ESCUELA SUPERIOR POLITÉCNICA DEL LITORAL

Facultad de Ingeniería en Electricidad y Computación

"REDISEÑO Y OPTIMIZACIÓN DE UNA RED DE TRANSMISIÓN DE DATOS EMPRESARIALES, INTEGRANDO UNA RED INALÁMBRICA DE ÚLTIMA GENERACIÓN"

INFORME DE MATERIA INTEGRADORA

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Angela Beatriz Bravo Prieto

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Jessenia Elizabeth Rodríguez Avilés

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Dedicado especialmente a Dios, creador de todas las cosas, mi fortaleza en todo momento, el responsable de mi vida y mi éxito profesional. Quiero dedicar también este proyecto a mis padres, que han estado presentes en cada situación que se presentaba en este interesante proceso, ofreciéndome lo mejor de ellos para culminarlo.

Angela Beatriz Bravo Prieto

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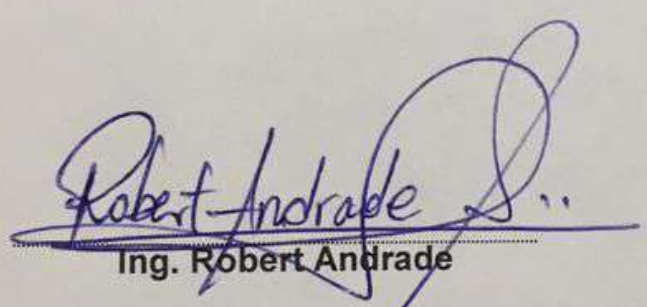
El presente proyecto lo dedico a Jesús mi fiel amigo, quien lo dio todo por mí y lo sigue haciendo, sin su salvación mis metas profesionales y personales no tendrían sentido.

Jessenia Elizabeth Rodríguez Avilés

TRIBUNAL DE EVALUACIÓN



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RESUMEN

El presente proyecto realiza el rediseño de una red empresarial añadiendo un segmento de red inalámbrico utilizando una tecnología de última generación, dando solución a la necesidad de proveer del servicio de red de telecomunicaciones inalámbrico a los galpones de bodegaje de la empresa Parque Industrial Guayaquil.

La empresa tiene un sistema de soterramiento y su medio principal de transmisión de datos es la fibra óptica, debido a las áreas que existen entre los bloques son extensas; se hará uso de este sistema para acceder a cada galpón. Tomando en cuenta la limitante que se presenta en la infraestructura física de los galpones es necesario diseñar una solución cableada que mantenga en conexión a los puntos de acceso que forman la red inalámbrica.

El diseño de red propuesto ofrece un servicio de alto rendimiento que es limitado por la red que posee la empresa, ya que a pesar de que sus dispositivos cuentan con la capacidad necesaria, se requiere reemplazar el cableado que limita a la red a trabajar a mayores velocidades.

Una vez concluido nuestro diseño se pone a disposición adaptadores que permiten que los equipos finales que no cuenten con capacidades para soportar dicha tecnología puedan disfrutar de sus beneficios.

Esta propuesta de diseño tiene un retorno de la inversión a corto plazo y a su vez la empresa podrá incorporar un servicio de telecomunicaciones de calidad que aportará al nivel competitivo de Parque Industrial Guayaquil.

ÍNDICE GENERAL

CAPÍTULO 1

1. PLANTEAMIENTO DEL PROBLEMA.

Parque Industrial Guayaquil, ubicado en la Vía a Daule, es una empresa de inversión y administración extranjera, su misión es proveer galpones de alta seguridad a sus clientes, dichos galpones están ubicados en 13 bloques identificados alfabéticamente, 5 bloques utilizados para locales comerciales y 8 para bodegaje.

En la actualidad Parque Guayaquil proporciona un servicio de red de telecomunicaciones [1] para los locales comerciales, posibilitando la operatividad de sus oficinas de manera electrónica, no así en los galpones utilizados para bodegas, siendo esto una limitante en los beneficios ofrecidos por el parque, causando peticiones constantes de este servicio.

