio system operating in the 5 GHz band as a self-forming, self-balancing, and self-healing wireless mesh network. Each SkyPilot Gateway controls a subnetwork of associated SkyPilot Extenders and Connectors to provide coverage and capacity as needed. By deploying additional SkyPilot Gateways, a service provider can "inject" capacity into the network, extend network coverage, and enhance network reliability. Unlike a conventional point-to-multipoint base station, the SkyPilot Gateway is the foundation of a true mesh topology that delivers multi-hop versatility, dynamic re-routing in the event of node failure, and outstanding scalability.

Each SkyPilot Gateway uses a dynamically switched high-gain antenna array of eight separate 45° beams to provide omni-directional coverage and a range between mesh nodes of up to 10 miles (16 km). The intelligent, self-forming SkyPilot mesh technology manages traffic across the mesh network to mitigate interference, maximize available bandwidth, and support the prioritization of voice and data for improved Quality of Service performance. The SkyPilot mesh architecture improves network reliability and link integrity by creating a self-healing infrastructure with a best-path, vector-based routing algorithm. Automatic link discovery and dynamic adjustment of modulation and Forward Error Correction (FEC) parameters further optimize the quality of the network's links. All of these system enhancements enable throughput rates of up to 20 Mbps (UDP) and 12 Mbps (TCP) with a two-way latency of < 10 ms per hop on the SkyPilot network.

SkyPilot Gateways are also available in DualBand and TriBand models. These models provide integrated access points that allow for simultaneous wireless client access without interrupting backhaul communications by seamlessly managing traffic throughout the SkyPilot wireless mesh network. The access points operate using either the 2.4 GHz band for public Wi-Fi connectivity or using the licensed 4.9 GHz band for municipal public safety communications or using both bands (the TriBand model) for dual application support.



Each SkyPilot Gateway acts as a capacity injector and network takeout point to define a mesh subnetwork as part of the overall SkyPilot network deployment

Carrier-Class Network Base Station
- Network take-out point
- Highly scalable capacity

Layer 2 Ethernet Transport

Optional Access Point Radios
- 2.4 GHz 802.11b/g Wi-Fi (unlicensed)
- 4.9 GHz public safety band 802.11a (licensed)

SkyPilot Network
- Low latency: < 10 ms per hop (round-trip)
- High capacity: throughput of up to 20 Mbps (UDP) and 12 Mbps (TCP)
- Superior communications performance: supports end-to-end QoS on a per-application or per-client basis, allowing differentiated service offerings
- Mesh network topology allows deployment across entire service area, supporting applications such as:
  - Fixed broadband Internet services
  - Public Wi-Fi access
  - Public safety and first responder communications
  - Other public or private communications network initiatives

Traffic Management
- VLAN support with IEEE 802.1Q
- Traffic prioritization using IEEE 802.1p, protocol type, IP port, IP DiffServ/ToS field and/or IP address
- Traffic filtering using protocol type, IP port and/or IP address
- Traffic shaping with upstream and downstream per-user rate control

Configuration, Management & Monitoring
- SkyPilot Element Management System (EMS) using SNMPv2c
- Dynamic or static IP addresses
- Firmware is "over-the-air" upgradeable
- Manual or automated provisioning
- Local management via an RS-232 serial console port
- Remote management of the CLI via Telnet, SNMPv2c or web interface
- Remote logging

SkyPilot Gateway Specifications



Models	SkyPilot Gateway	SkyPilot Gateway DualBand	SkyPilot Gateway TriBand
SkyPilot Mesh Network Frequency Band	4.990 – 6.075 GHz	4.990 – 6.075 GHz	5.250 – 6.075 GHz
Head-end Connectivity	10/100 Mbps Ethernet	10/100 Mbps Ethernet	10/100 Mbps Ethernet
Wireless Local Access	None	802.11b/g (2.4 GHz) or 802.11a (4.9 GHz)	802.11b/g (2.4 GHz) and 802.11a (4.9 GHz)

5 GHz Mesh Specifications

Frequency Band	4.940 to 6.075 GHz, including: - US: 4.940 - 4.990 GHz public safety - US: 5.250 – 5.350 GHz U-NII mid - US: 5.470 – 5.725 GHz U-NII worldwide - US: 5.725 – 5.850 GHz U-NII upper - World: 5.850 – 6.075 GHz extended range
Transmit Power	- 20 dBm (maximum at radio antenna port) - Reduced as needed for regulatory compliance
Antenna	8 integrated antennas, 360° coverage - Gain per antenna: 18 dBi - Beamwidth per antenna: 45° azimuth, 6° elevation
Media Access	Time Division Duplex (TDD)
Modulation	OFDM with adaptive modulation
Data Rates	6 / 9 / 12 /15 / 18 / 24 / 36 /48 / 54 Mbps
Receive Sensitivity (3% FER at antenna port)	- -90.0 dBm @ 6 Mbps - -87.5 dBm @ 9 Mbps - -86.0 dBm @ 12 Mbps - -84.0 dBm @ 18 Mbps - -80.0 dBm @ 24 Mbps - -78.0 dBm @ 36 Mbps - -70.0 dBm @ 48 Mbps - -68.0 dBm @ 54 Mbps
Channel Width	20 MHz
Channel Resolution	5 MHz frequency control
Range	Up to 10 miles / 16 kilometers
Network Security	- AES-128 encryption - Certificate-based authentication

Physical Specifications

Connectivity	- 10/100BaseT port to/from head end and as Power-over-Ethernet (PoE) power input - To/from SkyPilot Extenders and/or Connectors as a root node of the SkyPilot 5 GHz mesh network - RS-232 serial console port for maintenance - Optional access point(s) for 802.11b/g (2.4 GHz) and/or 802.11a (4.9 GHz)
Input Voltage	- 24 VDC proprietary PoE - EPIC connector
Power	- SkyPilot Gateway: maximum 14 Watts - SkyPilot Gateway DualBand: maximum 25 Watts - SkyPilot Gateway TriBand: maximum 31 Watts
Surge Protection	- Requires Trilliant part 620-00095-01 or equivalent - Weatherproof PoE-compatible 10/100Base-T CAT5 lightning protector (EPIC or unterminated)
Dimensions	- Height - without access point antennas: 25" / 63.5 cm - with access point antennas: 37" / 94.0 cm - Base diameter: 12" / 30.5 cm
Weight	15.0 pounds / 6.75 kilograms
Operating Temperature	-40 to +158 °F / -40 to +70 °C
Humidity	5 to 95% non-condensing
Wind Loading	Up to 150 mph / 242 km/h
Installation	Mast, tower, utility pole, streetlight pole arm, or building (optional mounting kits available)
Enclosure	NEMA Type 4X / IP66

Compliance Specifications

Unlicensed Radio Operation	- FCC Part 15 Subpart E (Subpart C for Wi-Fi) - Industry Canada RSS-210 - EN 301-893 (EN 300-328 for Wi-Fi) - Other regulatory domains
Device IDs	5.250-5.350 GHz; 5.470-5.850 GHz - FCC: RKT-SD1005 - IC: 5550A-SD1005 4.940-4.990 GHz - FCC: RKT-SD1007 - IC: na Wi-Fi Access Point: 2.400-2.4835 GHz - FCC: SWX-SR2 - IC: 6545A-SR2 802.11a Access Point: 4.940-4.990 GHz - FCC: SWX-SR4 - IC: na
EMI/EMC	- FCC Part 15 Subpart B (Class A) - Industry Canada ICES-003 (Class A) - EN 301-489
Safety	- UL 60950-1 - CSA C22.2 No. 60950-1 - EN 60950-1
Environmental	RoHS

Optional Wireless Access Point Specifications

Access Point	2.4 GHz	4.9 GHz
Frequency Band	2.400-2.483 GHz	4.940-4.990 GHz
Transmit Power	- 28 dBm (maximum at antenna port) - Reduced as needed for regulatory compliance	- 28 dBm (maximum at antenna port) - Reduced as needed for regulatory compliance
Antennas	7.4 dBi omni	9.5 dBi omni
Protocol	IEEE 802.11b/g	IEEE 802.11a
Modulation	- 802.11b: DSSS - 802.11g: OFDM	802.11a: OFDM
Channel Width	20 MHz	5, 10, or 20 MHz
Receive Sensitivity (3% FER at antenna port)	- 802.11b: -97 dBm @ 1 Mbps; -93 dBm @ 11 Mbps - 802.11g: -94 dBm @ 6 Mbps; -74 dBm @ 54 Mbps	802.11a: -94 dBm @ 6 Mbps; -74 dBm @ 54 Mbps
Security	WPA, WPA2, multiple SSIDs, MAC address Access Control List, MAC address filter, 802.1x EAP-TLS, EAP-TTLS, RADIUS support	

Trilliant

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ANEXO 9 Hojas de Especificaciones Open-Mesh

Enterprise Dual-Band Mesh Router: MR500

Enterprise 802.11n: For complete coverage

The MR500 is an enterprise wireless mesh router ideally suited for providing fast internet coverage (both wireless and wired via its 5-port switch) in offices, hotel lobbies, conference rooms and schools. Its zero-config mesh means hard-to-reach dead zones are a thing of the past.

Each router is an access point, mesh gateway and repeater all in one reliable package.
It is also two networks in one with both open and secure (WPA2 and WPA-Enterprise) encrypted & VLAN tagged SSIDs so you can provide customer or guest access without sharing access to your internal LAN.

KEY FEATURES:

- Zero Config / Plug & Play
- Self Forming / Self Healing Mesh
- Hardware Watchdog
- Free Cloud Controller
- Control & Monitor Usage
- Dual SSIDs for Public & Private Use
- Dual 300mbps radios 2.4 & 5ghz
- Quad Internal Antennas
- 2x2 MIMO each band
- QoS: Voice, video prioritization
- VLAN tagging (not in beta)
- Security: WPA2 / WPA-Enterprise
- RF Power: 18-21dBm
- Receive Sens: -89 to -92 dBm
- Ethernet: 5 Port 10/100 Switch
- POE: 8-18v non 802.3af
- Power Supply: 12vdc, 110/240v
- LEDs: Power, Internet, Wireless
- Temperature: 0-45° C
- Size: 17cm x 11cm x 2.5cm
- Certifications: FCC / CE / UL / ROHS

OPTIONS:

- Outdoor (Pole & Wall) Enclosure
- Desk Stand (Improves Range)
- 802.3af POE splitter
- EU Power Supply (240v, EU Plug)

For exceptional reliability, the MR500 includes a hardware watchdog processor that will restart the router should it lock up due to environmental or power spikes or short outages. This greatly minimizes truck rolls and customer service calls

Creating a mesh network is now simple & fast:

Just plug at least one MR500 into your LAN or other internet connection. Then place additional MR500s around the area you want to cover. Each will repeat the wireless signal extending the range by up to 150 feet and give virtually everyone "5 bar" coverage. Then monitor and customize your network using our free Cloud Controller in just 3 easy steps:

1. Create your own network site at http://www.cloudtrax.com.
2. Point and click to add your routers to the map. Customize your network's name (SSID), design a splash page users will see when they login, set how much bandwidth users get – even charge for access with our convenient "vouchers" feature.
3. View and manage your network at any time from any place using just a web browser. See total users, their combined and individual usage over 24 hours, every router and its signal quality, speed, ping latency, routes to the nearest gateway and neighbor nodes.

OPEN-MESH

Hospitality & Enterprise Mesh Solutions
www.open-mesh.com

Plug and Play Wireless Mesh Router: OM1P

Ultra Low-Cost Mesh: Wifi Where You Need It

The OM1P is an ultra-low cost professional wireless mesh router ideally suited for providing robust internet coverage just about anywhere you need to share a connection. Examples include hotels, apartments, neighborhoods, coffee shops, shopping malls, campgrounds, and marinas.

Each router is an access point, mesh gateway and repeater all in one tiny reliable package.
It's also two networks in one with both open (public) and secure (WPA) encrypted SSIDs so you can share a connection without sharing your data.

For exceptional reliability, the OM1P includes a hardware watchdog chip that will restart the router should it lock up due to environmental or power spikes or short outages. This greatly minimizes truck rolls and customer service calls.

KEY FEATURES:

- Zero Config / Plug & Play
- Self Forming / Self Healing Mesh
- Hardware Watchdog Chip
- Free Online Hosted Management
- Control & Monitor Usage
- Dual SSIDs for Public & Private Use

SPECIFICATIONS:

- WLAN Standard: 802.11g
- Main Antenna: 2.5dbi RP-SMA
- Diversity Antenna: 2dbi chip
- RF Power: 100mw (20dBm)
- Ethernet: 1 (WAN or LAN)
- POE: 6-18v
- Power Supply: 12vdc, 110vac
- LEDs: Power, Internet, Wireless
- Temperature: 0-50 C
- Dimensions: 3.75" x 2.75" x 1"
- Certifications: FCC / IC / CE

OPTIONS:

- Indoor Wall Plug Enclosure
- Outdoor (pole & wall) Enclosure
- EU Power Supply (240v)

Creating a mesh network is now simple & fast:

Just plug one router into a DSL, cable modem or other internet connection. Then place additional routers around the area you want to cover. Each will repeat the wireless signal extending the range by up to 150 feet and give virtually everyone "5 bar" coverage. Then monitor and customize your network using our free hosted services in just 3 easy steps:

1. Create your own network site at http://www.cloudtrax.com.
2. Point and click to add your routers to the map. Customize your network's name (SSID), design a splash page users will see when they login, set how much bandwidth users get – even charge for access with our convenient "vouchers" feature.
3. View and manage your network at any time from any place using just a web browser. See total users, their combined and individual usage over 24 hours, every router and its signal quality, speed, ping latency, routes to the nearest gateway and neighbor nodes.

OPEN-MESH

Hospitality & Enterprise Mesh Solutions
www.open-mesh.com

ANEXO 10 Hojas de Especificaciones ArrowSpan

MA3100-X
Outdoor
Dual 5GHz/Single 2.4GHz Wireless Mesh Access Point & Point-to-Point Device

Reliable, Intelligent, and High Performance Wireless Mesh

- Patent pending, auto-discovery, auto-configure, and auto-healing POP (Predictable Optimum Path) mesh routing algorithm
- Multiple wireless radios design of backhaul mesh network eliminates co-channel interference and provides zero performance degradation across multiple hop counts
- Best network throughput of zero performance degradation and via layer 2 fast packet switching and bridging from node to node to support real time video, voice, and data applications
- Advanced real time diagnostic tool to ensure quality of mesh network at installation time
- Feature rich software supports enterprise and carrier-class applications

Signal Locator Tool for Point to Point Connection Support

- Graphic display of signal strength in real time to support antenna pointing
- Broadcasting signal strength out of computer's speaker to facilitate antenna installaion on site
- Separate Uplink and Downlink signal strength display
- Up to 50km distance

Management and Security

- Supports SNMP v2c & Web Based browser
- Supports 128bit AES encryption on each mesh link across whole mesh network
- MeshID and multiple level administration password protection

ArrowSpan Inc.
4800 Great America Parkway
Suite 238
Santa Clara, CA 95054
www.arrowspan.com

ARROWSPAN

Providing WiFi access to any community as large or small mesh network. The MeshAP 3100 provides users with a dependable/flexible and cost-effective network either in a small scale or constructed with long distance point-to-point mesh connection. ArrowSpan's MeshAP 3100 provides WiFi access using wireless mesh technology with plug-n-play easy installation, and allows carriers and service providers to deliver a true wireless network over a good size hotzone or large geographical areas with point to point connection support.

A Mesh Link is a true wireless connection between any two MeshAP units. ArrowSpan MeshAP 3100 will automatically discover its neighboring MeshAP 3100 and interconnect all the MeshAP units together to form a bigger coverage wireless network.

A Mesh Link can also be a long distance point to point link. Signal Locator is a graphical display with beeping indicating signal strength of single or multiple stations to support pointing directional antenna at installation with optimum signal quality result of up to 50km.

MeshAP 3100 implements Layer 2 mesh routing which provides excellent network performance and is fully compatible with existing network equipment and applications. The MeshAP 3100 is able to support high-bandwidth and low latency applications like real-time video and voice.

Predictable Optimum Path (POP) routing algorithm creates a MeshAP 3100 based WiFi mesh network with the best throughput, reliable mesh link, and self-discovery/self-configuration/self-healing benefits. The algorithm's human-like intelligence examines the network and makes appropriate connections among MeshAPs at system boot time or when the meshlink is broken due to obstacles or individual node problems.

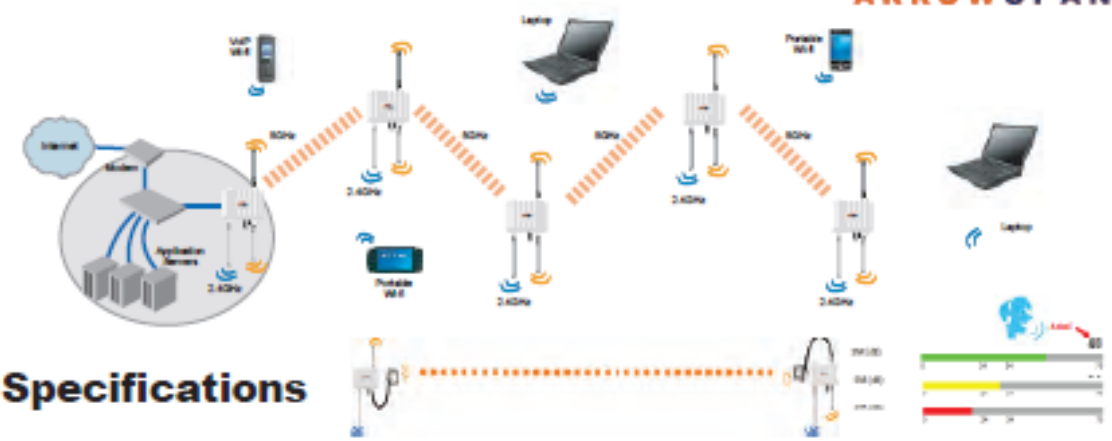
High throughput Mesh Network is achieved by a non-blocking and no-interference design for client and backhaul traffic. The MeshAP 3100 multi-radio and multi-channel architecture eliminates the wireless signal interference and traffic conflict problems that exist on many other mesh network products.

SNMP v2c and web-based (HTML) management interface enables both professional and non-technical users to easily handle network management and maintenance tasks for the MeshAP units. The "Point and Click" browser interface permits users to monitor node condition, link quality, traffic flow, and event logs of the MeshAP units on the mesh network. The web-based Topology function also allows Network administrators to easily configure, update, and monitor every MeshAP node on the mesh network. SNMP private MIBs are also available for ArrowSpan NMS manager or 3rd party manager.

MeshAP™ 3100 Series

MeshAP™3100 Series

ARROWSPAN



Specifications

Product Model

3100-X

Wireless

Backhaul Radio

Number of Radio: 2
Frequency: 5.8GHz ISM radio band
Frequency Bands: 5.725 - 5.850 GHz/2.4GHz (optional)
Channel Size: 20MHz/40MHz

Modulation: OFDM(64-QAM, 16-QAM, QPSK, BPSK)

Data Rates: 6, 9, 12, 18, 24, 36, 48, 54Mbps (x2 trunk optional)

Tx Radio Power: up to 27dBm (avg)*

Receiving Sensitivity:
-94dBm@6Mbps; -82dBm@36Mbps; -78dBm@48Mbps; -74dBm@54Mbps

Antenna Connector:
(2x) N-type outdoor waterproof connector

Access Point Radio

Number of Radio: 1
Standards: IEEE 802.11g, 802.11b
Media Access Protocol: CSMA/CA with ACK
Frequency: 2.4GHz ISM radio band
Frequency Bands: 2.4 - 2.462 GHz

Modulation:
802.11g: OFDM(64-QAM, 16-QAM, QPSK, BPSK)
802.11b: CCK(11, 5.5Mb/s), DQPSK(2Mbps), DQPSK(1Mbps)

Data Rates:
802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps
802.11b: 1,2, 5.5, 11Mbps

Tx Radio Power: up to 27dBm (avg)*

Receiving Sensitivity:
-82dBm @36Mbps; -78dBm @48Mbps; -74dBm @54Mbps

Channels:
802.11g: USA, Canada, Saudi Arabia, Taiwan: 11
Most European countries, China: 13
France: 4
Japan: 14
802.11b: USA, Canada, Saudi Arabia, Taiwan: 11
Most European countries: 13
France: 4
Japan: 14

Antenna & Connector:
(1x) 8dbi 2.4GHz omni directional antenna
(1x) N-type outdoor waterproof connector

Mesh Network Throughput

Up to 30Mbps wireless mesh node to node throughput at 5th hop counts* at any type of topology

Over 50Mbps at x2 speed for point to point trunk link

Operating Range

Backhaul Wireless Mesh
Node-to-node Distance: up to 50km

802.11g (3100-X only)
Client AP: 150m(492ft)@54Mbps
500m(1640ft)@6Mbps

Software Feature

Security & Encryption

64/128/152bit WEP encryption
WPA/WPA-2 (Hardware Accelerated, 128bit AES)
Radius support
Multi-level Mesh operator username/password
Mesh ID protection
MAC address based filtering

AP Features (3100-X only)

Up to 16 separate SSID/VLAN
Wifidl
User privacy on AP and across whole mesh network
QOS, VLAN, 802.1Q
SSID Broadcast enable/disable
AP setting synchronization to Mesh Manager control
Symmon-Syn SSID field
User MAC list, SNR, Tx/Rx count, Error count
Auto-channel assignment

Wireless Mesh RF Control

Tx Power Control - Settable Tx levels to adjust coverage cell size
Automatic / Manual Channel Selection
Automatic / Manual Mesh node selection
Self-discovering / Self-configuring / Self-routing / Self-healing Mesh Link

P2P and P2MP Wireless Signal Locator Tool

Search available remote wireless signals and their strengths
Support setting of optimum pointing direction of directional antenna
Graphic display and voice broadcast of signal strength

Management

Web based (HTML) GUI Management & SNMP v1/v2c, Private MIB
Multiple level & priority administration login security
Topology and log
Fail-safe IP
Fail-safe Hidden BSSID
DHCP Client IP
NTP time server
IP based router alive detection
Remote software upgrade and settings
Software RESET button to factory default
Mesh Link quality diagnostic tool - Retry, SNR/RSSI, Noise Floor, Speed

Hardware Specification

Network Port

(1) 10/100Mbps, IEEE802.3, IEEE802.3U
Auto crossover Ethernet WAN Port, waterproof connector, RJ-45

Power

Power Interface: POE
Input: 48VDC 380mA
Power consumption: typical 12W
Power Supply Input to Adapter: 110V-240V

Environment Conditions

Operating Temperature: -40°F to 149°F (-40°C to 65°C)
Industrial Class OKT Design: -40°F to 185°F (-40°C to 85°C)
Storage Temperature: -60°F to 158°F (-58°C to 70°C)
Humidity: 95% maximum relative humidity, non-condensing

Physical Specifications

Dimension: 21.3cm x 18.4cm x5.7cm
Weight: 1.5kg

Enclosure

Rating: IP66 water proof
Vertical/horizontal mounting kit

Regulatory Compliance

Certification: NCC, FCC Part 15 Class B, ETSI EN 300328, ETSI EN 301893, IEC68-2-64, IEC 68-2-11, IEC 61000-4-2 class 2
(Please contact ArrowSpan for other Certifications)

Information presented herein is based on data available, is subject to change without notice.

MeshAP 3800-A9 Outdoor
Tri 900MHz Single 2.4GHz Full-Duplex Mesh Network Access Point

Reliable, Intelligent, High Performance Mesh Network

- Patent pending, auto-discovery, auto-configure, and auto-healing POP (Predictable Optimum Path) mesh routing algorithm
- Multiple wireless path design for both backhaul and user traffic eliminates adjacent AP signal interference and provides zero performance degradation
- Best network throughput via layer 2 fast switching and bridging from AP to AP to support real time video, voice, and data applications
- Up to 16 separate SSID/VLAN with different authentication and encryption algorithms simultaneously

Fully Compatible with Existing Access Servers, Routers, and Gateways

- Transparent to layer 3 and up protocols, fully compatible with existing network equipment
- Directly connects to existing Routers, Gateways, or APs through 10/100 Ethernet

Management and Security

- Supports Web Based browser & SNMP*
- Supports WEP encryption security across wireless mesh network
- Mesh network protection with user defined Mesh ID
- WPA/WPA2 Security protection for the backhaul network.

ARROWSPAN

Providing Wi-Fi access to any community with heavy foliage coverage like camp site, RV park, city park, and campus. The MeshAP 3800-A9 provides users with a dependable flexible network, and at the same time improves community productivity, and encourages economic development. ArrowSpan's MeshAP 3800-A9 provides Wi-Fi access using wireless mesh technology with plug-n-play easy installation, and allows carriers and service providers to deliver a true wireless network over large geographical areas or other locations where wiring is too difficult or expensive to install.

A Mesh Link is a true wireless connection between any two MeshAP units. ArrowSpan MeshAP 3800-A9 will automatically discover its neighboring MeshAP 3800-A9 and interconnect all the MeshAP units together to form a large coverage wireless network.

MeshAP 3800-A9 implements Layer 2 mesh routing which provides excellent network performance and is fully compatible with existing network equipment and applications. The MeshAP 3800-A9 is able to support high-bandwidth and low latency applications like real-time video and voice.

Predictable Optimum Path (POP) routing algorithm creates a MeshAP 3800-A9 based Wi-Fi mesh network with the best throughput, reliable mesh link, and self-discovery/self-configuration/self-healing benefits. The algorithm's human-like intelligence examines the network and makes appropriate connections among MeshAPs in real time. It also re-establishes a new network when obstacles, individual node problems, new nodes or internet access events occur.

High throughput Mesh Network is achieved by a non-blocking and no-interference design for client and backhaul traffic. The MeshAP 3800-A9 multi-radio and multi-channel architecture eliminates the wireless signal interference and traffic conflict problems that exist on many other mesh network products.

The web-based (HTML) management interface and SNMP enables both professional and non-technical users to easily handle network management and maintenance tasks for the MeshAP units. The "Point and Click" browser interface permits users to monitor node condition, link quality, traffic flow, and event logs of the MeshAP units on the mesh network. The web-based Topology function also allows Network administrators to easily configure, update, and monitor every MeshAP station on the mesh network. SNMP private MIBs are available for advanced users preferring to manage through their own network manager.

MeshAP™ 3800-A9

MeshAP™ 3800-A9

ARROWSPAN

Specifications

MESH NETWORK PERFORMANCE

Up to 6Mbps* backhaul throughput

*(Transmission speed may vary according to the interference of the environment)

OPERATING RANGE

Backhaul: *Based on 5dBi Antenna
Node-to-node Distance: up to 1km with open space

Access Point: Based on 8dbi Antenna
500m @54Mbps with high power CPE

Wireless

BACKHAUL RADIOS

Number of Radio: 3
Media Access Protocol: CSMA/CA with ACK
Frequency: 902MHz - 928MHz

MODULATION
OFDM (64-QAM, 16-QAM, QPSK, BPSK)

DATA RATES
13.5 Mbps

CHANNEL WIDTH
5MHz

TX POWER
up to 1W (average)

RECEIVING SENSITIVITY
-72dBm

ACCESS POINT RADIO

Number of Radio: 1
Standards: IEEE 802.11g, 802.11b
Media Access Protocol: CSMA/CA with ACK
Frequency: 2.4GHz ISM radio band

MODULATION
802.11g: OFDM(64-QAM, 16-QAM, QPSK, BPSK)
802.11B: CCK(11, 5.5MHz), DQPSK(2Mbps), DQPSK(1Mbps)

DATA RATES
802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps
802.11b: 1,2, 5.5, 11Mbps

TX POWER
802.11b/g: up to 400mW

CHANNELS
802.11b/g: USA, Canada: 11

ANTENNA (Not included in package)

Backhaul: (3x) 5dbi 900MHz omni directional antenna
Access Point: (1x) 8dbi 2.4GHz omni directional antenna

Software Feature

SECURITY & ENCRYPTION
64bit, 128bit WEP encryption (Hardware Accelerated)
WPA/WPA-2 (Hardware Accelerated)
Mesh operator username/password
Mesh ID protection
Software RESET button to factory default

MULTIPLE SSID/VLAN
support up-to 16 separate SSID/VLAN with different authentication and encryption simultaneously

RF CONTROL
Tx Power Control - Settable Tx levels to adjust coverage cell size
Automatic / Manual Channel Selection
Automatic / Manual Mesh node selection
Self-forming / self-healing Mesh Link

MANAGEMENT
Web based (HTML) Management
SNMP*

Hardware Specifications

NETWORK PORT
(1x) 10/100Mbps auto crossover Ethernet WAN Port
(For connecting to Router or Gateway)

POWER
Power Interface: POE
Input: 48VDC 380mA

ENVIRONMENTAL CONDITIONS
Operating Temperature: -40°F to 131°F (-40°C to 55°C)
Storage Temperature: -50°F to 158°F (-58°C to 70°C)
Humidity: 95% maximum relative humidity, non-condensing

PHYSICAL SPECIFICATIONS
Dimension: 23.4cm x 17cm x6.3cm
Weight: 1.5kg

ENCLOSURE
Rating: IP66 water proof
Antenna Connector: (5x) weatherproof antenna connectors
Power Connector: (1x) weatherproof Power/Data connector

REGULATORY COMPLIANCE
Certification: FCC Part 15
(Please contact ArrowSpan for other Certifications)

Ordering Information

Part Number	Product Description
MA3800-A9	US Version
ANT-ODA905	890-960 MHz 5dBi Omnidirectional Antenna with N Connector
ANT-ODA2408	2.4GHz 8dBi Omnidirectional Antenna with N Connector
PE-35-48	Outdoor PoE Injector
POE-40W	40W PoE Injector

ArrowSpan, Inc.
4800 Great America Parkway
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www.arrowspan.com

MAM7700

700MHz
Full-Duplex Mobile Mesh Wireless Access Point

Reliable, Intelligent, High Performance Mesh Network

- Patent pending, auto-discovery, auto-configure, real-time routing, and auto-healing POP (Predictable Optimum Path) mesh routing algorithm
- Real-time mesh routing based on monitoring current environment
- Multiple wireless path design eliminates adjacent MAM7700 signal interference and provides zero performance degradation
- Best network throughput via layer 2 fast switching and bridging from MAM7700 to MAM7700 to support real time video, voice, and data applications
- Transparent to layer 3 and up protocols, fully compatible with existing network equipment

Management and Security

- Supports Web Based browser & SNMP*
- Supports WEP/WPA/WPA2 encryption security across wireless mesh network
- Mesh network protection with user defined Mesh ID
- WPA/WPA2 Security protection for the backhaul network.

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ARROWSPAN

ArrowSpan's MAM7700 will automatically discover its neighboring MAM700s and interconnect all the MAM700s together to form an instant coverage mobile wireless network.

MAM7700 implements Layer 2.5 mesh routing which provides excellent network performance and is fully compatible with existing network equipment and applications. The MAM7700 is able to support high-bandwidth and low latency applications like real-time video and voice.

Predictable Optimum Path (POP) routing algorithm creates a MAM7700 based mesh network with the best throughput, reliable mesh link, and auto-discovery/auto-configuration/auto-healing benefits. The algorithm is like human intelligence; it examines the network and makes appropriate connections among MAM700s in real time. The algorithm also re-establishes a new network when obstacles, individual node problems, new nodes or internet access events occur.

High throughput Mesh Network is achieved by non-blocking and no-interference for client and backhaul traffic. MAM7700 multi-radio and multi-channel design eliminates wireless signal interference and traffic conflict problems that exist on many other mesh network products.

The web-based management interface enables both professional and non-technical users to easily handle network management and maintenance tasks for the MAM700 units. The "Point and Click" browser interface permits users to monitor node condition, link quality, traffic flow, and event logs of the MAM700 units on the mesh network. The web-based Topology function also allows Network administrators to easily configure, update, and monitor every MAM700 station on the mesh network.

MAM7700 is highly secured through full support of wireless Advanced 128-bit AES encryption on both backhaul and user traffic. The multi-level administration password control provides MAM700 users with the highest security guard for all services and applications.

MAM 7700

MAM 7700

ARROWSPAN

Specifications

Wireless	
Frequency	700 – 721MHz, 760 – 781MHz
Modulation	Orthogonal Frequency Division Multiplexing (OFDM)
Throughput	Up to 5Mbps throughput at 5th hop count
Tx Power	Up to 1W
Receiving Sensitivity	Typical -75dBm
Antenna	0dBi 700MHz mono-pole antenna
Operating Range	Node-to-node Distance Up to 500m non-line-of-sight (Transmission speed may vary according to the environment)
Predictable Optimum Path (POP)	Automatically discovers and configures the interconnect mesh link between nodes
Fast Switching	Layer 2.5 enable fast-packet switching wireless
Full Compatibility Structure	Data packets transparent to Layer 3 and higher protocols
Multi-Radio Full-Duplex Design	Multiple radios provide up link and down link
Auto Association	Automatic select the favorable uplink based on signal quality and hop count
Active Scan - Site Survey	Constant monitoring the mesh network for mesh link optimization
QoS	Support for multimedia applications: streaming video, video teleconferencing and voice over IP (VoIP)
GPS (Optional)	Topology displaying users' positions with GPS coordinate position
Security & Encryption	Advanced 128-bit AES Encryption (Hardware Accelerated)
Management	Web based (HTML) Management
Diagnostic	
Mesh Link quality	Link Speed, SNR, Noise Floor, Various Packet Counts
Topology Change Log	Time, Topology Map
Radio Self-Test	Uplink / Downlink Radio Test
Traffic Log	Packet Count
Ethernet	Tx / Rx Packet Count
Network Port	(1x) 10/100Mbps Auto Cross-over Ethernet RJ45
Power	Battery 14.8V, 10.2Ah, and 150Wh
Maximum power consumption	18W
Environment Conditions	
Operating Temperature:	-40°F to 131°F (-40°C to 55°C)
Storage Temperature:	-50°F to 158°F (-58°C to 70°C)
Humidity:	95% maximum relative humidity, non-condensing
Physical Specifications	
Dimension:	(w)27cm x (h)24cm x (d)7cm
Weight:	3.5kg

MeshAP™ 3800 Outdoor

Triple 5GHz/Single 2.4GHz Full-Duplex Mobile Mesh Technology Wireless Access Point

Reliable, Intelligent, High Performance Mesh Network

- Patent pending, auto-discovery, auto-configure, real-time routing, and auto-healing POP (Predictable Optimum Path) mesh routing algorithm
- Real-time mesh routing based on monitoring current environment, product function change and administrator bandwidth adjustment needs
- Multiple wireless path design for both backhaul and user traffic eliminates adjacent AP signal interference and provides zero performance degradation
- Best network throughput via layer 2 fast switching and bridging from AP to AP to support real time video, voice, and data applications
- Up to 16 separate SSID/VLAN with different authentication and encryption algorithms simultaneously

Fully Compatible with Existing Access Servers, Routers, and Gateways

- Transparent to layer 3 and up protocols, fully compatible with existing network equipment
- Directly connects to existing Routers, Gateways, or APs through 10/100 Ethernet

Management and Security

- Supports SNMP v2c & Web Based browser
- Supports WEP encryption security across wireless mesh network
- Mesh network protection with user defined Mesh ID
- WPA/WPA2 Security protection for the backhaul network.

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ARROWSPAN

Providing City-Wide Wi-Fi access to any community large or small. The Metro MeshAP 3800 provides users with a dependable flexible network, and at the same time improves city-wide productivity, increases safety and encourages economic development. ArrowSpan's MeshAP 3800 provides Wi-Fi access using wireless mesh technology with plug-n-play easy installation, and allows carriers and service providers to deliver a true wireless network over large geographical areas or other locations where wiring is too difficult or expensive to install.

A Mesh Link is a true wireless connection (Point-to-multipoint, and Point-to-point) between any two MeshAP units. ArrowSpan MeshAP 3800 will automatically discover its neighboring MeshAP 3800 and interconnect all the MeshAP units together to form a large coverage wireless network.

MeshAP 3800 implements Layer 2 mesh routing which provides excellent network performance and is fully compatible with existing network equipment and applications. The MeshAP 3800 is able to support high-bandwidth and low latency applications like real-time video and voice.

Predictable Real-time Optimum Path (POP) routing algorithm creates a MeshAP 3800 based Wi-Fi mesh network with the best throughput, reliable mesh link, and self-discovery/self-configuration/self-healing benefits. The algorithm's human-like intelligence examines the network and makes appropriate connections among MeshAPs in real time. It also re-establishes a new network when obstacles, individual node problems, new nodes or internet access events occur.

High throughput Mesh Network is achieved by a non-blocking and no-interference design for client and backhaul traffic. The MeshAP 3800 multi-radio and multi-channel architecture eliminates the wireless signal interference and traffic conflict problems that exist on many other mesh network products.

SNMP v2c and web-based (HTML) management interface enables both professional and non-technical users to easily handle network management and maintenance tasks for the MeshAP units. The "Point and Click" browser interface permits users to monitor node condition, link quality, traffic flow, and event logs of the MeshAP units on the mesh network. The web-based Topology function also allows Network administrators to easily configure, update, and monitor every MeshAP station on the mesh network. SNMP private MIBs are available for advanced users preferring to manage through their own network manager.