1.1 Estructura de la empresa.

La estructura general de la empresa tiene aproximadamente 42 hectáreas, aunque aún tiene galpones disponibles para el alquiler o compra, aloja a la presente fecha a más de 250 empresas. Parque Guayaquil está conformado por 13 bloques, torres de vigilancia para el control perimetral, una garita para el control de ingreso de vehículos, circulación interna mediante una avenida principal y varias vías conectadas, y por último un área para administrar de manera general el parque; la ubicación de cada área y sus respectivas medidas son mostradas en la Figura 1.1.

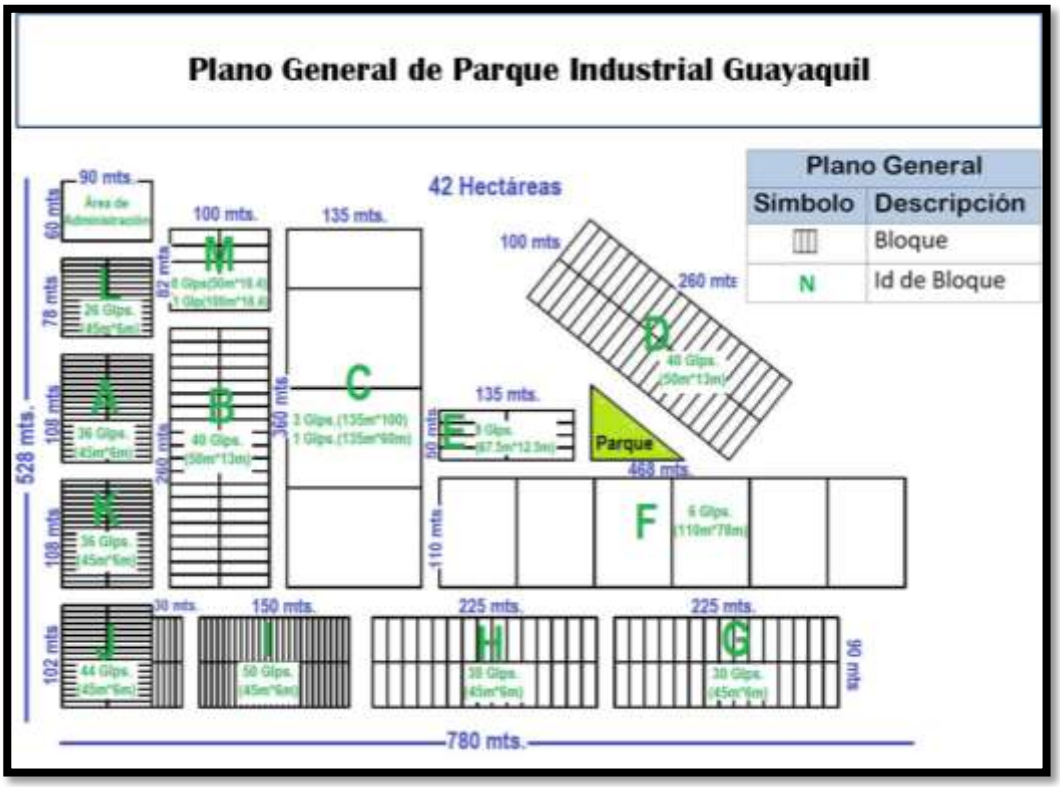

Figura 1.1: Plano general Parque Industrial Guayaquil

El edificio del área administrativa de Parque Guayaquil es de dos plantas, constituido por los siguientes departamentos Gerencia General, Administración, Finanzas, Control de Gestión, Marketing, Recursos Humanos, Secretaria y Recepción; cada departamento cuenta con cinco empleados a excepción de Recepción que solo consta de dos empleados y Gerencia general que cuenta con tres; en la planta baja están situadas los departamentos de Recepción y de Secretaria y en la planta alta las correspondientes a Recursos Humanos y Administración.

Los bloques son de diferentes medidas, divididos a su vez en galpones que en su mayoría son de dimensiones variadas. Los galpones de los bloques L, A, K, J e I están situados en las vías más concurridas y son arrendados o vendidos estratégicamente para oficinas, locales comerciales, supermercados y afines, con el fin de aportar directamente a la publicidad del parque. Parque Guayaquil también ofrece galpones amplios de hasta 10000m2 que son usados como bodegas de almacenamiento masivo de mercadería.

El detalle de medidas exactas de cada bloque con la cantidad de galpones que contienen es especificado en la Tabla 1, dando información necesaria para el presente proyecto.

BLOQUE	# GALPONES	MEDIDAS GENERALES	MEDIDAS DE GALPÓN	Bodega(B) / Local comercial(LC)
Bloque A	36	108mx90m(9720m^2)	45mx6m	LC
Bloque B	40	260mx100m(26000m^2)	50mx13m	B
Bloque C	4	360mx135m(40500m^2)	135mx100m y 135mx60m	B
Bloque D	40	260mx100m(26000m^2)	50mx13m	B
Bloque E	8	135mx50m(6750m^2)	67.5mx12.5m	B
Bloque F	6	468mx110m(51480m^2)	110mx78m	B
Bloque G	30	225mx90m(51480m^2)	45mx15m	B
Bloque H	30	225mx90m(20250m^2)	45mx6m	B
Bloque I	50	150mx90m(13500m^2)	45mx6m	LC
Bloque J	44	120mx102m(12240m^2)	45mx6m	LC
Bloque K	36	108mx90m(9720m^2)	45mx6m	LC
Bloque L	26	78mx90m(7020m^2)	45mx6m	LC
Bloque M	9	100mx82m(8200m^2)	50mx16.4m y 100mx16.4m	B

Tabla 1: Dimensiones de los Bloques de Parque Guayaquil

1.2 Sistema de soterramiento de Parque Guayaquil.

Parque Guayaquil, posee canalizaciones subterráneas de telecomunicaciones [2], su diseño provee cuatro ductos, de los cuales dos están destinados para voz y dos para datos. Este sistema de soterramiento permite la conexión desde el área administrativa hasta cada galpón de locales comerciales, y así gozar de los beneficios que le otorga la red de la empresa.

En la Figura 1.2 se expone el diseño de la canalización de todo Parque Guayaquil.

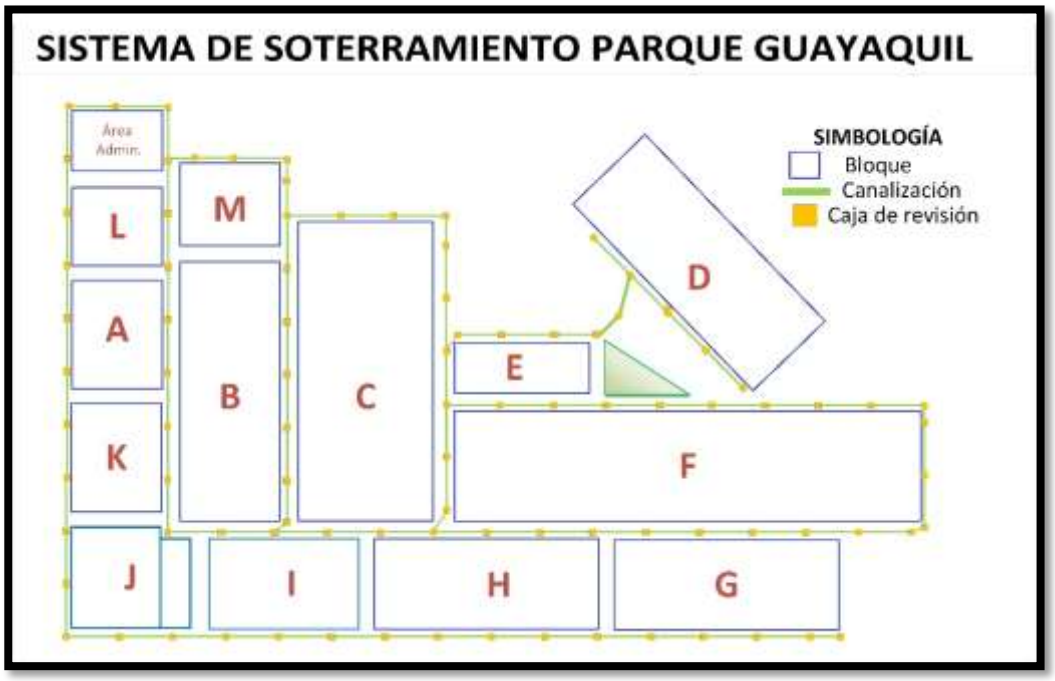

Figura 1.2: Sistema de soterramiento de Parque Guayaquil

1.3 Diseño actual de la red.

Obteniendo un funcionamiento integral de manera óptima Parque Industrial Guayaquil posee una infraestructura de red cableada cuya función es mantener la comunicación entre los departamentos de la empresa y al mismo tiempo de las oficinas o locales comerciales de la misma (Bloque L, A, K, J, I y Área administrativa), esta infraestructura es mostrada en la Figura 1.3.