MeshAP™ 3800

MeshAP™ 3800 Series

ARROWSPAN

Specifications

Wireless

Backhaul Mesh Radio

Number of Radio: 3
Frequency: 5.8GHz/5.4GHz/5.3GHz/4.9GHz ISM radio band
Frequency Bands: 4.9 - 5.091 GHz
5.470 - 5.725 GHz, 5.725 - 5.850 GHz
Modulation: OFDM(64-QAM, 16-QAM, QPSK, BPSK)
Data Rates*: 6, 9, 12, 18, 24, 36, 48, 54Mbps
Tx Radio Power*: up to 27dBm (avg)
Receiving Sensitivity:
-82dBm @3Mbps; -78dBm @48Mbps; -76dBm @54Mbps
Antenna & Connector:
(3x) 8dbi 5GHz omni directional antenna
(3x) N-type outdoor waterproof connector

AP (Access Point) Radio

Number of Radio: 1
Standards: IEEE 802.11g, 802.11b
Media Access Protocol: CSMA/CA with ACK
Frequency: 2.4GHz ISM radio band
Frequency Bands: 2.4 - 2.462 GHz
Modulation:
802.11g - OFDM(64-QAM, 16-QAM, QPSK, BPSK)
802.11B - CCK(11, 5.5Mbps), DQPSK(2Mbps), DQPSK(1Mbps)
Data Rates:
802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps
802.11B: 1,2, 5.5, 11Mbps
Tx Radio Power*: 2.4GHz: up to 27dBm (avg)
Receiving Sensitivity:
-82dBm @3Mbps; -78dBm @48Mbps; -76dBm @54Mbps
Channels:
802.11g - USA, Canada, Saudi Arabia, Taiwan: 11
Most European countries, China: 13
France: 4
Japan: 14
802.11b - USA, Canada, Saudi Arabia, Taiwan: 11
Most European countries: 13
France: 4
Japan: 14
Antenna & Connector:
(1x) 8dbi 2.4GHz omni directional antenna
(1x) N-type outdoor waterproof connector

Mesh Backhaul Performance

Up to 30Mbps mesh backhaul throughput at the 5th hop count

Operating Range

Mesh Backhaul: Node-to-node Distance: 304m(1000ft)@54Mbps
802.11bg AP:
150m(492ft)@54Mbps
500m(1640ft)@6Mbps

*Note: (1). Actual Txpower dBm depends on regulatin and product model.
(2). Transmission speed vs. distance may vary according to the environment, government regulation, and product model.

Software Feature

Security & Encryption

64bit, 128bit WEP encryption (Hardware Accelerated)
WPA/WPA-2 (Hardware Accelerated, 128bit AES)
Radius support
Multi-level Mesh operator username/password
Mesh ID protection
MAC based filter

AP Features

Up to 16 separate SSID/VLAN
WMM
AP user privacy across whole mesh network
QOS
SSID Broadcast enable/disable
AP setting synchronization to Mesh Manager control
Symhron Syn SSID field
User MAC list, SNR, Tx/Rx count, Error count
Auto-channel assignment

Backhaul Mesh RF Control

Tx Power Control - Settable Tx levels to adjust coverage cell size
Automatic / Manual Channel Selection
Automatic / Manual Mesh node selection
Self-discovering / Self-configuring / Self-routing / Self-healing Mesh Link
Real time mesh routing
Mesh Link quality diagnostic tool

Management

Web based (HTML) Management
SNMP v2c, Private MIB
Topology and log
Fail-safe IP
Fail-safe SSID
DHCP Client IP
NTP time server
IP based router alive detection
Remote software upgrade
Software RESET button to factory default

Hardware Specification

Network Port

(1) 10/100Mbps auto crossover Ethernet WAN Port, waterproof connector

Power

Power Interface: POE
Input: 48VDC 380mA

Environment Conditions

Operating Temperature: -40°F to 131°F (-40°C to 55°C)
Storage Temperature: -58°F to 158°F (-50°C to 70°C)
Humidity: 95% maximum relative humidity, non-condensing

Physical Specifications

Dimension: 23.4cm x 11cm x6.3cm
Weight: 1.5kg

Enclosure

Rating: IP66 water proof
Vertical/Horizontal mounting kit

Regulatory Compliance

Certification: FCC Part 15
(Please contact ArrowSpan for other Certifications)

Information presented herein is based on data available, is subject to change without notice.

ANEXO 11 Hojas de Especificaciones Cisco

Data Sheet

Cisco Aironet 1520 Series Lightweight Outdoor Access Points

Flexible, Secure Mesh Platform for Demanding Environments

- Self-configuring and self-healing mesh in response to interference or outages
- Multiple-radio support (802.11a, 802.11b/g, licensed for 4.9-GHz public safety applications)
- Improved 802.11b/g radio sensitivity and range performance with maximal ratio combining (MRC)
- Multiple uplink options (Gigabit Ethernet-10/100/1000BaseT, Fiber SFP interface, cable interface in some models)
- Internal battery backup power
- 802.3af-compliant Power over Ethernet interface to connect IP devices
- NEMA Type 4X certified enclosure
- FIPS 140-2 certifiable

Cisco Aironet 1522 Lightweight Outdoor Mesh Access Point

- Dual-radio support (backhaul with 802.11a, access with 802.11b/g)
- Hazardous Location Certified (Class 1, Zone 2 / Div 2)
- Cable modem interface

Cisco Aironet 1524 Lightweight Outdoor Mesh Access Point

- 2 different models available (1524SB, 1524PS)
- 1524SB: Dual-backhaul: each radio dedicated to transmitting data either upstream or downstream for greater throughput
- 1524PS: Designed for public safety applications with 4.9-GHz radio

Outdoor Access Points

Wireless networks enable people, devices, and applications to stay continually connected with applications and information. The Cisco® wireless mesh network extends wireless access over large, metro-scale areas, extending into areas where wiring is impractical or cost-prohibitive. The wireless mesh can be easily deployed and maintained with zero-touch configuration deployment and self-healing capacity. The Cisco Outdoor Wireless Mesh Solution is a component of the Cisco Unified Wireless Network, delivering a robust wireless network with maximum capacity and uptime.

Flexible, Secure Mesh Platform for Demanding Environments

The Cisco Aironet® 1520 Series Lightweight Outdoor Access Points are a flexible, secure, and scalable mesh platform that is designed for deployments across large metropolitan-sized areas. As part of the Cisco Unified Network architecture, the wireless mesh can be seamlessly deployed as an extension of wired and wireless networks, with central management through controllers and the Cisco Wireless Control System. The unified architecture centralizes critical functions of the wireless LAN to provide scalable management, advanced security, seamless mobility, and proven reliability. With maximum ratio combining (MRC) technology, the access points provide greater access range for consumer-grade client devices throughout the wireless mesh network. Rugged enclosures allow deployment in extreme weather and hazardous environments, and can be painted to adapt to local aesthetics. The Cisco Aironet 1520 Series includes the Cisco Aironet 1522AG, 1522HZ, 1522CV and Cisco Aironet1524SB, 1524PS, and 1523CV Lightweight Outdoor Mesh Access Points.

Central Network Management

Cisco Wireless Control System (WCS) is the industry-leading platform for wireless LAN planning, configuration, and management. Cisco WCS provides a powerful foundation that allows IT managers to design, control, and monitor wireless networks from a centralized location, simplifying operations and reducing the total cost of ownership. The Cisco WCS works in conjunction with Cisco Aironet Lightweight Access Points, Cisco Wireless LAN Controllers, and the Cisco Wireless Location Appliance. With Cisco WCS, network administrators have a single solution for RF prediction, policy provisioning, network optimization, troubleshooting, security monitoring, and wireless LAN systems management. Robust graphical interfaces make wireless LAN deployment and operations simple and cost-effective.

Robust Unified Security

The Cisco mesh solution addresses wireless network security as part of a unified wired and wireless solution. Cisco Wireless Network Security offers the highest level of network security, which helps ensure that data remains private and secure and that the network is protected from unauthorized access. The Cisco intrusion prevention system (IPS) protects your entire network by identifying, classifying, and preventing known and unknown threats to your network.

Flexible, High-Performance Mesh Solution

All of the Cisco Aironet 1520 Series Lightweight Outdoor Access Points provide high-performance device access through improved 802.11b/g radio sensitivity and range performance with maximal ratio combining (MRC) technology. Flexible deployability and multiple uplink options and power options are available. The 802.3af-compliant, Power-over-Ethernet (PoE) interface makes it easy to connect IP devices, such as IP video cameras. NEMA Type 4X enclosures help ensure a robust system that can withstand rough weather conditions. The Cisco Aironet 1520 Series Access Points are Federal Information Processing Standards (FIPS 140-2) certifiable for applications that require this standard. To help ensure uptime for crucial applications even in the event that electrical power becomes unavailable, the 1520 Series offers an internal battery for backup power.

Cisco Aironet 1522 Lightweight Access Point

The Cisco Aironet 1522 Lightweight Outdoor Mesh Access Point is a dual-radio system with dual-band radios that are compliant with IEEE 802.11a (5-GHz) and 802.11b/g standards (2.4-GHz). Where service providers have already invested in a broadband cable network, the Cisco mesh can seamlessly extend network connectivity with the Cisco Aironet 1522CV access point, by connecting to its integrated cable modem backhaul (DOCSIS 2.0). Designed for the most demanding environments, the Cisco Aironet 1522HZ has been classified for hazardous locations (Class 1, Zone 2/ Div 2) such as petroleum refineries and utility gas plants.

Cisco Aironet 1524SB Lightweight Access Point

The Cisco Aironet 1524SB Lightweight Outdoor Access Point is a multiple-radio system with dual-backhaul IEEE 802.11a (5-GHz) radios, where each radio is dedicated to transmitting data either upstream or downstream, provide greater throughput for bandwidth-intensive applications such as video surveillance. The third radio is dedicated to client access. With uncompromised throughput and latency, the Cisco 1524SB enables a reliable and high-performance mesh network.

Cisco Aironet 1524PS Lightweight Access Point

The Cisco Aironet 1524PS Lightweight Outdoor Mesh Access Point has been specifically designed for public safety applications, providing a flexible and secure outdoor wireless LAN that scales to meet demands for public safety and mobility services. The Cisco Aironet 1524PS Access Point is a multiple-radio mesh access point, preconfigured with three radios that comply with IEEE 802.11a, 802.11b/g, and 4.9-GHz public safety standards. By dedicating multiple separate radios to access, it creates a robust and secure mesh infrastructure capable of supporting public and private applications simultaneously.

Cisco Aironet 1523CV Lightweight Access Point

Designed for Service Providers, this outdoor mesh access point features one 2.4GHz radio and two 5GHz radios for access, and a cable modem backhaul (DOCSIS 2.0).

Product Specifications

Table 1 lists specifications for the Cisco Aironet 1520 Series.

Table 1. Cisco Aironet 1520 Series Product Specifications

Item	Specification
Part numbers	**Cisco Aironet 1522 Lightweight Access Point** • AIR-LAP1522AG-A-K9-FCC configuration • AIR-LAP1522AG-C-K9-China configuration • AIR-LAP1522AG-E-K9-ETSI configuration • AIR-LAP1522AG-K-K9-Korea configuration • AIR-LAP1522AG-N-K9-Non-FCC configuration • AIR-LAP1522AG-P-K9-Japan configuration • AIR-LAP1522AG-S-K9-Singapore configuration • AIR-LAP1522AG-T-K9-Taiwan configuration • AIR-LAP1522CV-A-K9-FCC configuration, Power over cable • AIR-LAP1522HZ-A-K9-FCC configuration (Class 1, Div 2) • AIR-LAP1522HZ-E-K9-ETSI configuration (Class 1, Div 2) • AIR-LAP1522HZ-N-K9-Non-FCC configuration (Class 1, Div 2) • AIR-LAP1522HZ-S-K9-Singapore configuration (Class 1, Div 2) **Cisco Aironet 1524SB Lightweight Access Point** • AIR-LAP1524SB-A-K9-FCC configuration • AIR-LAP1524SB-C-K9-China configuration • AIR-LAP1524SB-E-K9—ETSI configuration • AIR-LAP1524SB-M-K9—Middle East configuration • AIR-LAP1524SB-N-K9-Non-FCC configuration • AIR-LAP1524SB-K-K9—Korea configuration • AIR-LAP1524SB-S-K9—Singapore configuration • AIR-LAP1524SB-T-K9—Taiwan configuration **Cisco Aironet 1524PS Lightweight Access Point** • AIR-LAP1524PS-A-K9-Public Safety (4.9 GHz, 5.8 GHz, 2.4 GHz), FCC configuration **Cisco Aironet 1523CV Lightweight Access Point** • AIR-LAP1523CV-A-K9
Wireless standards	• 802.11a • 802.11b/g • Public safety 4.9 GHz (5, 10, 20 MHz channels)
Data rates and modulation	• 802.11a: 54, 48, 36, 24, 18, 12, 9, 6 Mbps, Orthogonal Frequency Division Multiplexing (OFDM) • 802.11b: 11, 5.5, 2, 1 Mbps, Direct Sequence Spread Spectrum (DSSS) • 802.11g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps, OFDM **4.9 GHz:** • 5 MHz: 13.5, 12, 9, 6, 4.5, 3, 2.25, 1.5 Mbps • 10 MHz: 27, 24, 18, 12, 9, 6, 4.5, 3 Mbps • 20 MHz: 54, 48, 36, 24, 18, 12, 9, 6 Mbps

Item	Specification			
Frequency Band and Operating Channels	**Cisco 1522** -A (Americas (FCC)): • 2.401 to 2.473 GHz; 11 channels • 4.940 to 4.990 GHz; • 5MHz-10 channels • 10MHz-8 channels • 20MHz-2 channels • 5.250 to 5.850 GHz; 16 channels (excludes channel 120, 124, 128) -C (China): • 2.401 to 2.483 GHz; 13 channels • 5.725 to 5.850 GHz; 5 channels -E (ETSI): • 2.401 to 2.483 GHz; 13 channels • 5.470 to 5.725 GHz; 8 channels -K (Korea): • 2.401 to 2.483 GHz; 13 channels • 5.250 to 5.560 GHz; 10 channels -N (Non-FCC): • 2.401 to 2.473 GHz; 11 channels • 5.725 to 5.850 GHz; 5 channels -P (Japan2): • 2.401 to 2.495 GHz; 14 channels • 4.910 to 5.090 GHz; 6 channels -S (Singapore): • 2.401 to 2.483 GHz; 13 channels • 5.725 to 5.850 GHz; 5 channels -T (Taiwan): • 2.401 to 2.473 GHz; 11 channels • 5.470 to 5.850 GHz; 16 channels		**Cisco 1524SB** -A (Americas (FCC)): • 2.401 to 2.473 GHz; 11 channels • 5.250 to 5.850 GHz; 16 channels (excludes channel 120, 124, 128) -C (China): • 2.401 to 2.473 GHz; 13 channels • 5.725 to 5.850 GHz; 5 channels -E (ETSI): • 2.401 to 2.483 GHz; 13 channels • 5.470 to 5.725 GHz; 8 channels -K (Korea): • 2.401 to 2.483 GHz; 13 channels • 5.250 to 5.560 GHz; 10 channels -N (Non-FCC): • 2.401 to 2.473 GHz; 11 channels • 5.725 to 5.850 GHz; 5 channels -S (Singapore): • 2.401 to 2.483 GHz; 13 channels • 5.725 to 5.850 GHz; 5 channels -T (Taiwan): • 2.401 to 2.473 GHz; 11 channels • 5.470 to 5.850 GHz; 16 channels **Cisco 1524PS** -A (Americas (FCC)): • 2.401 to 2.473 GHz; 11 channels • 4.940 to 4.990 GHz; • 5MHz-10 channels • 10MHz-8 channels • 20MHz-2 channels • 5.725 to 5.850 GHz; 5 channels **Cisco 1523CV** -A (Americas (FCC)): • 2.401 to 2.473 GHz; 11 channels • 5.250 to 5.850 GHz; 16 channels (excludes channel 120, 124, 128)	
Receive Sensitivity (typical)	**802.11a 5.0 GHz** • 6 Mbps: –91 dBm • 9 Mbps: –90 dBm • 12 Mbps: –89 dBm • 18 Mbps: –86 dBm • 24 Mbps: –84 dBm • 36 Mbps: –80 dBm • 48 Mbps: –76 dBm • 54 Mbps: –73 dBm	**802.11b** • 1 Mbps: –96 dBm • 2 Mbps: –96 dBm • 5.5 Mbps: –95dBm • 11 Mbps: –92 dBm	**802.11g with MRC** • 1 Mbps: –96 dBm • 2 Mbps: –96 dBm • 5.5 Mbps: –95 dBm • 6 Mbps: –91 dBm • 9 Mbps: –91 dBm • 11 Mbps: –92 dBm • 12 Mbps: –91 dBm • 18 Mbps: –90 dBm • 24 Mbps: –89 dBm • 36 Mbps: –86 dBm • 48 Mbps: –80 dBm • 54 Mbps:–80 dBm	**4.9 GHz, 5MHz** • 1.5 Mbps: –93 dBm • 2.25 Mbps: –93 dBm • 3 Mbps: –93 dBm • 4.5 Mbps: –92 dBm • 6 Mbps: –88 dBm • 9 Mbps: –85 dBm • 12 Mbps: –80 dBm • 13.5 Mbps: –79 dBm **4.9 GHz, 10 MHz** • 3 Mbps: –92 dBm • 4.5 Mbps: –92 dBm • 6 Mbps: –91 dBm • 9 Mbps: –89 dBm • 12 Mbps: –86 dBm • 18 Mbps: –82 dBm • 24 Mbps: –78 dBm • 27 Mbps: –77 dBm **4.9 GHz, 20 MHz** • 6 Mbps: –89 dBm • 9 Mbps: –89 dBm • 12 Mbps: –86 dBm • 18 Mbps: –86 dBm