Este diseño de red dispone de ocho pequeños cuartos de telecomunicaciones, que alojan a los equipos de red necesarios para satisfacer los requisitos generales de un área específica, proveyendo cuatro puntos de red en cada galpón, y los necesarios para las estaciones de trabajo en los diferentes departamentos del área administrativa.

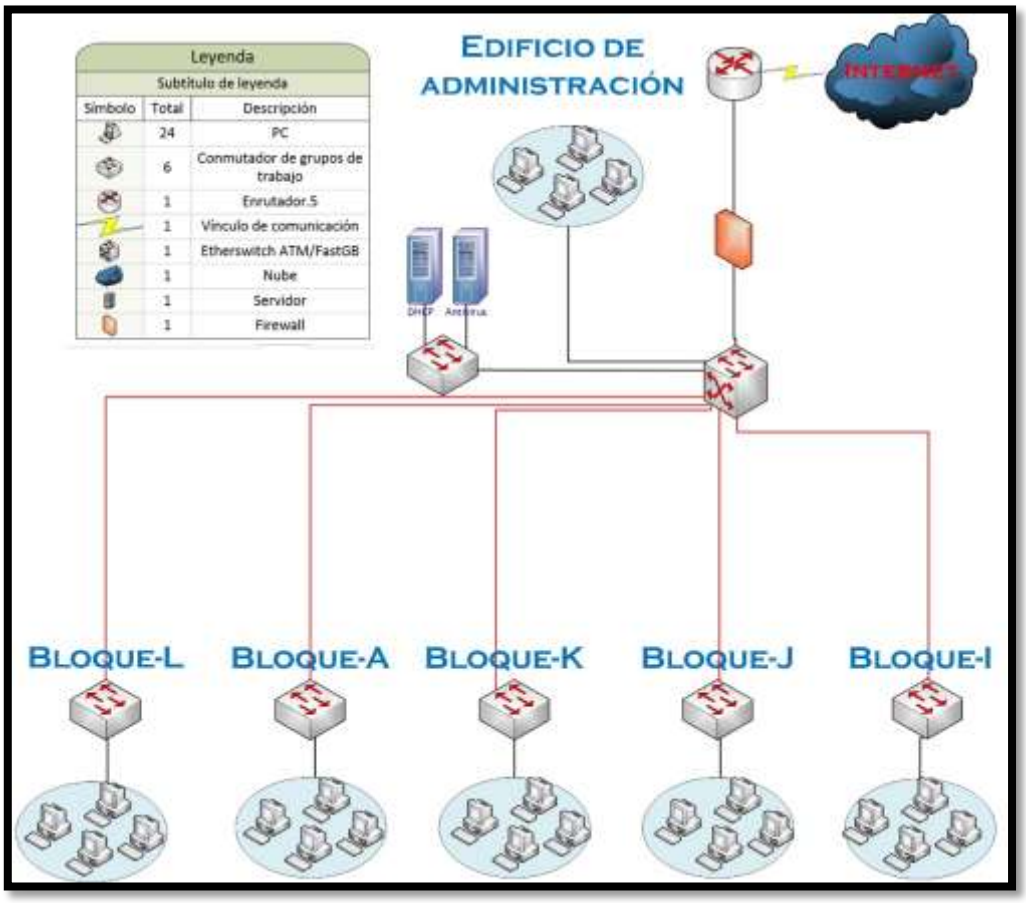

Figura 1.3: Red actual Parque Industrial Guayaquil

Hay ciertas características que nos permiten definir la funcionalidad de la red de una empresa, dichas observaciones se han revisado en Parque Guayaquil, dando como resultado información importante a la hora de fijar un criterio acerca del rendimiento de la red en la empresa.

Esta red aloja alrededor de 800 estaciones de trabajo y más de 15 equipos intermediarios conectados a través de enlaces de Fibra Óptica [3] desde el cuarto de telecomunicaciones del área administrativa hasta las entradas de los cuartos de telecomunicaciones situados en los bloques antes nombrados, y están interconectados mediante cable UTP Categoría 5 [4] dando conexión a los equipos finales.

En la siguiente tabla se ven reflejadas las particularidades de la red actual de Parque Guayaquil, que tiene lugar tanto en el área administrativa como en los bloques de locales comerciales.

	Descripción Actual
Modelo de la red	Jerárquico
Estaciones de trabajo	35 (Área administrativa) y 704 (Locales comerciales)
Tecnología	100BaseTx
Medio	Cable y Fibra Óptica
Tipo de cable	UTP Categoría 5, FO Multimodo
Velocidad de transmisión	100Mbps
Distancia Máxima	100m

Tabla 2: Especificaciones generales de la red

La productividad de la red, así como la velocidad o escalabilidad que pueda tener, depende mucho de las características que poseen los dispositivos utilizados o como han sido configurados, por ello se ha analizado y colocado en una tabla informativa las especificaciones descritas para cada uno de ellos, ya que son de vital importancia a la hora de evaluar una red (Véase Tabla 3).

DISPOSITIVO		CANTIDAD
Dispositivo Firewall HP F1000-A-EI VPN (JG214A)		
Tasa de transferencia	4GB	1
Puertos de doble personalidad	12 puertos	
ranuras para módulos de E/S	2 ranuras	
Throughput de Firewall	4GB	
Sesiones concurrentes	1 millón	
Túneles VPN IPSec	2000	

Router CISCO 7201		
Estándar de red	IEEE 802.1Q	1
Conexión WAN	Ethernet (RJ-45)	
Ethernet LAN, velocidad de transferencia de datos	10/100 / 1000Mbps	
Media Interface	10Base-T: Categoría 3 o superior UTP Categoría 3 100Base-TX: Categoría 5 UTP 1000Base-T: Súper Categoría 5 UTP	
Tecnología de cableado	10/100/1000Base-T(X)	
Seguridad	CAN/CSA-C22.2 No. 60950-1-03, EN 60950-1, IEC 60950-1, AS/NZS 60950-1, EN/IEC 60825-1, 21 CFR 1040, UL60950-1	
Switch TP-Link TL-SF1024D		
Estándar de red	EEE 802.3i, IEEE 802.3u, IEEE 802.3x	13
Interface	10BASE-T: cable UTP categoría 3, 4, 5 (máximo 100m) 100BASE-TX: cable UTP categoría 5, 5e o cable superior (máximo 100m)	
Computadora de escritorio HP Pavilion p6-2013it		
Procesador	AMD A6 3600	35
Memoria	8Gb	
LAN	1000-Base-T	
Disco Duro	1T	
CANON PIXMA MG2550		
Funciones	Impresión, copia, escaneo	6

Tecnología de impresión	2 cartuchos FINE (negro y color) Sistema de inyección de tinta con gotas de 2 picolitros (mín.)	
Tipo de interfaz	PC / Mac Hi-Speed USB (Puerto B)	
CISCO SYSTEMS WS-C2960 +24 LC-S CATALYST 2960 PLUS 24 PUERTOS		
Power over Ethernet	SI	1
Velocidad	1000 Mbps	
Conmutación	Capa 2 y 3	
Puertos LC	24	
NETGEAR FR114P		
Servidor1	DHCP	2
Servidor2	Antivirus	
TOTAL ELEMENTOS DE RED		59

Tabla 3: Especificaciones de los Equipos de la empresa

1.4 Definición del problema.

Cuando Parque Industrial Guayaquil realizó su plan de diseño de red de telecomunicaciones, no tomó en consideración que el acceso a internet es de suma importancia para facilitar el trabajo que se realiza en las bodegas, debido a esto, ha acordado anexar una red WIFI [5] de última generación que dé cobertura a las bodegas de cada bloque, de manera que tengan acceso a un servicio de comunicación de alta disponibilidad, fiabilidad y confianza para la transmisión de voz y datos de sus usuarios móviles, agilitando procesos como la toma de inventario electrónico, control de actividades generales en tiempo real e inclusive hacer uso de un servicio de video vigilancia dentro de las bodegas.