Item	Specification			
				• 24 Mbps: –83 dBm • 36 Mbps: –80 dBm • 48 Mbps: –75 dBm • 54 Mbps: –74 dBm
Maximum Transmit Power **(Varies by channel and data rate)**	**2.4 GHz**	**5 GHz**	**4.9 GHz**	
	Cisco 1522AG			
	-A 28 dBm -C 14 dBm -E 14 dBm -K 14 dBm -M 14 dBm -N 28 dBm -P 16 dBm -S 14 dBm -T 28 dBm	-A 28 dBm -C 22 dBm -E 22 dBm -K 19 dBm -M 22 dBm -N 28 dBm -P 20 dBm -S 22 dBm -T 28 dBm	-A 20 dBm	
	Cisco 1524SB			
	-A 28 dBm -C 14 dBm -N 28 dBm -E 14 dBm -M 14 dBm -K 14 dBm -S 14 dBm -T 28 dBm	-A 28 dBm -C 22 dBm -N 28 dBm -E 22 dBm -M 22 dBm -K 19 dBm -S 22 dBm -T 28 dBm		
	Cisco 1524PS			
	-A 28 dBm	-A 28 dBm	-A 28 dBm	
Network Interface	• 10/100/1000BASE-T Ethernet, autosensing (RJ-45) • Fiber SFP • Cable modem backhaul interface (only available on 1522CV and 1523CV models)			
Dimensions (W x L x H)	12.0 in. x 7.8 in. x 6.4 in. (30.48 cm x 19.81 cm x 16.26 cm) (including antenna mount)			
Weight	1522AG: 17 lbs (7.9 kg) 1522CV: 17 lbs (7.9 kg) 1522HZ: 18 lbs (8.0 kg) 1524SB: 18 lbs (8.4 kg) 1524PS: 18 lbs (8.4 kg) 1523CV: 18 lbs (8.4 kg) Battery backup: 2 lbs (0.7kg) Mounting bracket: 6 lbs (2.8 Kg)			
Environmental	Operating temperature: –40 to 55°C (–40 to 131°F) p lus Solar Loading Storage temperature: –50 to 85°C (–58 to 185°F) Wind resistance: • Up to 100 MPH sustained winds • Up to 165 MPH wind gusts			
Environmental ratings	• IP67 • NEMA Type 4X			
Powering Options	• 90–480 VAC, 47–63 Hz • Power over Ethernet: 48 VDC, +/–10 percent • 12 VDC			
Warranty	90 days			
Compliance	**Safety** • UL 60950 • CAN/CSA-C22.2 No. 60950 • IEC 60950 • EN 60950			

Item	Specification
	Immunity • <= 5 mJ for 6kV/3kA @ 8/20 ms waveform • ANSI/IEEE C62.41 • EN61000-4-5 Level 4 AC Surge Immunity • EN61000-4-4 Level 4 Electrical Fast Transient Burst Immunity • EN61000-4-3 Level 4 EMC Field Immunity • EN61000-4-2 Level 4 ESD Immunity • EN60950 Overvoltage Category IV **Radio approvals** • FCC Part 15.247, 90.210 • FCC Bulletin OET-65C • RSS-210 • RSS-102 • AS/NZS 4268.2003 • EN 300.328 • EN 301.893 **EMI and susceptibility** • FCC part 15.107, 15.109 • ICES-003 **Security** • Wireless bridging/mesh · X.509 digital certificates · MAC address authentication · Advanced Encryption Standards (AES), Temporal Key Integrity Protocol (TKIP) • Wireless access · 802.11i, Wi-Fi Protected Access (WPA2), WPA · 802.1X authentication, including Extensible Authentication Protocol and Protected EAP (EAP-PEAP), EAP-Transport Layer Security (EAP-TLS), EAP-Tunneled TLS (EAP-TTLS), and Cisco LEAP · Advanced Encryption Standards (AES), Temporal Key Integrity Protocol (TKIP) · VPN pass-through · IP Security (IPsec), Layer 2 Tunneling Protocol (L2TP) • MAC address filtering **Other** • CSA and ATEX (AIR-LAP1522HZ-X-K9 only)

Service and Support

Cisco and our specialized partners offer a broad portfolio of end-to-end services to help you improve your organization's productivity and collaboration by assisting with the readiness, deployment, and optimization of your wireless and mesh network and mobility services. Our services help you successfully deploy the Cisco Aironet 1520 Series Lightweight Access Points and integrate mobility solutions effectively to lower the total cost of ownership and secure your wireless network.

To learn more about Cisco Wireless LAN Service offers, visit: http://www.cisco.com/go/wirelesslanservices

For More Information

For more information about Cisco wireless mesh, contact your local account representative or visit: http://www.cisco.com/go/outdoorwireless

For more information about the Cisco Unified Wireless Network framework, visit: http://www.cisco.com/go/unifiedwireless

Cisco Aironet 1550 Series Outdoor Access Point

Next-Generation Outdoor Wireless

- Cisco® CleanAir technology provides integrated spectrum intelligence for a self-configuring and self-healing network
- ClientLink improves reliability and coverage for legacy clients
- Improved 802.11n range and performance with 2x3 multiple-input multiple-output (MIMO) technology
- 300 Mbps data rates per radio
- Multiple-radio support (802.11a/n, 802.11b/g/n)
- DOCSIS 3.0/EuroDOCSIS 3.0, 8x4 hybrid fiber-coaxial (HFC) cable modem option
- Improved 802.11n radio sensitivity and range performance with three antenna MIMO and two spatial streams
- Multiple uplink options (Gigabit Ethernet-10/100/1000 BaseT, Fiber SFP interface-cable (certain models)
- Internal battery backup power
- NEMA Type 4X certified enclosure

Cisco Aironet 1552E
- External antenna model

Cisco Aironet 1552C
- Cable modem model

Cisco Aironet 1552H
- Hazardous location model

Cisco Aironet 1552I
- Integrated antenna model

High-Performance Outdoor Wireless

The Cisco Aironet 1550 Series Outdoor Access Point with CleanAir technology is the industry's first enterprise and carrier-grade 802.11n access point to create a self-healing, and self-optimizing wireless network that mitigates the impact of wireless interference. It offers a flexible, secure, and scalable mesh network for high-performance mobility across large metropolitan-sized areas, enterprise campuses, manufacturing yards, and mining pits. The Cisco Aironet 1550 Series supports multiple-device and multiple-network application delivery such as real-time seamless mobility, video surveillance, 3rd Generation (3G) and 4G data offload, and public and private Wi-Fi access. Designed to meet customer needs in a broad range of industries, the Cisco Aironet 1550 Series offers the following benefits:

- Flexible deployment options: Access or mesh network, extension of an Ethernet network, and Ethernet, fiber, wireless, or cable backhaul.
- Service provider support: Wi-Fi for next-generation mobile data offload and personalized mobile services.
- Cisco CleanAir technology: Integrated spectrum intelligence to detect, classify, and mitigate RF interference from unauthorized wireless bridges or malicious devices.
- High-bandwidth video surveillance over Wi-Fi without the high cost of installing cables over long distances.
- High-performance, multipurpose network with low CapEx and OpEx.
- Integrated wired and wireless: The Cisco Borderless Networks Architecture provides cost savings with end-to-end network access solutions that include wireless, switching, routing, and security.

Flexible, High-Performance Mesh

The Cisco Aironet 1550 Series Outdoor Access Point offers a flexible, secure, and scalable mesh platform that is part of the Cisco Unified Wireless Network and the Cisco Service Provider Wi-Fi solution. It offers high performance mobility across large metropolitan-sized areas and enterprise campuses, manufacturing yards, and mining pits. Carrier-grade design allows service providers to take advantage of Wi-Fi for next-generation mobile data offloads. The Cisco Aironet 1550 Series provides high-performance device access through improved radio sensitivity and range with 802.11a/b/g/n multiple-input multiple-output (MIMO) technology, with two spatial streams. Multiple uplink and power options are available. The 802.3af-compliant, Power-over-Ethernet (PoE) interface makes it easy to connect IP devices, such as IP video cameras. NEMA Type 4X enclosures help ensure a robust system that can withstand demanding environments. To help ensure uptime for mission-critical applications even in the event that electrical power becomes unavailable, the Cisco Aironet 1550 Series offers an internal battery for backup power.

Cisco CleanAir Technology

The Cisco Aironet 1550 Series with Cisco CleanAir technology provides the highest-performance 802.11n connectivity for mission-critical outdoor networks by detecting interference from unauthorized devices, as well as common outdoor interference sources such as WiMAX networks and wireless bridging products. The 1550 Series uses chip-level intelligence to create a spectrum-aware, self-healing, and self-optimizing wireless network that mitigates the impact of wireless interference. CleanAir is a systemwide feature of the Cisco Unified Wireless Network that improves wireless network quality by detecting RF interference that other systems can't recognize, identifying the source, locating it, and then making automatic adjustments to optimize wireless coverage.

RF Excellence

Building on the Cisco Aironet heritage of RF excellence, the Cisco Aironet 1550 Series delivers industry-leading performance for secure and reliable wireless connections. Industrial-grade parts, enterprise-class silicon-level intelligence, and optimized radios deliver a robust mobility experience. The Cisco Aironet 1550 Series provides a set of tools that deliver the robust, scalable wireless foundation required to realize the true potential of outdoor wireless mobility:

- Cisco ClientLink technology to raise uplink and downlink performance of and coverage to existing 802.11a/g clients
- Radio resource management (RRM) for automated channel selection and power setting management of access points
- Advanced capabilities to select data rates, adjust power, and manage quality of service (QoS) for access points

Centrally Managed Mesh Network

Central management and troubleshooting of the Cisco outdoor wireless access points prevent costly maintenance service calls to outdoor locations. The Cisco Wireless Control System (WCS) works in conjunction with the Cisco Aironet Access Points and Cisco Wireless LAN Controllers to configure and manage the wireless networks. With Cisco WCS, network administrators have a single solution for RF prediction, policy provisioning, network optimization, troubleshooting, security monitoring, and wireless LAN systems management. Cisco CleanAir technology is integrated into the WCS to provide real-time information on your outdoor network. Wireless network security is also a part of a unified wired and wireless solution. Cisco wireless network security offers the highest level of network security, which helps ensure that data remains private and secure and that the network is protected from unauthorized access.

Cisco Aironet 1552E External Antenna Access Point

The Cisco Aironet 1552E Outdoor Access Point is the standard model, dual-radio system with dual-band radios that are compliant with IEEE 802.11a/n (5-GHz) and 802.11b/g/n standards (2.4 GHz). The 1552E has three external antenna connections for three dual-band antennas. It has Ethernet and fiber Small Form-Factor Pluggable (SFP) backhaul options, along with the option of a battery backup. This model also has a PoE-out port and can power a video surveillance camera. A highly flexible model, the Cisco Aironet 1552E is well equipped for municipal and campus deployments, video surveillance applications, mining environments, and data offload.

Cisco Aironet 1552C Cable Modem Access Point

Where service providers have already invested in a broadband cable network, the Cisco next-generation outdoor wireless mesh can seamlessly extend network connectivity with the Cisco Aironet 1552C access point by connecting to its integrated cable modem interface. The Cisco Aironet 1552C Outdoor Mesh Access Point is a dual-radio system with DOCSIS 3.0/EuroDOCSIS 3.0 (8x4 HFC) cable modem for power and backhaul. It has dual-band radios that are compliant with IEEE 802.11a/n (5 GHz) and 802.11b/g/n standards (2.4 GHz). The 1552C has an integrated, three-element, dual-band antenna and easily fits within the 30 cm height restriction for service providers. This model is perfect for 3G data offload applications and public Wi-Fi.

Cisco Aironet 1552H Hazardous Location Access Point

This access point is designed for hazardous environments like oil and gas refineries, chemical plants, mining pits, and manufacturing factories. The Cisco Aironet 1552H Outdoor Access Point is Class 1, Div 2/Zone 2 hazardous location certified. It has similar options as the 1552E, with the exception of the battery backup.

Cisco Aironet 1552I Integrated Antenna Access Point

The Cisco Aironet 1552I Outdoor Access Point is a low-profile, lighter weight model in the 1550 Series. The smaller size and sleeker look helps it blend in with the surrounding environment. The smaller power supply also makes it a more energy-efficient product. The 1552I does not have PoE out or a fiber SFP port.

External and Integrated Antennas

The Cisco Aironet 1552E and 1552H Outdoor Access Points, use three Cisco AIR-ANT2547V-N Antennas. These dual band, omni-directional, stick antennas have a gain of 4 dBI (2.4GHz) and 7 dBI (5GHz).

For the Cisco Aironet 1552C and 1552I Outdoor Access Points include a dual band, integrated antenna radome. This antenna has 3 omni-directional antenna elements that have antenna gains of 2 dBI (2.4GHz) and 4 dBI (5GHz). More information, including antenna patterns, can be found in the Cisco Aironet Antennas and Accessories Guide. http://www.cisco.com/en/US/products/hw/wireless/ps469/index.html.

Product Specifications

Table 1 lists specifications for the Cisco Aironet 1550 Series.

Table 1. Cisco Aironet 1550 Series Product Specifications

Item	Specification
Part numbers	**Cisco Aironet 1552E Access Point** • AIR-CAP1552E-A-K9 • AIR-CAP1552E-C-K9 • AIR-CAP1552E-E-K9 • AIR-CAP1552E-M-K9 • AIR-CAP1552E-N-K9 • AIR-CAP1552E-K-K9 • AIR-CAP1552E-R-K9 • AIR-CAP1552E-S-K9 • AIR-CAP1552E-T-K9 **Cisco Aironet 1552C Access Point with DOCSIS 3.0 Cable Modem** • AIR-CAP1552C-A-K9 • AIR-CAP1552C-E-K9 • AIR-CAP1552C-N-K9 **Cisco Aironet 1552H Hazardous Location Access Point** • AIR-CAP1552H-A-K9 • AIR-CAP1552H-C-K9 • AIR-CAP1552H-E-K9 • AIR-CAP1552H-M-K9 • AIR-CAP1552H-N-K9 • AIR-CAP1552H-S-K9 **Cisco Aironet 1552I Integrated Antenna Access Point** • AIR-CAP1552I-A-K9 • AIR-CAP1552I-E-K9 • AIR-CAP1552I-K-K9 • AIR-CAP1552I-Q-K9 **Cisco SMARTnet® Services for the Cisco Aironet 1550 Series Access Points** • CON-SNT-CAP1552x - SMARTnet 8x5xNBD 1552E Access Point • CON-SNT-CAP1552x - SMARTnet 8x5xNBD 1552C Access Point with Cable Modem • CON-SNT-CAP1552x - SMARTnet 8x5xNBD 1552H Hazardous Location Access Point • CON-SNT-CAP1552x - SMARTnet 8x5xNBD 1552I Integrated Antenna Access Point Not all regulatory domains have been approved. As they are approved, the part numbers will be available on the Global Price List.
802.11n Version 2.0 (and Related) Capabilities	• 2x3 multiple-input multiple-output (MIMO) with two spatial streams • Legacy beamforming • 20- and 40-MHz channels • PHY data rates up to 300 Mbps • Packet aggregation: A-MPDU (Tx/Rx), A-MSDU (Tx/Rx) • 802.11 dynamic frequency selection (DFS) • Cyclic shift diversity (CSD) support
DOCSIS 3.0 Capabilities	DOCSIS 3.0 8x4 cable modem provides: • Eight (8) bonded channels with total throughput in excess of 300 Mbps • Designed to meet DOCSIS 3.0 specifications as well as backward compability with existing DOCSIS 2.0, 1.1 and 1.0 networks • Enhanced packet processing technology to maximize performance • Downstream data rates in excess of 320 Mbps • Upstream data rates up to 120 Mbps Channel-bonded cable modems must be used in conjunction with a cable modem termination system (CMTS) that supports channel bonding per the DOCSIS 3.0 specifications. When used with a non-channel-bonded CMTS, channel- bonded cable modems function as conventional DOCSIS 2.0 cable modems.
Data Rates Supported	802.11a: 6, 9, 12, 18, 24, 36, 48, and 54 Mbps
	802.11g: 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, and 54 Mbps
	802.11n data rates (2.4 GHz and 5 GHz):

Item	Specification				
	MCS Index[1]	GI[2] = 800ns		GI = 400ns	
		20-MHz Rate (Mbps)	40-MHz Rate (Mbps)	20-MHz Rate (Mbps)	40-MHz Rate (Mbps)
	0	6.5	13.5	7.2	15
	1	13	27	14.4	30
	2	19.5	40.5	21.7	45
	3	26	54	28.9	60
	4	39	81	43.3	90
	5	52	108	57.8	120
	6	58.5	121.5	65	135
	7	65	135	72.2	150
	8	13	27	14.4	30
	9	26	54	28.9	60
	10	39	81	43.3	90
	11	52	108	57.8	120
	12	78	162	86.7	180
	13	104	216	115.6	240
	14	117	243	130	270
	15	130	270	144.4	300
Frequency Band and 20-MHz Operating Channels	-A Domain: • 2.400 to 2.4835 GHz; 11 channels • 5.725 to 5.850 GHz; 5 channels -C Domain: • 2.400 to 2.4835 GHz; 13 channels • 5.725 to 5.850 GHz; 5 channels -E Domain: • 2.401 to 2.4835 GHz; 13 channels • 5.470 to 5.725 GHz; 8 channels -K Domain: • 2.400 to 2.4835 GHz; 11 channels • 5.250 to 5.825 GHz; 14 channels -M Domain • 2.400 to 2.4835 GHz; 13 channels • 5.470 to 5.850 GHz; 12 channels -N Domain: • 2.400 to 2.4835 GHz; 11 channels • 5.725 to 5.850 GHz; 5 channels -Q Domain: • 2.400 to 2.4835 GHz; 13 channels • 5.470 to 5.725 GHz; 11 channels -R Domain: • 2.400 to 2.4835 GHz; 13 channels • 5.250 to 5.725 GHz; 11 channels -S Domain: • 2.400 to 2.4835 GHz; 13 channels • 5.725 to 5.850 GHz; 5 channels -T Domain: • 2.400 to 2.4835 GHz; 11 channels 5.470 to 5.850 GHz; 16 channels				
Note: This varies by regulatory domain. Refer to the product documentation for specific details for each regulatory domain.					

[1] MCS Index: The Modulation and Coding Scheme (MCS) index determines the number of spatial streams, the modulation, the coding rate, and data rate values.
[2] GI: A guard interval (GI) between symbols helps receivers overcome the effects of multipath delays.

Item	Specification			

Maximum Number of Nonoverlapping Channels	2.4 GHz
	• 802.11b/g:
	  ◦ 20 MHz: 3
	• 802.11n:
	  ◦ 20 MHz: 3
			5 GHz
			• 802.11a:
			  ◦ 20 MHz: 16
			• 802.11n:
			  ◦ 20 MHz: 16
			  ◦ 40 MHz: 8	

Note: This varies by regulatory domain. Refer to the product documentation for specific details for each regulatory domain.				
Receive Sensitivity	802.11b (Complementary Code Keying [CCK]) -101 dBm @ 1 Mb/s -98 dBm @ 2 Mb/s -92 dBm @ 5.5 Mb/s -89 dBm @ 11 Mb/s	802.11g (non HT20) -94 dBm @ 6 Mb/s -93 dBm @ 9 Mb/s -92 dBm @ 12 Mb/s -90 dBm @ 18 Mb/s -86 dBm @ 24 Mb/s -84 dBm @ 36 Mb/s -79 dBm @ 48 Mb/s -78 dBm @ 54 Mb/s	802.11a (non HT20) -92 dBm @ 6 Mb/s -91 dBm @ 9 Mb/s -89 dBm @ 12 Mb/s -87 dBm @ 18 Mb/s -85 dBm @ 24 Mb/s -81 dBm @ 36 Mb/s -77 dBm @ 48 Mb/s -76 dBm @ 54 Mb/s	
	2.4-GHz 802.11n (HT20) -93 dBm @ MCS0 -91dBm @ MCS1 -89dBm @ MCS2 -86 dBm @ MCS3 -82 dBm @ MCS4 -78 dBm @ MCS5 -77 dBm @ MCS6 -75 dBm @ MCS7 -93 dBm @ MCS8 -91 dBm @ MCS9 -89 dBm @ MCS10 -86 dBm @ MCS11 -82 dBm @ MCS12 -78 dBm @ MCS13 -77 dBm @ MCS14 -75 dBm @ MCS15		5-GHz 802.11n (HT20) -92 dBm @ MCS0 -89 dBm @ MCS1 -87 dBm @ MCS2 -85 dBm @ MCS3 -81 dBm @ MCS4 -77 dBm @ MCS5 -76 dBm @ MCS6 -75 dBm @ MCS7 -90 dBm @ MCS8 -87 dBm @ MCS9 -85 dBm @ MCS10 -82 dBm @ MCS11 -78 dBm @ MCS12 -74 dBm @ MCS13 -73 dBm @ MCS14 -72 dBm @ MCS15	5-GHz 802.11n (HT40) -89 dBm @ MCS0 -86 dBm @ MCS1 -84 dBm @ MCS2 -82 dBm @ MCS3 -78 dBm @ MCS4 -74 dBm @ MCS5 -73 dBm @ MCS6 -72 dBm @ MCS7 -87 dBm @ MCS8 -84 dBm @ MCS9 -82 dBm @ MCS10 -79 dBm @ MCS11 -75 dBm @ MCS12 -71 dBm @ MCS13 -70 dBm @ MCS14 -69 dBm @ MCS15

Maximum Transmit Power	2.4 GHz
	• 802.11b (CCK)
	  ◦ 28 dBm with 2 antennas
	• 802.11g (non HT duplicate mode)
	  ◦ 28 dBm with 2 antennas
	• 802.11n (HT20)
	  ◦ 28 dBm with 2 antennas
			5 GHz
			• 802.11a
			  ◦ 28 dBm with 2 antennas
			• 802.11n non-HT duplicate (802.11a duplicate) mode
			  ◦ 28 dBm with 2 antennas
			• 802.11n (HT20)
			  ◦ 27 dBm with 2 antennas
			• 802.11n (HT40)
			• 27 dBm with 2 antennas	

Note: The maximum power setting will vary by channel and according to individual country regulations. Refer to the product documentation for specific details.				
Network Interface	• 10/100/1000BASE-T Ethernet, autosensing (RJ-45) • Fiber SFP • DOCSIS 3.0 (8x4) Cable modem interface (option available)			
Dimensions (W x L x H)	12.0 in. x 7.0 in. x 6.4 in. (30.48 cm x 19.81 cm x 16.26 cm) (including antenna mount)			
Weight	1552E: 17.3 lbs (7.8 kg) 1552C: 14 lbs (6.4 kg) 1552H: 17.6 lbs (8 kg) 1552I: 14 lbs (6.4 kg) Battery backup: 1.5 lbs (0.7kg) Pole mounting bracket: 6.1 lbs (2.8 kg) Cable strand mounting bracket: 1.3 lbs (0.6 kg)			

Item	Specification
Environmental	Operating temperature: -40 to 55°C (-40 to 131°F) plus Solar Loading Storage temperature: -50 to 85°C (-58 to 185°F) Wind resistance: • Up to 100 MPH sustained winds • Up to 165 MPH wind gusts
Environmental Ratings	• IP67 • NEMA Type 4X
Antenna Gain	• Integrated Dual Band Omni-directional Antenna Radome ◦ 2 dBi (2.4GHz), 4 dBi (5GHz) • External Dual Band Omni-directional Antennas (AIR-ANT2547V-N) ◦ 4 dBi (2.4GHz), 7 dBi (5GHz)
Powering Options	• 90–480 VAC, 47-63 Hz • 40 - 90 VAC, 47-63 Hz, quasi-square wave, Power over Cable • Power over Ethernet: 56 VDC, +/-10 percent • 12 VDC
Warranty	90 days
Compliance	**Safety** • UL 60950, 2nd Edition • CAN/CSA-C22.2 No. 60950, 2nd Edition • IEC 60950, 2nd Edition • EN 60950, 2nd Edition **Immunity** • <= 5 mJ for 6kV/3kA @ 8/20 ms waveform • ANSI/IEEE C62.41 • EN61000-4-5 Level 4 AC Surge Immunity • EN61000-4-4 Level 4 Electrical Fast Transient Burst Immunity • EN61000-4-3 Level 4 EMC Field Immunity • EN61000-4-2 Level 4 ESD Immunity • EN60950 Overvoltage Category IV **Radio approvals** • FCC Part 15.247, 15.407 • FCC Bulletin OET-65C • RSS-210 • RSS-102 • AS/NZS 4268.2003 • EN 300 328 • EN 301 893 **EMI and susceptibility** • FCC part 15.107, 15.109 • ICES-003 • EN 301 489-1, -17 **Security** • Wireless bridging/mesh ◦ X.509 digital certificates ◦ MAC address authentication ◦ Advanced Encryption Standards (AES), Temporal Key Integrity Protocol (TLIP) • Wireless access ◦ 802.11i, Wi-Fi Protected Access (WPA2), WPA ◦ 802.1X authentication, including Extensible Authentication Protocol and Protected EAP (EAP-PEAP), EAP Transport Layer Security (EAP-TLS), EAP-Tunneled TLS (EAP-TTLS), and Cisco LEAP ◦ Advanced Encryption Standards (AES), Temporal Key Integrity Protocol (TLIP) ◦ VPN pass-through ◦ IP Security (IPsec), Layer 2 Tunneling Protocol (L2TP) • MAC address filtering **Other** • ATEX (AIR-CAP1552H-X-K9 only)

Plan, Build, and Run Services for a Seamless Outdoor Experience

Professional services from Cisco and Cisco Advanced Wireless LAN Specialized Partners facilitate a smooth deployment of the next-generation wireless outdoor solution, while tightly integrating it with the wired and indoor wireless networks. Based on proven methodologies for planning and deploying end-to-end solutions with secure voice, video, and data technologies and years of experience designing and implementing some of the world's most complex enterprise-class wireless networks, our specialists can help you optimize mobile connectivity to transform your business operations.

We work with your IT staff to see that your architecture, physical sites, and operational staff are ready to support Cisco's integrated, next-generation, outdoor wireless solution that combines the high performance of the 802.11n standard and Cisco CleanAir technology.

For More Information

For more information about Cisco wireless mesh, contact your local account representative or visit:
http://www.cisco.com/go/outdoorwireless

For more information about the Cisco Unified Wireless Network framework, visit:
http://www.cisco.com/go/unifiedwireless

For more information about the Cisco service provider Wi-Fi solution, visit:
http://www.cisco.com/go/ap1550

For more information about the Cisco Wireless LAN Services, visit:
http://www.cisco.com/go/wirelesslanservices

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Cisco Aironet 1300 Series Outdoor Access Point or Bridge

Product Overview

The Cisco® Aironet® 1300 Series Outdoor Access Point or Bridge (Figure 1) is an 802.11g access point and bridge that provides high-speed and cost-effective wireless connectivity between multiple fixed or mobile networks and clients. Building a metropolitan-area wireless infrastructure with the Cisco Aironet 1300 Series provides deployment personnel with a flexible, easy-to-use solution that meets the security requirements of wide-area networking professionals. The Cisco Aironet 1300 Series can be deployed as an autonomous access point or bridge, providing intelligent network services as a standalone device. Alternatively, the Cisco Aironet 1300 Series can be deployed as part of the Cisco Unified Wireless Network, managed centrally by a Cisco wireless LAN controller.

Figure 1. Cisco Aironet 1300 Series

The Cisco Aironet 1300 Series supports the 802.11g standard—providing 54-Mbps data rates with a proven, secure technology while maintaining full backward compatibility with legacy 802.11b devices. It is delivered in a compact, rugged enclosure for deployment in outdoor environments, and is available in two versions. The Cisco Aironet 1300 Series with integrated antenna can be quickly installed to provide a LAN bridge to a remote site or multiple sites. The 1300 Series with antenna connectors supports a variety of Cisco 2.4-GHz antennas, providing range and coverage versatility.

The Cisco Aironet 1300 Series is available either as part of the Cisco Unified Wireless Network or as an autonomous access point or bridge. The Cisco Unified Wireless Network is a comprehensive solution that delivers an integrated, end-to-end wired and wireless network. Using the radio and network management features of the Cisco Unified Wireless Network for simplified deployment, the Cisco Aironet 1300 Series extends the security, scalability, reliability, ease of deployment, and manageability available in wired networks to the wireless LAN. Unified access points operate with the Lightweight Access Point Protocol (LWAPP) and work in conjunction with Cisco wireless LAN controllers and the Wireless Control System (WCS). When configured with LWAPP, the Cisco Aironet 1300 Series can automatically detect the best-available Cisco wireless LAN controller and download appropriate policies and configuration information with no hands-on intervention.

Autonomous access points are based on Cisco IOS® Software and may optionally operate with the CiscoWorks Wireless LAN Solution Engine (WLSE). Autonomous access points, along with the WLSE, deliver a core set of features and may be field-upgraded to take advantage of the full benefits of the Cisco Unified Wireless Network as requirements evolve. As an autonomous access point or bridge, the Cisco Aironet 1300 Series may be configured to operate as a wireless access point, bridge, or a workgroup bridge.

Users and Applications

The Cisco Aironet 1300 Series can provide outdoor wireless access, an ongoing savings of leased-line expenses, a method to connect networks despite physical barriers such as lakes or highways, and rapid deployment of network connections—often while waiting on other facilities, such as fiber-optic installations. The types of organizations that will benefit from the advantages of the Cisco Aironet 1300 Series include education, enterprise, government, healthcare, military, public safety, transportation, and WLAN service providers. These organizations have a variety of possible applications, as shown in Figure 2 and described in the following paragraphs.

Campus Networks

Whether the deployment is in a typical college campus or corporate offices with multiple buildings, IT professionals are faced with interconnecting local area networks around and in between each of the buildings. These LANs require cost-effective, high-bandwidth connections with seamless mobility throughout the WLAN. They also require the flexibility and control that is unavailable through leased lines or that would otherwise require trenching for new cable installations. The Cisco Aironet 1300 Series can be used as an outdoor access point, either operating with the Cisco wireless LAN controller and WCS or autonomously as an intelligent access point. It can also be used as an autonomous wireless bridge to connect remote buildings to the LAN.

Nomadic Networks and Users

More and more, networks are "on the move." Vehicles such as buses, trains, ambulances, and patrol cars are being equipped with their own LAN-supported devices, including notebooks, personal digital assistants (PDAs), cameras, and scanners. These mobile networks provide new passenger services, improved public service, and operational efficiency but they need to be interconnected to enable information-sharing and more informed decision-making. The Cisco Aironet 1300 Series can operate in autonomous mode as a workgroup bridge connecting in-vehicle devices to Cisco Aironet access points and bridges that are fixed throughout the service area.

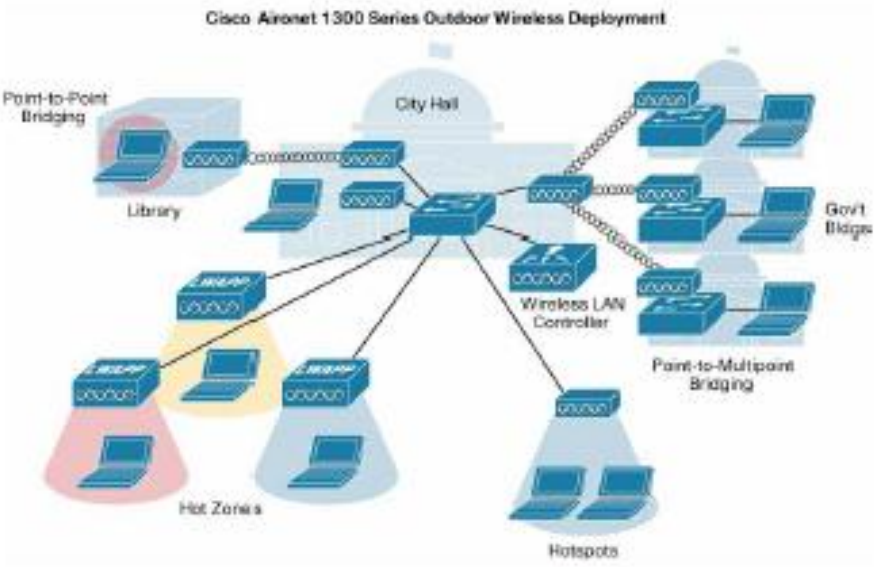
Outdoor Public Access

The proliferation of WLAN hotspots has allowed users to stay connected while in hotels, airports, and even coffee shops. As more users desire ubiquitous connectivity, outdoor hotspots are being added—and some include multiple city blocks or even town centers. These outdoor hotspots can be cost-effectively deployed with the Cisco Aironet 1300 Series unified or autonomous access points.

Temporary Networks

The variety of temporary solutions is limitless, with applications such as remote military campaigns, short-term office leases, temporary buildings such as trailers, or even parking lot tent sales. These deployments require a temporary network infrastructure that is rugged, portable, easy to install, and flexible. The Cisco Aironet 1300 Series can be quickly deployed, with complete functionality packaged in the integrated antenna version, or with a selection of easy-to-install remote antennas for the connectorized version.

Figure 2. Cisco Aironet 1300 Series Applications Example



Benefits

Industry-Leading Performance

- Data rates of 54 Mbps in the 2.4-GHz band
- Bridge range of 20 miles (32 kilometers [km]) at 11 Mbps
- Aggregate throughput approaching 28 Mbps
- Maximum transmit power of 100 milliwatts (mW) for 802.11b and 30 mW for 802.11g. Maximum power setting will vary according to individual country regulations.
- For vehicle-installed deployments, over 100 km per hour speeds at 12 and 24 Mbps with 128-byte packets at 1 percent packet error rate (PER) (workgroup bridge mode connected to a Cisco Aironet access point or bridge)
- Support for antenna diversity

Low Total Cost of Ownership

- Compelling return on investment (ROI) compared to cable installation or ongoing leased-line fees
- Low bridging-system cost
- Low outdoor access-point system cost
- Ability to reuse existing Cisco Aironet Series 350 Wireless Bridges for low upgrade costs
- Investment protection with future Cisco IOS Software upgrades

Flexible and Easy to Install

- The Cisco Unified Wireless Network simplifies wireless LAN deployment and management by providing clear visibility and dynamic control of the RF environment.
- Convenient LEDs provide bridge alignment feedback and diagnostics.

- Quick-hang mounting bracket allows for an easy installation process; roof and wall mounting kits offer more mounting options.
- Rapid deployment, redeployment, and recommissioning can be achieved with no reliance upon third-party service providers or a lengthy license or trenching process.
- Multiple, configurable radio network roles enable point-to-point and point-to-multipoint bridging.
- Wide DC power-input range allows a variety of power supply options such as solar power or vehicle power (+10 to +48 volts direct current [VDC]).
- Supports a wide operating-temperature range of –22°F to 131°F (–30°to +55°C).
- Meets NEMA 4 and IP56 specifications for harsh environments.
- Supports captured antennas for easy mounting and support for external antennas, including existing Cisco Aironet 2.4-GHz antennas.

Award-Winning Security

The Cisco Aironet 1300 Series has achieved National Institute of Standards and Technology (NIST) FIPS 140-2 level 2 validation and is in process for Common Criteria validation under the National Information Assurance Partnership (NIAP) program.

The Cisco Aironet 1300 Series supports 802.11i, Wi-Fi Protected Access 2 (WPA2), WPA, and numerous Extensible Authentication Protocol (EAP) types. WPA and WPA2 are the Wi-Fi Alliance certifications for interoperable, standards-based WLAN security. These certifications support IEEE 802.1X for user-based authentication, Temporal Key Integrity Protocol (TKIP) for WPA encryption, and Advanced Encryption Standard (AES) for WPA2 encryption. These certifications help to ensure interoperability between Wi-Fi-certified WLAN devices from different manufacturers.

The Cisco Aironet 1300 Series hardware-accelerated AES encryption supports enterprise-class, government-grade secure encryption over the WLAN without compromising performance. IEEE 802.1X authentication helps to ensure that only authorized users are allowed on the network. Backward compatibility and support for WPA client devices running TKIP, the RC4 encryption algorithm, is also supported by the Cisco Aironet 1300 Series.

Cisco Aironet 1300 Series access points operating with LWAPP support Cisco Unified Intrusion Detection System or Intrusion Prevention System (IDS/IPS), which is part of the Cisco Self-Defending Network and is the industry's first integrated wired and wireless network security solution. The Cisco Unified IDS/IPS takes a comprehensive approach to security—at the wireless edge, wired edge, WAN edge, and through the data center. When a trusted client acts maliciously, the Cisco wired IDS detects the attack and sends shun requests to the Cisco wireless LAN controllers, which will then disassociate the client device. Cisco Unified IDS goes beyond simple fire walling. If a user is allowed to access a specific server, but is not allowed to access a particular directory on the server, the anomalous behavior is detected and mitigated.

Autonomous or unified Cisco Aironet 1300 Series Access Points support management frame protection for the authentication of 802.11 management frames by the wireless network infrastructure. This allows the network to detect spoofed frames from access points or malicious users impersonating infrastructure access points. If an access point detects a malicious attack, an incident will be generated by the access point and reports will be gathered on the controller, Cisco WCS, or CiscoWorks WLSE.

Product Architecture

A flexible outdoor wireless-bridge or access-point solution is provided through the combination of the Cisco Aironet 1300 Series, a power injector, and options for both antennas and mounting. Figure 3 shows how the units connect.

Figure 3. Network Diagram with Power Injector

Cisco Aironet 1300 Series

The Cisco Aironet 1300 Series provides the 802.11g interface for access-point capability or bridge connections. By placing the unit outdoors, close to the antenna, you can minimize the wireless cable losses—thereby maximizing the range of the network. The unit is available with either an integrated antenna, or with connectors for external antennas (Figure 4). The high-gain, integrated antenna is designed for easy installations of point-to-point links or non-root nodes of point-to-multipoint networks as an autonomous bridge. The nonintegrated antenna version provides professional installers with an RP-TNC connector that allows the deployment of omnidirectional, sector, or high-gain dish antennas for specific application requirements.