Esta red suplirá la necesidad de comunicación de estas empresas, pero también se requiere que trabaje en conjunto y en las más óptimas condiciones con su red actual, sin embargo, existe un problema adicional suscitado

frecuentemente al momento de integrar una red WIFI como la antes detallada, es cuando se identifican las características de la red actual y estas se tornan deficientes en comparación con nuestros requerimientos para la red inalámbrica, produciendo una incompatibilidad entre ambas redes y por ende una comunicación inalámbrica de baja calidad, desaprovechando los beneficios que ofrece una red WIFI competente. Estos aspectos que han sido mencionados son los que se tomaran en cuenta en el desarrollo del diseño.

1.5 Objetivos General.

1.5.1 Objetivo General

Diseñar una red inalámbrica de última generación para los bloques de galpones destinados para bodegaje de la empresa Parque Industrial Guayaquil.

1.5.2 Objetivos Específicos.

1. Analizar la red actual de la empresa y determinar factores importantes que influyen en la integración de la nueva red.
2. Proponer una solución en respuestas a los aspectos deficientes de la red actual, para que trabaje de manera congruente con la red inalámbrica de última generación.
3. Establecer la mejor solución en tecnologías inalámbricas y plantear las mejores prácticas para la infraestructura de la red actual de la empresa.

CAPÍTULO 2

2. DISEÑO DE LA PROPUESTA DE RED.

En este capítulo se explicará el diseño propuesto para la red de telecomunicaciones del Parque Industrial Guayaquil, innovando su red actual y anexando una red inalámbrica moderna. Dicho trabajo se realizará de manera pormenorizada, explicando la estructura de la red actual, características utilizadas y los inconvenientes actuales o por suscitarse en la incorporación de la red inalámbrica, la que se estará detallando y adjuntando su correspondiente análisis, tanto características de los equipos como sus respectivas configuraciones, así mismo la seguridad implementada, mostrando el diseño físico y lógico de la red.

2.1 Diagrama de solución.

Se ha tratado de aprovechar al máximo las instalaciones y equipos que están alojados en la empresa haciendo válida la inversión inicial de la misma. Para ello mediante la Figura 2.1 se detalla la propuesta del diagrama simplificado de la solución de red general de la empresa.

La estructura lógica de la red estará basada en el modelo de tres capas [6], separando las funciones de cada elemento de la red relacionado, optimizando el ancho de banda, facilitando a su vez la administración y escalabilidad a la misma.

Para el acceso a los bloques se utilizará la estructura de cableado de fibra óptica soterrado que existe en la empresa, a la que se conectarán los conmutadores para proveer comunicación a los puntos de acceso [7] (AP por sus siglas en inglés) que permitirán a los usuarios finales acceder a la red. Los puntos de acceso de cada galpón se interconectarán de manera cableada a conmutadores designados a su respectivo bloque y por ende a la red, por medio de éste los demás darán cobertura al interior del mismo. Estos APs serán administrados a través de controladores inalámbricos [8].