Figure 4. Cisco Aironet 1300 Series Connector Options

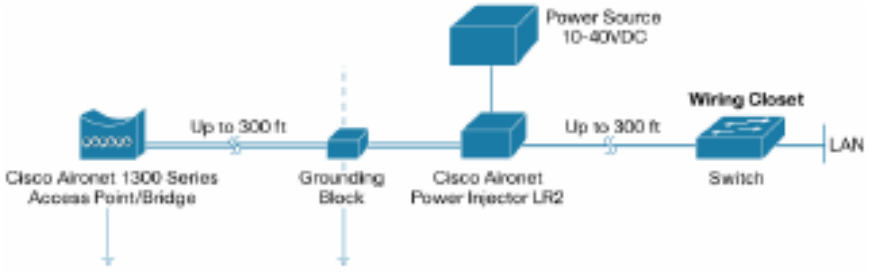
Power Injector

The Cisco Aironet Bridge Power Injector converts the standard 10/100BASE-T Ethernet interface that is suitable for weather-protected areas to a dual F-Type connector interface for coaxial cables that are more suitable for harsh outdoor environments. The power injector also provides power to the outdoor unit over the same cables with a power-discover feature and surge protection. To support longer cabling from your wired switch or router, the power injector enables total cable runs up to 200 meters (Category 5 [Cat5] and coaxial). The Cisco Aironet 1300 Series ships with the Cisco Aironet Power Injector LR2 (Figure 5) and an AC power supply.

Figure 5. Cisco Aironet Power Injector AIR-PWRINJ-BLR2/AIRPWRINJ-BLR2T

The optional Cisco Aironet Power Injector LR2T takes power from any +12 to +40 VDC source not supplied by Cisco. Typically, the DC source is a vehicle or solar-power source (Figure 6). This power injector provides the flexibility needed when an AC power source is not available.

Figure 6. Network Diagram with Optional Power Injector



Mounting Hardware and Antennas

In addition to having a variety of antennas available from Cisco, the Cisco 1300 Series also has different mounting options (Figure 7). These optional mounting kits are available for mounting to a roof, wall, or pole. The quick-hang mounting bracket enables a simple, one-person installation. For more information on available antennas, please refer to the Cisco Aironet Antennas and Accessories Data Sheet and Reference Guide:

- Data Sheet:
  http://www.cisco.com/en/US/prod/collateral/wireless/ps7183/ps469/product_data_sheet09186a008022b11b.html
- Reference Guide:
  http://www.cisco.com/en/US/prod/collateral/wireless/ps7183/ps469/product_data_sheet09186a008008883b.html

Figure 7. Cisco Aironet 1300 Series Mounting Hardware and Antennas

Features

The Cisco Aironet 1300 Series access point or bridge provides the following features.

Antenna Alignment Assistance

The autonomous Cisco Aironet 1300 Series provides an autoconfiguration and installation mode for quick deployment of point-to-point links without the need for configuration through Telnet, FTP, or Simple Network Management Protocol (SNMP). This mode provides LEDs with signal-strength information used in the installation and alignment process. As a result, installers are free to perform their installation process and verify the link quality without knowledge of Cisco IOS Software or data networking.

Automatic RF Configuration

Under the Cisco Unified Wireless Network, radio resource management provides automatic configuration of RF parameters for access points such as the Cisco Aironet 1300 Series Access Points. The result is a coordinated RF plan for access points under the span of the Cisco wireless LAN controller, which also recognizes the presence of other RF emitting devices. This minimizes interference to and from neighboring access points, ensuring optimal network capacity.

Seamless Layer 2 and Layer 3 Roaming

The Cisco Aironet 1300 Series provides fast secure roaming of wireless clients and autonomous non-root bridges and workgroup bridges. In both the unified access point and the autonomous access point, the encryption keys for mobile devices are cached locally, allowing the mobile device to roam between access points while remaining authenticated to the network. This significantly reduces roaming time by eliminating the need to conduct the four-way handshake with each roam. Autonomous non-root bridges and workgroup bridges also scan in the background to search for alternative Cisco Aironet access points and bridges that mobile device may be roaming to, which also reduces roaming time.

Support for Port Aggregation Protocol and Cisco Fast EtherChannel Technology

Bandwidth can be increased between bridged networks through the aggregation of multiple autonomous bridges at each site via Cisco Fast EtherChannel® technology, Port Aggregation Protocol (PAgP), or routing protocols.

Wireless Link-Distance Adjustment

For an autonomous Cisco Aironet 1300 Series device, the link-distance parameter allows the user to tune the Carrier-Sense Multiple Access/Collision Avoidance (CSMA/CA) parameters for the particular range in use to maximize performance.

Wireless Packet Concatenation

The concatenation of smaller packets into larger ones allows autonomous Cisco Aironet 1300 Series access point or bridge to more efficiently use the wireless medium and provide higher overall data throughputs.

Wireless Programmable Clear-Channel Assessment

With a programmable clear-channel assessment, an autonomous Cisco Aironet 1300 Series access point or bridge can be configured to the particular background-interference level found in your environment. This provides reduced contention overhead with other wireless systems.

Summary

The Cisco Aironet 1300 Series is a flexible outdoor 802.11b and 802.11g access point or bridge that provides high-speed and cost-effective wireless connectivity between multiple fixed or mobile networks and clients.

Product Specifications

Link Roles and Product Compatibility

Table 1 outlines the link roles in which the Cisco Aironet 1300 Series can operate, and identifies the products that it is compatible with in the particular role.

Table 1. Link Role and Product Compatibility

Role	Applications	Unified or Autonomous Architecture	Compatibility
Access Point	Engineered specifically for harsh outdoor environments, yet also capable in indoor deployments, the Cisco Aironet 1300 Series is ideal for WLANs requiring outdoor coverage. The Cisco Aironet 1300 Series is Wi-Fi certified as an access point and also supports the innovative features available with Cisco Aironet and Cisco Compatible client devices.	Unified or Autonomous	• Compatible with any Wi-Fi certified WPA or WPA2 client device for basic capability • Compatible with Cisco Aironet clients and Cisco Compatible clients for extended capability
Bridge	The Cisco Aironet 1300 Series supports either point-to-point or point-to-multipoint configurations to cost-effectively interconnect remote, temporary, or mobile networks. It can serve as an upgrade or replacement to the Cisco Aironet 350 Wireless Bridge by providing over-the-air compatibility with existing Cisco Aironet 350 Series Wireless Bridges. While in bridge mode, client associations are also accepted—effectively providing simultaneous bridge and access-point capability.	Autonomous	Compatible with Cisco Aironet 1300 Series and 350 Series Wireless Bridges
Workgroup Bridge	There is no hard/soft limit on the number of devices you can have, however we only recommend up to a maximum of 20 devices.	Autonomous	Supports operation with Cisco Aironet access points and Cisco bridges

Protocols

Table 2 lists the protocols supported by the Cisco Aironet 1300 Series.

Table 2. Protocols

Protocols	Description
Air Interface Standard	IEEE 802.11b or IEEE 802.11g **Note:** Autonomous bridge mode has enhancements to the standard to allow longer-range bridging communications.
Frequency Band	• 2.412 to 2.462 GHz (FCC) • 2.412 to 2.472 GHz (ETSI) • 2.412 to 2.472 GHz (TELEC)
Wireless Modulation	802.11b • Direct Sequence Spread Spectrum (DSSS): ◦ Differential Binary Phase Shift Keying (DBPSK) at 1 Mbps ◦ Differential Quadrature Phase Shift Keying (DQPSK) at 2 Mbps ◦ Complementary Code Keying (CCK) at 5.5 and 11 Mbps 802.11g • Orthogonal Frequency Divisional Multiplexing (OFDM): ◦ BPSK at 6 and 9 Mbps ◦ QPSK at 12 and 18 Mbps ◦ 16-quadrature amplitude modulation (QAM) at 24 and 36 Mbps ◦ 64-QAM at 48 and 54 Mbps
Media Access Protocol	Carrier-Sense Multiple Access with Collision Avoidance (CSMA/CA)
Lightweight Access Point Protocol	A network protocol for lightweight access points that also provides for centralized management.
Operating Channels	802.11b/g • ETSI: 13 • Americas: 11 • TELEC (Japan): 13

Protocols	Description
Nonoverlapping Channels	3
Security—Bridge Role*	Cisco Wireless Security Suite, including: **Authentication** 802.1X support including LEAP to yield mutual authentication and dynamic per-user, per session encryption keys **Encryption** • Cisco TKIP or WPA TKIP; key hashing (per-packet keying), Message Integrity Check (MIC) and broadcast key rotation • AES (802.11i)
Security—Access Point Role	Cisco Wireless Security Suite supporting WPA and WPA2, including: **Authentication** • Management frame protection provides for the authentication of 802.11 management frames by the wireless network infrastructure. This allows the network to detect spoofed frames from access points or malicious users impersonating infrastructure access points. If an access point detects a malicious attack, an incident will be generated by the access points and reports will be gathered on the Cisco wireless LAN controller, Cisco WCS, or CiscoWorks WLSE. • 802.1X support including Cisco LEAP, Protected EAP-Generic Token Card (PEAP-GTC), PEAP-Microsoft Challenge Authentication Protocol Version 2 (MSCHAPv2), EAP Message Digest 5 (EAP MD5), EAP-Transport Layer Security (EAP-TLS), EAP-Tunneled TLS (EAP-TTLS), EAP-Subscriber Identity Module (EAP-SIM), and EAP-Flexible Authentication via Secure Tunneling (EAP-FAST) to yield mutual authentication and dynamic per user, per-session encryption keys **Encryption** • WPA: Cisco TKIP or WPA TKIP; key hashing (per-packet keying), MIC and broadcast key rotation • WPA2: AES (802.11i)
Security—Workgroup Bridge Role*	Cisco Wireless Security Suite, including: **Authentication** • 802.1X support including Cisco LEAP to yield mutual authentication and dynamic per-user, per session encryption keys **Encryption** • Cisco TKIP or WPA TKIP; key hashing (per-packet keying), MIC and broadcast key rotation • AES (802.11i)
SNMP Compliance	Versions 1 and 2

* Cisco Aironet 1300 Series can operate as a workgroup bridge or wireless bridge when it is an autonomous device. When the Cisco Aironet 1300 Series is operating under the Cisco Unified Wireless Network architecture, it only operates as an access point.

Components

Table 3 lists the components available for the Cisco Aironet 1300 Series.

Table 3. Components

Components	Description
Power Injector LR2	The power injector converts the standard 10/100BASE-T Ethernet Cat5 RJ-45 interface that is suitable for weather-protected areas to a dual F-Type connector interface for dual coaxial cables that are more suitable for harsh outdoor environments. While providing a 100BASE-T interface to the Cisco Aironet 1300 Series, the power injector also provides power to the unit over the same cables with a power discovery feature that protects other appliances from damage should they accidentally be connected. As an added benefit to the installer, the automatic medium-dependent interface crossover (Auto-MDIX) feature is built in, allowing the dual cables to be swapped while maintaining the same capability. To support longer cable runs from your network switch or router, the power injector is designed to accommodate up to a 100 meter coaxial cable run plus 100 meters of indoor Cat5 cable—enabling total cable runs up to 200 meters. Lightning and surge protection is also included at the F-Type connector interface to provide added protection to your network devices. The power injector requires a 48V DC source supplied by Cisco.
Power Injector LR2T	The Power Injector LR2T supports all the capabilities of LR2. It is designed for use in transportation applications and operates with an input voltage range of +12 to +40V DC. The DC source is provided by the user. The LR2T can therefore be vehicle- or solar-powered.
Power Supply	• 48V DC supply for AIR-PWRINJ-BLR2= • User-supplied 12 to 40V DC source for AIR-PWRINJ_BLR2T=. Could require an external load-dump-module for automotive and bus installations.
AIR-BR1310G- x-K9 or AIR LAP1310G-x-K9 Integrated Antenna	• Vertical polarization • 13-dBi gain • 36°E-plane by 36°H-plane (3-dB beam width)

Interfaces

Table 4 lists the Cisco Aironet 1300 Series interfaces.

Table 4. Interfaces

	AIR-BR1310G-x-K9 AIR-BR1310G-x-K9-R AIR-LAP1310G-x-K9 AIR-LAP1310G-x-K9R	AIR-PWRINJ-BLR2 AIR-PWRINJ-BLR2T
Status LEDs	Four LEDs: Install, Radio, Status, and Ethernet	One bicolor LED showing power status
F-Type Connectors	Dual coaxial cable carries full-duplex Ethernet, DC power, and full-duplex console port (RS-232 connection)	Dual coaxial cable carries full-duplex Ethernet, DC power, and full-duplex console port (RS 232 connection)
Antenna Interface	• AIR-BR1310G-x-K9 or AIR-LAP1310G-x-K9: Air interface (integrated directional antenna) • AIR-BR1310G-x-K9-R or AIR-LAP1310G-x-K9R: Two RP-TNC type connectors for external antennas	—
DC Power	—	One two-pin Switchcraft connector (with threaded locking sleeve) and matching connector
RJ-45 Interface	—	One RJ-45 connector for console-port access (9600 bps only), a second RJ-45 connector for 10/100BASE-T LAN interface
Grounding Lugs	Two grounding lugs for lightening protection.	—

Memory Requirements

Table 5 lists the memory specifications for the Cisco Aironet 1300 Series.

Table 5. Memory Requirements

8 MB of Flash Memory	Memory space for future firmware upgrades to support new 802.11 standards and advanced features.

Performance

Table 6 lists the Cisco Aironet 1300 Series performance capabilities.

Table 6. Performance Capabilities

	AIR-BR1310G-A-K9 or AIR-LAP1310G-A-K9	AIR-BR1310G-A-K9-R or AIR-LAP1310G-A-K9R
Available Transmit Power Settings	802.11b: • 100 mW (20 dBm) • 50 mW (17 dBm) • 30 mW (15 dBm) • 20 mW (13 dBm) • 10 mW (10 dBm) • 5 mW (7 dBm) • 1 mW (0 dBm) 802.11g: • 30 mW (15 dBm) • 20 mW (13 dBm) • 10 mW (10 dBm) • 5 mW (7 dBm) • 1 mW (0 dBm)	802.11b: • 100 mW (20 dBm) • 50 mW (17 dBm) • 30 mW (15 dBm) • 20 mW (13 dBm) • 10 mW (10 dBm) • 5 mW (7 dBm) • 1 mW (0 dBm) 802.11g: • 30 mW (15 dBm) • 20 mW (13 dBm) • 10 mW (10 dBm) • 5 mW (7 dBm) • 1 mW (0 dBm)
	Note: Maximum power setting will vary according to individual country regulations.	
Maximum Operational Receive Level	–20 dBm	–20 dBm
Maximum Survivable Receive Level	10 dBm	10 dBm

	AIR-BR1310G-A-K9 or AIR-LAP1310G-A-K9	AIR-BR1310G-A-K9-R or AIR-LAP1310G-A-K9R
Receive Sensitivity (10 Percent with 3200 Byte Packets)	• 1 Mbps: –94 dBm • 2 Mbps: –91 dBm • 5.5 Mbps: –89 dBm • 11 Mbps: –85 dBm • 6 Mbps: –90 dBm • 9 Mbps: –89 dBm • 12 Mbps: –86 dBm • 18 Mbps: –84 dBm • 24 Mbps: –81 dBm • 36 Mbps: –77 dBm • 48 Mbps: –73 dBm • 54 Mbps: –72 dBm	• 1 Mbps: –94 dBm • 2 Mbps: –91 dBm • 5.5 Mbps: –89 dBm • 11 Mbps: –85 dBm • 6 Mbps: –90 dBm • 9 Mbps: –89 dBm • 12 Mbps: –86 dBm • 18 Mbps: –84 dBm • 24 Mbps: –81 dBm • 36 Mbps: –77 dBm • 48 Mbps: –73 dBm • 54 Mbps: –72 dBm
Maximum Bridge Relative Velocity (Autonomous-Mode Only)	Over 100 km per hour at 12 and 24 Mbps with 128-byte packets at 1 percent PER	
Access Point Role: Outdoor Range	Americas • 865 feet (260 meters) at 54 Mbps • 3465 feet (1055 meters) at 11 Mbps ETSI • 150 feet (45 meters) at 54 Mbps • 775 feet (235 meters) at 11 Mbps TELEC • 485 feet (145 meters) at 54 Mbps • 1085 feet (330 meters) at 11 Mbps Note: Access point with 13-dBi integrated antenna and Cisco clients	Americas • 350 feet (105 meters) at 54 Mbps • 1410 feet (430 meters) at 11 Mbps ETSI • 195 feet (60 meters) at 54 Mbps • 630 feet (190 meters) at 11 Mbps TELEC • 195 feet (60 meters) at 54 Mbps • 445 feet (135 meters) at 11 Mbps Note: Access point with 5.2-dBi patch antenna and Cisco clients
Bridge Role: Point to Point Range*	Americas • 1.3 miles (2 km) at 54 Mbps • 9 miles (15 km) at 11 Mbps EMEA • 0.2 miles (0.36 km) at 54 Mbps • 2.3 miles (3.5 km) at 11 Mbps TELEC • 0.7 miles (1.1 km) at 54 Mbps • 3.2 miles (5 km) at 11 Mbps Note: 13-dBi integrated antenna at root and non root bridge	Americas • 4.5 miles (7 km) at 54 Mbps • 14 miles (23 km) at 11 Mbps EMEA • 5.5 miles (9 km) at 11 Mbps TELEC • 4.5 miles (7 km) at 54 Mbps • 12 miles (20 km) at 11 Mbps Note: 21-dBi dish antenna at root and non root bridge
Bridge Role: Point to Multipoint Range*	Americas • 1.1 miles (1.8 km) at 54 Mbps • 8 miles (13 km) at 11 Mbps EMEA • 0.25 miles (0.4 km) at 54 Mbps • 1.1 miles (1.8 km) at 11 Mbps TELEC • 0.8 miles (1.3 km) at 54 Mbps • 3.6 miles (5.8 km) at 11 Mbps Note: 14-dBi sector antenna at root and 13-dBi integrated antenna at non-root	Americas • 2.0 miles (3.3 km) at 54 Mbps • 10 miles (16 km) at 11 Mbps EMEA • 2.5 miles (4 km) at 11 Mbps TELEC • 2.0 miles (3.3 km) at 54 Mbps • 9.0 miles (14 km) at 11 Mbps Note: 14-dBi sector at root and 21-dBi dish at non root

* Bridge role is only available for autonomous deployments. The distances referenced here are approximations and should be used for estimation purposes only.

Physical Specifications

Table 7 lists the physical specifications of the Cisco Aironet 1300 Series.

Table 7. Physical Specifications

	AIR-BR1310G-x-K9 AIR BR1310G x K9 R AIR-LAP1310G-x-K9 AIR-LAP1310G-x-K9R	AIR-PWRINJ-BLR2	AIR-PWRINJ-BLR2T
Dimensions	8 in. x 8.1 in. x 3.12 in. (20.3 cm x 20.57 cm x 7.87 cm)	4.62 in. x 4.76 in. x 1.07 in. (11.73 cm x 12.09 cm x 2.71 cm)	4.62 in. x 4.76 in. x 1.07 in. (11.73 cm x 12.09 cm x 2.71 cm)
Weight	2.5 lb (1.25 kg)	2 lb (1 kg)	2 lb (1 kg)
Operational Temperature	–22° to +131°F (–30° to +55°C)	–22° to +131°F (–30° to +55°C)	–22° to +131°F (–30° to +55°C)
Storage Temperature	–40° to +185°F (–40° to +85°C)	–40° to +185°F (–40° to +85°C)	–40° to +185°F (–40° to +85°C)
Operational Altitude	10,000 ft (3048m)	10,000 ft (3048m)	10,000 ft (3048m)
Storage Altitude	16,000 ft (4877 m)	16,000 ft (4877 m)	16,000 ft (4877 m)
Humidity	0 to 100% at 100°F (38°C) (condensing)	0 to 90% at 100°F (38°C) (noncondensing)	0 to 90% at 100°F (38°C) (noncondensing)
Vibration	SAEJ1455 section 4.9	SAEJ1455 section 4.9	SAEJ1455 section 4.9
Enclosure	NEMA 4; IP56; UL2043; environmentally sealed	UL2043; metal case	UL2043; metal case

Power Requirements

Table 8 lists Cisco Aironet 1300 Series power requirements.

Table 8. Power Requirements

	AIR-BR1310G-x-K9 AIR BR1310G x-K9-R AIR-LAP1310G-x-K9 AIR-LAP1310G-x-K9R	AIR-PWRINJ-BLR2	AIR-PWRINJ-BLR2T
AC Power	Not required—uses DC voltage from power injector	100 to 240V AC, ±10% (power supply provided by Cisco)	Not required
DC Power	—	• +48V DC, ±10% • Up to 9 W	• +12 to +40V DC, ±10% • Up to 11 W

Approvals and Compliance

The Cisco Aironet 1300 Series meets the following approvals and compliance standards (Table 9).

Table 9. Approvals and Compliance

	AIR-BR1310G-x-K9 AIR-BR1310G-x-K9-R AIR-LAP1310G-x-K9 AIR-LAP1310G-x-K9R	AIR-PWRINJ-BLR2 AIR-PWRINJ-BLR2T
Country Compliance	Customers are responsible for verifying approval for use in their country. Please visit http://www.cisco.com/go/aironet/compliance to verify approval and to identify the regulatory domain that corresponds to a particular country. Not all regulatory domains have been approved. As they are approved, the part numbers will be available on the Global Price List.	
Wi-Fi Certification	Wi Fi CERTIFIED	—

	AIR-BR1310G-x-K9 AIR-BR1310G-x-K9-R AIR-LAP1310G-x-K9 AIR-LAP1310G-x-K9R	AIR-PWRINJ-BLR2 AIR-PWRINJ-BLR2T
Safety	• UL 60950 third edition • CSA C22.2 No. 60950-00 • IEC 60950 Sec Ed, amendments 1-4 • EN 60950; 1992, amendments 1-4 • CSA 94/UL50—NEMA rated	• UL 60950 third edition • CSA C22.2 No. 60950-00 • IEC 60950 Sec Ed, amendments 1-4 • EN 60950; 1992, amendments 1-4 • UL2043 • FIPS 140-2 prevalidation list
Radio Approvals	• FCC Part 15.247 • RSS—139-1, RSS-210 (Canada) • EN 300.328 (Europe) • Telec 338 (Japan) • ARIB-STD-T66 v2.1 • FCC Bulletin OET-65CRSS-102 • Designed to EN60945	—
EMI and Susceptibility (Class B)	• FCC Part 15.107 and 15.109 Class B • ICES-003 Class B (Canada) • EN 55022 Class B • EN 55024 • AS/NZS 3548 Class B • VCCI Class B • EN 301.489-1 and 17 (Europe) • Designed to CISPR 25, ISO 11452-24, EN50121, EN60571 and SAEJ1113	• FCC Part 15.107 and 15.109 • Class B • ICES-003 Class B (Canada) • EN 55022 Class B • EN 55024 • AS/NZS 3548 Class B • VCCI Class B • EN 301.489-1 and 17 (Europe)

Additional Specifications

Warranty: One year

Ordering Information

To place an order, visit the Cisco Ordering Home Page. For assistance in determining the correct wireless bridge to order, as well as appropriate accessories, please read the Cisco Aironet 1300 Series Ordering Guide.

To Download the Software

Cisco Aironet software can be downloaded at the Cisco Software Center.

Service and Support

Cisco Systems offers a wide range of service programs to accelerate customer success. These innovative programs are delivered through a unique combination of people, processes, tools, and partners, resulting in high levels of customer satisfaction. Cisco services help you to protect your network investment, optimize network operations, and prepare the network for new applications to extend network intelligence and the power of your business. For more information about Cisco Services, see Cisco Technical Support Services.

For More Information

For more information about the Cisco Aironet 1300 Series, visit http://www.cisco.com/go/aironet or contact your local account representative.

Data Sheet

Cisco Aironet 1400 Series Wireless Bridge

OVERVIEW

The Cisco Aironet® 1400 Series Wireless Bridge creates a new benchmark for wireless bridging by providing a high-performance and feature-rich solution for connecting multiple LANs in a metro area. Building a metropolitan area wireless infrastructure with the Cisco Aironet 1400 Series Wireless Bridge provides deployment personnel with a flexible, easy to use solution that meets the security requirements of wide area networking professionals. Designed to be a cost-effective alternative to leased lines, it is engineered specifically for harsh outdoor environments, yet also works well in indoor deployments. The Cisco Aironet 1400 Series Wireless Bridge is the premier high-speed, high-performance outdoor bridging solution for line-of-sight applications, providing features such as:

- Support for both point-to-point or point-to-multipoint configurations (Figure 1)
- Industry leading range and throughput, supporting data rates up to 54 Mbps
- Enhanced security mechanisms based on 802.11 and 802.11i standards
- Ruggedized enclosure optimized for harsh outdoor environments with extended operating temperature range
- Integrated or optional external antennas for flexibility in deployment
- Designed specifically for ease-of-installation and operation

BRIDGING FIXED NETWORKS

The Cisco Aironet 1400 Series Wireless Bridge can be used to provide either:

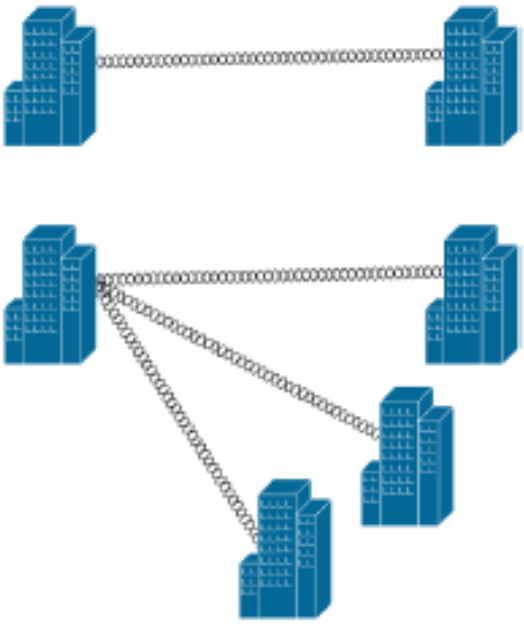
1. The sole connection
2. The primary connection with an additional technology such as a T1 line providing redundancy, or
3. As a back up solution for additional resiliency in conjunction with other technologies such as fiber optics.

Ideal applications include:

- Local Government—Backbone (backhaul) portion of community-based municipal networks such as public safety networks, or any fixed network location
- Education—Higher education campus building interconnects and K-12 schools within a metropolitan area

- Healthcare—Hospital campuses and physician offices
- Enterprise Campus—Building-to-building links (point-to-point or point-to-multipoint), or any situation where a company needs to expand across an area where right-of-way is not possible
- Service Provider—Backhaul to aggregate multiple lower-speed links into a higher speed link

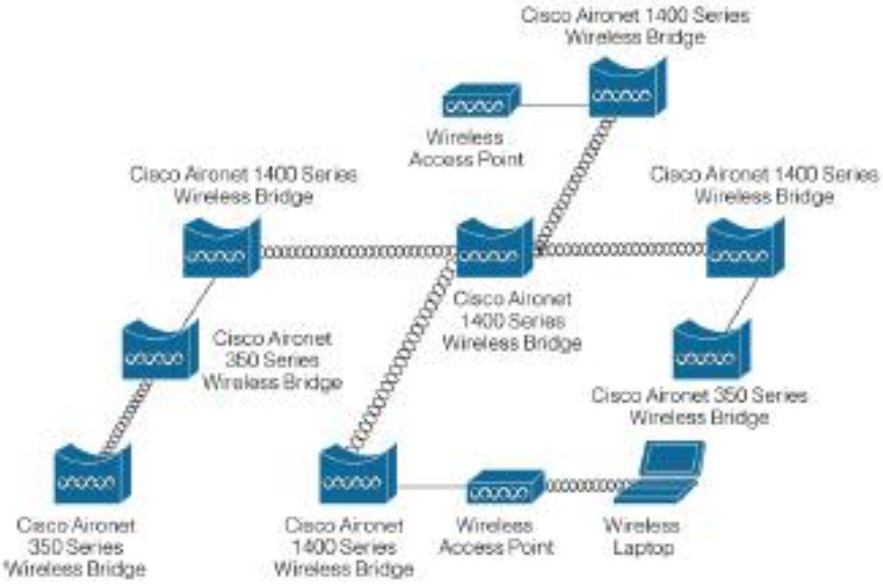
Figure 1. Point-to-Point and Point-to-Multipoint Applications



Mobile Networks and Wireless Bridges

The concept of mobile networks is significant not only for service providers looking to offer seamless network access, but also for individual organizations such as municipal public safety units. In many instances, the technology exists to create the zones that provide the mobile network, but the challenge lies in bringing the network to these zones. The Cisco Aironet 1400 Series Wireless Bridge provides a cost-effective solution to this application. The wireless bridge can connect to the network that contains the 2.4 GHz access points or bridges that are providing wireless zone coverage, and also provide the backhaul link to the high-speed network (Figure 2). Whether these zones are 802.11 hot spots at cafes and restaurants or bridged 802.11b cells for mobile networks, the Cisco Aironet 1400 Series Wireless Bridge provides a non-interfering and higher speed distribution service.

Figure 2. Public Safety Network Utilizing Wireless Bridges



ROI

The high-speed links between the wireless bridges deliver throughput several times faster than E1/T1 lines for a fraction of the cost—eliminating the need for expensive leased lines or difficult-to-install fiber-optic cable. Because bridges have no recurring charges, savings on leased-line services quickly pay for the initial hardware investment. The Cisco Aironet 1400 Series with its 54 Mbps throughput capability connects discrete sites into a single LAN at speeds much greater than leased lines, even when they are separated by obstacles such as freeways, railroads, or bodies of water that are practically insurmountable using copper or fiber-optic cable.

High Performance

Operating in the unlicensed 5.8 GHz band, the Cisco Aironet 1400 Series Wireless Bridge sets a new standard for performance, combining powerful 250 mW radios, industry-leading receive sensitivity, installation tools to assist in bridge placement, delay spread capabilities, and a choice of integrated or connectorized high gain antennas, Cisco provides a complete solution for a wide variety of fixed wireless applications.

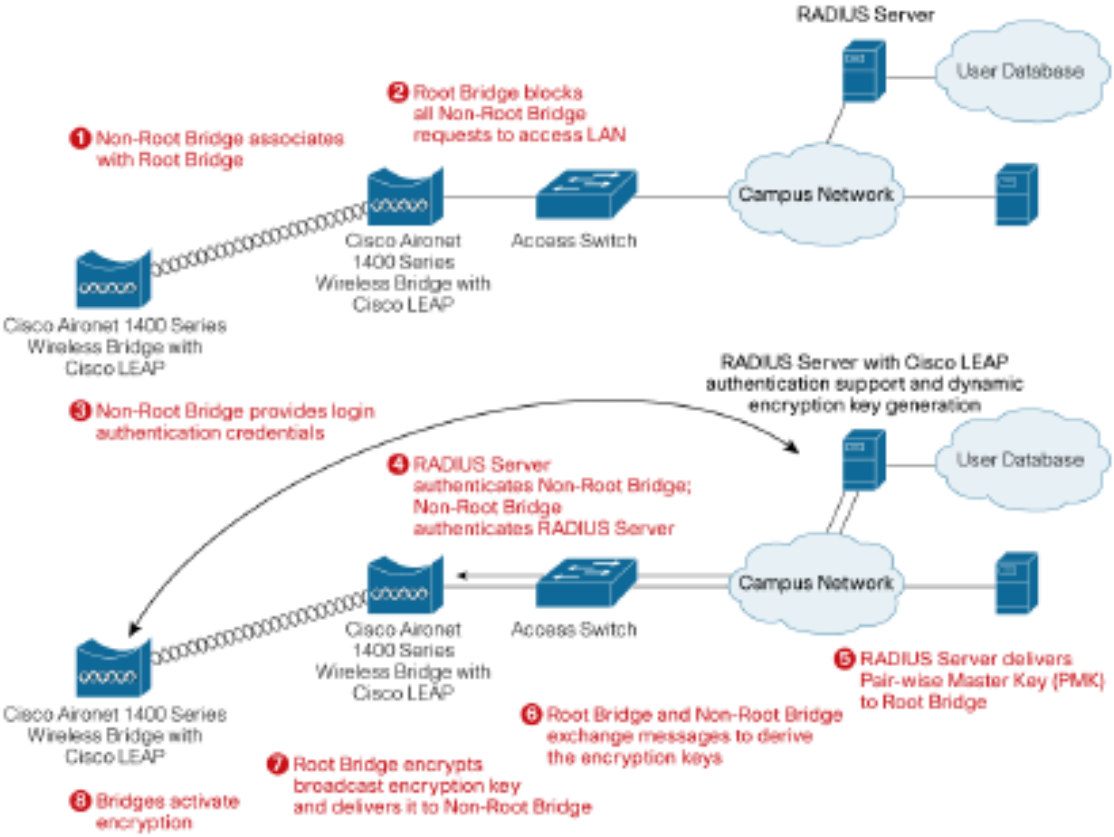
Data rates of 54 Mbps can be enabled for point-to-point links up to 8.5 miles, and for point-to-multipoint links up to 2.75 miles. Aggregate throughput can be obtained in excess of 28 Mbps. Also, by using higher gain antennas or lower data rates, ranges in excess of 20 miles point-to-point can be covered.[1]

[1] Aggregate throughput can be obtained in excess of 28 Mbps. Also, by using higher gain antennas or lower data rates, ranges in excess of 20 miles point-to-point can be covered.

Security

Cisco Aironet has a proven track record for leading the industry with advanced security features. Building on basic wireless security, support for the Cisco Wireless Security Suite is included with the Cisco Aironet 1400 Series Wireless Bridge (Figure 3), featuring support for IEEE 802.1X mutual authentication and strong encryption with Temporal Key Integrity Protocol (TKIP). Network managers can confidently deploy a wireless bridging solution that provides robust security and protection, with the ease of centralized management through a Remote Authentication Dial-In User Service (RADIUS) server such as Cisco Secure Access Control Server (ACS).

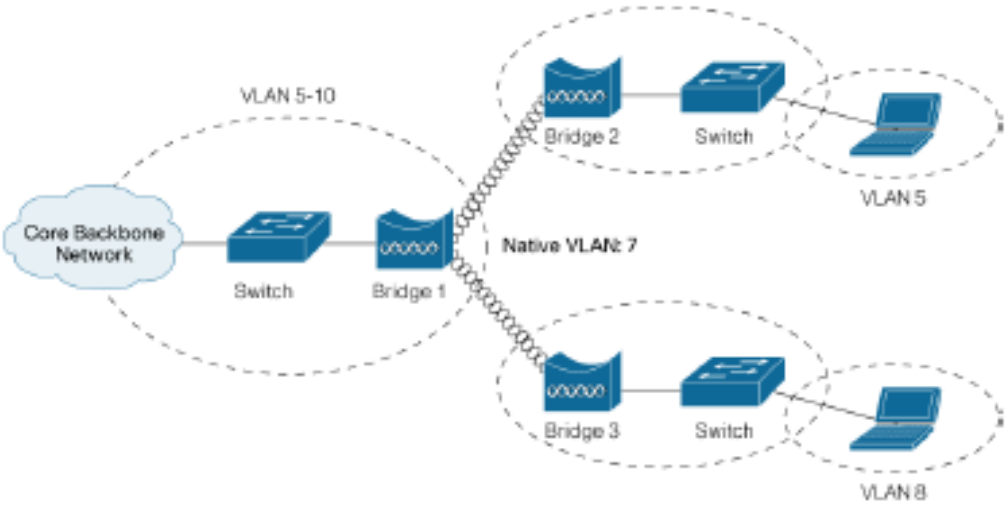
Figure 3. Wireless Bridge Security with the Cisco Wireless Security Suite



Intelligent Network Services

The Cisco Aironet 1400 Series Wireless Bridge utilizes Cisco IOS® Software to provide a familiar user interface with common functionality, scalability, and security. Additionally, advanced features such as quality of service (QoS) are included, enabling packet prioritization for voice, video, and data. Trunking up to 24 voice-over-IP (VoIP) circuits and data over point-to-point links is also possible. Bandwidth can be increased between bridged networks through the aggregation of multiple bridges at each site through Fast Ether Channel (FEC), or Port Aggregation Protocol (PAg-P), or through routing protocols. For a multipurpose network, Virtual Local Area Networks (VLANs) can be configured by allowing different non-root bridges operating on the same root bridge to trunk different VLANS. Network services can now be segmented based upon end user requirements (Figure 4).