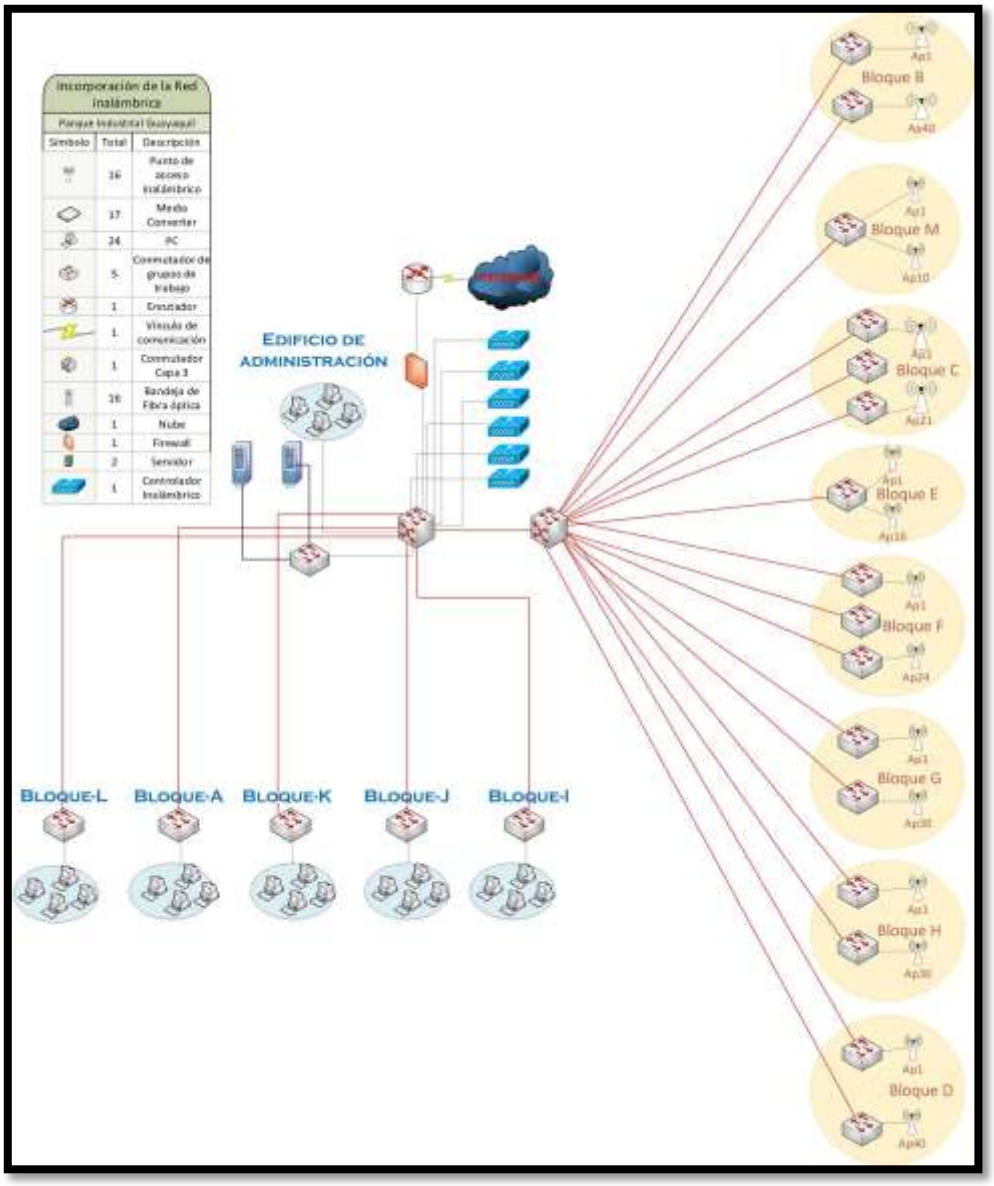

Figura 2.1: Diagrama de solución

2.2 Rediseño de la red cableada.

En el análisis de la situación actual de la empresa, se ha encontrado que la red con la que se está trabajando utiliza la tecnología 100BaseTx [9], esto quiere decir que la velocidad de transmisión es de 100Mbps, sin embargo los equipos

que forman la red cuentan con características técnicas de gran rendimiento, los mismos que nos ayudarán a migrar a una tecnología más avanzada.

La opción es transformar la red actual en una Gigabit Ethernet (GigaE) 1000Base-T [10] que permitirá la interacción eficiente con la red inalámbrica de última generación.

Para esto el único cambio necesario en la parte física de la red es cambiar el tipo de cable a UTP categoría 6a, que proporciona una velocidad de hasta 10Gbps, con una cobertura de máximo 100m, de esta forma la empresa estará un paso adelante frente a las exigencias de algunas tecnologías o aplicaciones que actualmente o en los próximos años podrían requerir mayor rendimiento. El trayecto dispuesto para este cableado será el mismo que llevó el de la red inicial.