Figure 4. VLAN Configuration for Wireless Bridges



Flexible

Rapid deployment and redeployment can be achieved with no reliance upon telecommunications providers nor a lengthy license or trenching process. The Cisco Aironet 1400 Series Wireless Bridge allows placement in an outdoor environment without the use of an expensive additional National Electrical Manufacturers Association (NEMA) enclosure. Further flexibility is achieved by enabling point-to-point or point-to-multipoint networks with a single product line. The mounting bracket has been designed to allow installation on poles, walls, and roofs, while also providing a mechanism for choosing the desired polarization. The Cisco Aironet 1400 Series Wireless Bridge offers an outdoor wireless bridging solution in two product SKUs. The captured antenna version features an integrated radio and high-gain integrated antenna for user installations of point-to-point links and the non-root nodes of point-to-multipoint networks. The connectorized version provides professional installers with an N-Type connector that allows the deployment of the root nodes of point-to-multipoint networks with omni-directional or sector antennas, or of high gain dish antennas for longer links. The external antenna options are:

- 9.0 dBi vertically polarized omni antenna
- 9.5 dBi sector antenna with support for vertical or horizontal linear polarization
- 28.0 dBi dish antenna with support for vertical or horizontal linear polarization

Ease of Use

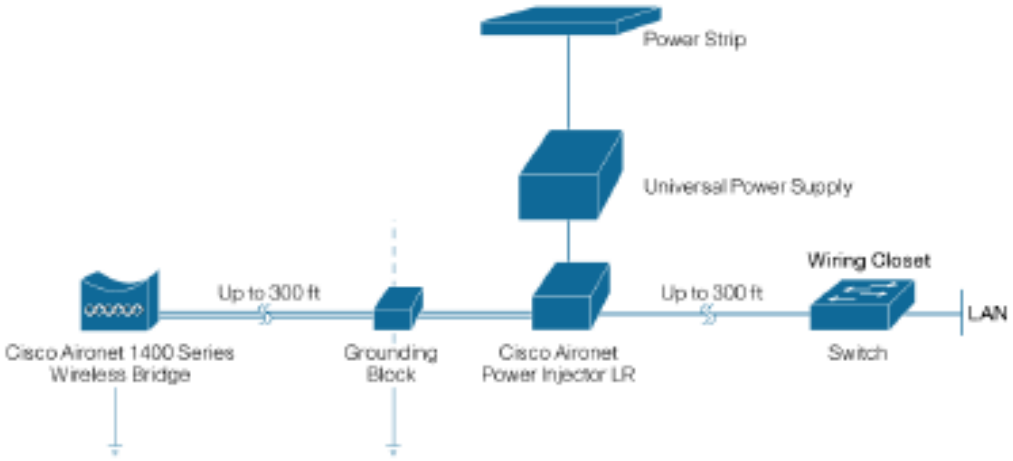
Based upon IEEE 802.11a technology and utilizing the same Cisco IOS Software as in a wired network, the Cisco Aironet 1400 Series provides a user with a familiar experience that supports an "out-of-the-box" deployment. Convenient LEDs and an externally accessible Received Signal Strength Indicator (RSSI) for alignment feedback/diagnostics and a quick-hang mounting bracket allows for an easy installation process.

To simplify ordering and installation, the Cisco Aironet 1400 Series Wireless Bridge provides the professional or IT installer with all of the components and accessories necessary to complete most deployments, including:

- The Cisco Aironet Power Injector LR for supplying power to the bridge without expensive electrician costs (Figure 5). The power injector also extends the distance the 1400 Series Wireless Bridge can be installed from the network. (Figure 6)
- The Cisco Aironet 1400 Series Multifunction Mount, with its innovative design, to provide greater ease of installation and flexibility. The mount comes complete with stainless steel hardware to improve corrosion resistance.
- Two lengths of shielded Dual RG-6 cables and a building entry point grounding block, all with F-Type connectors for use with the Power Injector LR and connection to the bridge unit.
- A power supply and cord, enough coaxial sealant for all outdoor connectors, and corrosion-proof gel to protect grounding connections.

Figure 5. Cisco Aironet Power Injector

Figure 6. Power Injector Distance Extension



Advanced Management Features

The CiscoWorks Wireless LAN Solution Engine (WLSE) is available as a management tool for Cisco Aironet access points operating autonomously (without a Wireless LAN Controller) and wireless bridges. CiscoWorks WLSE is a turnkey, scalable, and centralized management platform with an HTML-based interface. It uses Simple Network Management Protocol (SNMP) and Secure Shell (SSH)/Secure Sockets Layer (SSL) for managing Cisco Aironet access points and wireless bridges via a Web browser.

For more information on CiscoWorks WLSE, visit: http://www.cisco.com/go/wlse

See Table 1 for additional features and benefits. For system specifications of the Cisco Aironet 1400 Series Wireless Bridge see Table 2, for product specifications see Table 3.

Table 1. Features and Benefits

Features	Benefits
802.11a radio with 24 dBm (250 mW) maximum transmit power, -70 dBm receive sensitivity at 54 Mbps data rate[2]	The 5.8 GHz radio in the Cisco Aironet 1400 Series offers superior radio performance that results in industry-leading range. The greater the range, the higher the supported data rate or the more reliable the link at a given data rate.
Industry-leading security, network management, and software feature set	The Cisco Aironet 1400 Series software builds on the feature-rich, customer-driven Cisco Aironet software and the Cisco Wireless Security Suite, including 802.1X support with mutual authentication and dynamic encryption keys with TKIP; management through SNMP, Telnet, and Web browsers.
Fully weatherized metal housing and extended operating temperature (-30 to 55oC or -22 to 131oF)	The rugged weatherproof design of the Cisco Aironet 1400 Series provides flexibility for deployment in a variety of settings. The rugged features and broad operating temperature range support deployment in factories, warehouses, and the outdoors.
The Cisco Aironet Power Injector LR	The Power Injector LR converts the standard 10/100 baseT Ethernet category 5 RJ-45 interface that is suitable for weather-protected areas to a dual F-Type connector interface for dual coax cables that are more suitable for harsh outdoor environments. While providing a 100baseT interface to the Cisco Aironet 1400 Series, the Power Injector LR also provides power to the unit over the same cables with a power discovery feature that protects other appliances from damage should they accidentally be connected. As an added benefit to the installer, Auto MDIX is built in, allowing the dual cables to be swapped and while maintaining the same functionality. To support longer cable runs from your infrastructure network switch or router, the Power Injector LR is designed to accommodate 100 m coaxial cable run plus 100 m of indoor cat5 cable, to enable total cable runs up to 200 meters. Lightning and surge protection is also included at the F-Type connector interface to provide added protection to your network infrastructure devices.
Flexible mounting with multifunction mount or optional roof/wall mount	The Cisco Aironet 1400 Series Multifunction Mount allows the captured antenna Cisco Aironet 1400 Series to provide either horizontal or vertical polarization. With its quick-hang feature, the mount will support the weight of the bridge during the alignment process. To assist the installation, hoisting rings are attached to the mount. The mount will interface to poles or masts from 1.5 in. to 2.5 in. while allowing for elevation and azimuth alignment. For the connectorized version, the mount provides a wall mount mechanism. The captured antenna Cisco Aironet 1400 Series can be mounted to a wall, roof, or other flat surface with the addition of the optional Cisco Aironet 1400 Series Roof/Wall Mount kit.
Wireless root bridge	The wireless root bridge role provides the Cisco Aironet 1400 Series with support for both point-to-point or point-to-multipoint bridging
Wireless non-root bridge	The wireless non-root bridge allows the Cisco Aironet 1400 Series to operate as the remote node in a point-to-point or point-to-multipoint bridge network.
Wireless packet concatenation	The concatenation of smaller packets into larger ones allows the Cisco Aironet 1400 Series to more efficiently utilize the wireless medium and provide higher overall data throughputs.
Wireless link distance adjustment	The link distance parameter allows the user to tune the carrier sense multiple access with collision avoidance (CSMA/CA) parameters for the particular range to maximize performance.
Wireless programmable clear channel assessment	With a programmable clear channel assessment, the Cisco Aironet 1400 Series can be configured to the particular background interference level found in your environment for reduced contention overhead with other wireless systems.
Antenna alignment assistance	The Cisco Aironet 1400 Series Wireless Bridge provides an auto-configuration and installation mode for out of the box deployment of point to point links without the need for a configuration via telnet, File Transfer Protocol (FTP), or SNMP. This mode drives LEDs and a Received Signal Strength Indicator (RSSI) port with a voltage output proportional to received signal strength for use in the installation and alignment process. This frees up the installers to perform their installation process and verify the link quality without requiring Cisco IOS Software or data networking knowledge.
Diagnostic LEDs	Provide alignment feedback to the installer and diagnostic information to troubleshooters directly at the antenna

[2] 24 dBm transmit power only available in FCC configuration units

Features	Benefits
	without the use of a computer. Diagnostic information is also provided on the Power Injector LR LEDs
16 megabytes of flash memory	Memory space for future firmware upgrades to support new 802.11 standards and advanced features.
One N-Type connector for external antenna connection	The N-Type connector is the industry standard for higher performance RF systems in an outdoor environment and is compatible with the Cisco® line of optional 5.8 GHz antennas, enabling wireless bridging professional installers to customize radio coverage for specific deployment scenarios.
Easy weather sealing and grounding	The Cisco Aironet 1400 Series provides standard N-Type and F-Type coaxial cable connectors for easy and reliable weather sealing and grounding. A coaxial sealant is provided with each system, along with a standard grounding block to allow the installer to meet National Electric Code guidelines.

Table 2. Cisco Aironet 1400 Series Wireless Bridge System Specifications

	AIR-BR1410A-x-K9	AIR-BR1410A-A-K9-N
Frequency band	5.725 to 5.825 GHz (FCC UNII 3)	5.725 to 5.825 GHz (FCC UNII 3)
Wireless modulation	Coded Orthogonal Frequency Division Multiplexing (COFDM)	Coded Orthogonal Frequency Division Multiplexing (COFDM)
Media access protocol	Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)	Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)
Modulation	• BPSK @ 6 and 9 Mbps • QPSK @ 12 and 18 Mbps • 16-QAM @ 24 and 36 Mbps • 64-QAM @ 48 and 54 Mbps	• BPSK @ 6 and 9 Mbps • QPSK @ 12 and 18 Mbps • 16-QAM @ 24 and 36 Mbps • 64-QAM @ 48 and 54 Mbps
Non-overlapping channels	4	4
Receive sensitivity (10% PER with 3200 byte packets)	• 6 Mbps: –83 dBm • 9 Mbps: –83 dBm • 12 Mbps: –83 dBm • 18 Mbps: –82 dBm • 24 Mbps: –79 dBm • 36 Mbps: –76 dBm • 48 Mbps: –72 dBm • 54 Mbps: –70 dBm	• 6 Mbps: –83 dBm • 9 Mbps: –83 dBm • 12 Mbps: –83 dBm • 18 Mbps: –82 dBm • 24 Mbps: –79 dBm • 36 Mbps: –76 dBm • 48 Mbps: –72 dBm • 54 Mbps: –70 dBm
Maximum operational receive level	–19 dBm	–19 dBm
Maximum survivable receive level	0 dBm	0 dBm

	AIR-BR1410A-x-K9	AIR-BR1410A-A-K9-N
Available transmit power settings	• AIR-BR1410A-A-K9 ◦ 250 mW (24 dBm) ◦ 200 mW (23 dBm) ◦ 155 mW (22 dBm) ◦ 125 mW (21 dBm) ◦ 60 mW (18 dBm) ◦ 30 mW (15 dBm) ◦ 15 mW (12 dBm) • AIR-BR1410A-K-K9 ◦ 155 mW (22 dBm) ◦ 125 mW (21 dBm) ◦ 60 mW (18 dBm) ◦ 30 mW (15 dBm) ◦ 15 mW (12 dBm) • AIR-BR1410A-Z-K9 ◦ 20 mW (13 dBm) ◦ 10 mW (10 dBm) ◦ 8 mW (9 dBm) ◦ 6 mW (8 dBm) ◦ 5 mW (7 dBm) ◦ 2.5 mW (4 dBm) • AIR-BR1410A-E-K9 ◦ 5 mW (7 dBm) ◦ 2.5 mW (4 dBm)	• 250 mW (24 dBm) • 200 mW (23 dBm) • 155 mW (22 dBm) • 125 mW (21 dBm) • 60 mW (18 dBm) • 30 mW (15 dBm) • 15 mW (12 dBm)
	Note: Maximum power setting will vary according to individual country regulations	
Point-to-point range[3]	• Americas ◦ 8.5 miles (14 km) @ 54 Mbps ◦ 16 miles (26 km) @ 9 Mbps • Korea ◦ 5.5 miles (9 km) @ 54 Mbps ◦ 11.25 miles (18.25 km) @ 9 Mbps • Australia & New Zealand ◦ 3.5 miles (5.75 km) @ 54 Mbps ◦ 9.5 miles (15.25 km) @ 9 Mbps • Ireland & China ◦ 1.75 miles (2.75 km) @ 54 Mbps ◦ 7.25 miles (11.5 km) @ 9 Mbps	• Americas ◦ 13 miles (21 km) @ 54 Mbps ◦ 23 miles (37 km) @ 9 Mbps ◦ (Antennas are 28 dBi dish)
Point-to-multipoint range (sector antenna at root)[3]	• Americas ◦ 2.75 miles (4.5 km) @ 54 Mbps ◦ 8.5 miles (14 km) @ 9 Mbps • Korea ◦ 1 mile (1.75 km) @ 54 Mbps ◦ 5 miles (8 km) @ 9 Mbps • Australia & New Zealand ◦ 0.75 miles (1.2 km) @ 54 Mbps ◦ 3.25 miles (5.25 km) @ 9 Mbps • Ireland & China ◦ 0.4 miles (0.6 km) @ 54 Mbps ◦ 1.75 miles (2.75 km) @ 9 Mbps	• Americas ◦ 4.25 miles (7 km) @ 54 Mbps ◦ 11 miles (18 km) @ 9 Mbps ◦ (Non-root antenna is 28 dBi dish)
Antenna	Captured Linear Polarization; 22.5 dBi gain[4]; 10°E-plane by 12° H-plane beamwidth	One N-Type connector for professional installations (antennas sold separately)

[3] The distances referenced here are approximations and should be used for estimation purposes only.
[4] AIR-BR1410A-E-K9 has 20 dBi gain

	AIR-BR1410A-x-K9	AIR-BR1410A-A-K9-N
Security	Cisco Wireless Security Suite, including: • Authentication ◦ 802.1X support including LEAP to yield mutual authentication and dynamic per-user, per-session encryption keys • Encryption ◦ Support for static and dynamic IEEE 802.11 WEP keys of 40 bits and 128 bits ◦ WPA TKIP and Cisco TKIP enhancements: key hashing (per packet keying), Message Integrity Check (MIC), and broadcast key rotation	Cisco Wireless Security Suite, including: • Authentication ◦ 802.1X support including LEAP to yield mutual authentication and dynamic per-user, per-session encryption keys • Encryption ◦ Support for static and dynamic IEEE 802.11 WEP keys of 40 bits and 128 bits ◦ WPA TKIP and Cisco TKIP enhancements: key hashing (per packet keying), Message Integrity Check (MIC), and broadcast key rotation
SNMP compliance	v1 and v2	v1 and v2

Table 3. Cisco Aironet 1400 Series Wireless Bridge Product Specifications

	AIR-BR1410A-x-K9	AIR-BR1410A-A-K9-N	Power Injector LR
Status LEDs	Four LEDs: • Install • Radio • Status • Ethernet	Four LEDs: • Install • Radio • Status • Ethernet	Four LEDs: • Power ON • Injector status • LAN Ethernet status • Bridge Ethernet status
RSSI port	BNC connector DC Voltage port (0VDC to 2.7 VDC)	BNC connector DC Voltage port (0VDC to 2.7 VDC)	—
Uplink	100 Mbps over dual coaxial cables	100 Mbps over dual coaxial cables	10/100BaseT Ethernet
Configuration support	Telnet, HTTP, FTP, TFTP, SNMP	Telnet, HTTP, FTP, TFTP, SNMP	—
Compliance	Standards • Safety: ◦ UL 60950 ◦ CSA C22.2 No. 60950-00 ◦ IEC 60950 ◦ EN 60950 • Radio Approvals: ◦ FCC Part 15.207, 15.407 & 15.209 Class B ◦ ICES-003 Class B (Canada) ◦ Canada DGTP-010 ◦ FCC Bulletin OET-65C ◦ Industry Canada RSS-102, RSP100, RSS 210 Issue 5 • EMI and Susceptibility (Class B): ◦ FCC Part 15.107 & 15.109 Class B ◦ ICES-003 Class B (Canada) ◦ EN 55022 Class B ◦ EN 55024	Standards • Safety: ◦ UL 60950 ◦ CSA C22.2 No. 60950-00 ◦ IEC 60950 ◦ EN 60950 ◦ NEMA 4 • Radio Approvals: ◦ FCC Part 15.207, 15.407 & 15.209 Class B ◦ ICES-003 Class B (Canada) ◦ Canada DGTP-010 ◦ FCC Bulletin OET-65C ◦ Industry Canada RSS-102, RSP100, RSS 210 Issue 5 • EMI and Susceptibility (Class B): ◦ FCC Part 15.107 & 15.109 Class B ◦ ICES-003 Class B (Canada) ◦ EN 55022 Class B ◦ EN 55024	Standards • Safety: ◦ UL 60950 ◦ CSA C22.2 No. 60950-00 ◦ IEC 60950 ◦ EN 60950 • EMI and Susceptibility (ClassB): ◦ FCC Part 15.107 & 15.109 Class B ◦ ICES-003 Class B (Canada) ◦ EN 55022 Class B ◦ EN 55024
Country compliance	Customers are responsible for verifying approval for use in their country. Please see http://www.cisco.com/go/aironet/compliance to verify approval and to identify the regulatory domain that corresponds to a particular country. Not all regulatory domains have been approved. As they are approved, the part numbers will be available on the Global Price List.		
Dimensions	11.4in x 11.4in x 4.2in (29cm x 29cm x 11cm)	11.6in x 11.6in x 3.6in (29cm x 29cm x 9cm)	6.7in x 6.3in x 1.3in (17cm x 16cm x 3cm)
Weight	11 lbs. (5 kg)	10 lbs. (5 kg)	1.4lbs. (0.6kg)
Operational temperature	–30° to +55°C (–22° to +131°F)	–30° to +55°C (–22° to +131°F)	0° to +50°C (32° to 122°F)
Storage temperature	–40° to +85°C (–40° to +185°F)	–40° to +85°C (–40° to +185°F)	–40° to +70°C (–40° to +158°F)

	AIR-BR1410A-x-K9	AIR-BR1410A-A-K9-N	Power Injector LR
Operational altitude	4206 m (13,800 ft.)	4206 m (13,800 ft.)	4206 m (13,800 ft.)
Storage altitude	4877 m (16,000 ft.)	4877 m (16,000 ft.)	4877 m (16,000 ft.)
Humidity	0 to 100% (condensing)	0 to 100% (condensing)	0 to 90% (non-condensing)
Vibration	0.001 G2/Hz from 5–100 Hz	0.001 G2/Hz from 5–100 Hz	0.001 G2/Hz from 5–100 Hz
Storage vibration	0.01 G2/Hz from 5–100 Hz	0.01 G2/Hz from 5–100 Hz	0.01 G2/Hz from 5–100 Hz
Enclosure	Aluminum with environmentally sealed plastic radome	NEMA-4, aluminum	Metal case
AC power	Not Required as uses DC voltage from Power Injector	Not Required as uses DC voltage from Power Injector	100 to 240 VAC +/– 10% (power supply)
DC power	48 VDC +/–2V	48 VDC +/–2V	48 VDC +/–2V
Warranty	One year	One year	One year

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