Una vez que esté instalado todo el cableado y los equipos tengan las mismas especificaciones del enlace, tanto en el modo de transmisión con el que fluyen los datos por la interfase de red, como en la velocidad; la configuración de la tecnología 1000Base-T se dará automáticamente en cada uno de los dispositivos mediante la autonegociación [11] que se mantiene entre estos en la red.

Con esto se ha logrado que Parque Industrial Guayaquil tenga una infraestructura de red robusta y altamente disponible para los 5 bloques y el edificio de administración.

2.3 Diseño de la red inalámbrica propuesta.

En respuesta de los requerimientos de la empresa en sus 8 bloques que han sido asignados como bodegas, donde hay limitación en la estructura y debido a la actividad que se realiza en ellas sus equipos están en constante movilidad; por ende, lo solicitado es una red inalámbrica de alto rendimiento, para ello se ha procedido a evaluar las diferentes tecnologías que nos ofrece el mercado en la actualidad, dando como resultado que la tecnología 802.11ac [12] ofrece mayores beneficios, el más sobresaliente de ellos es la velocidad que opera por

encima de 1Gbps y va de acuerdo a nuestra demanda, y sobretodo es la puerta abierta para la compatibilidad con futuras tecnologías que podrán ser implementadas sin ninguna limitante, no así las anteriores.

2.3.1 Diseño de la infraestructura física de la red inalámbrica.

El área en donde se va a establecer la red inalámbrica es bastante crítica, ya que por seguridad Parque Guayaquil cuenta con una infraestructura hecha de hormigón [13], tanto en las vías para circulación interna como en los galpones, factor que impide llegar mediante señal a ellos. Pensando en este inconveniente, se ha visto la necesidad de utilizar la fibra óptica subterránea que posee la empresa, implementado en canalizaciones con diseño rectilíneo, paralelo a los bordes de cada bloque. Esta fibra óptica que está alojada en bandejas de fibra, tiene entrada a cada galpón, y consta de 64 hilos que serán distribuidos de 2 en 2 en cada galpón mediante el uso de un cable de 6 hilos, llegando hasta un conmutador y mediante cable de cobre UTP Cat. 6a [14] llegar a los APs.

El diseño de la ruta de fibra óptica que utilizará la red inalámbrica para acceder a cada bloque es mostrado de manera general en la Figura 2.3.

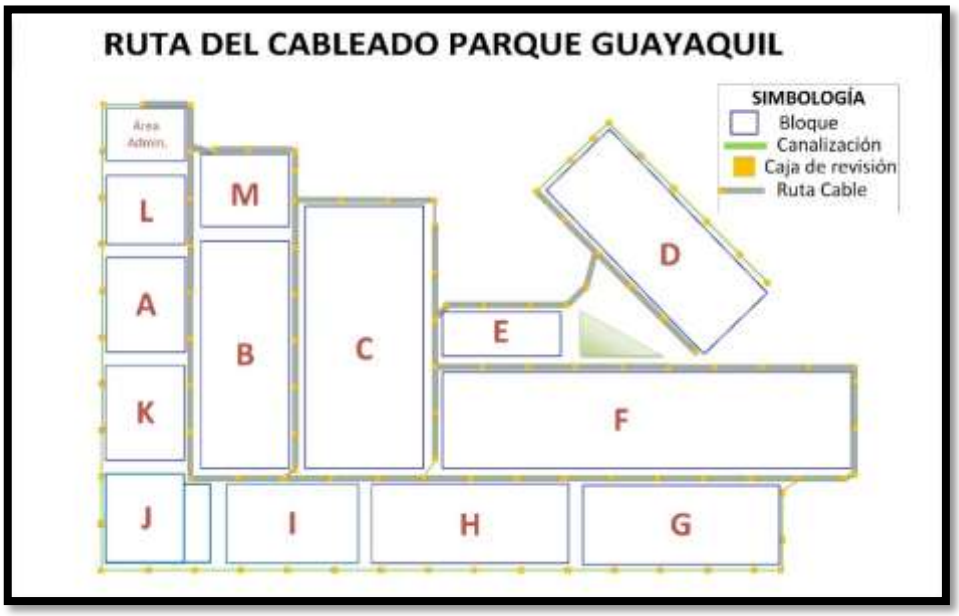

Figura 2.3: Diseño de cableado subterráneo

2.3.2 Esquema de dispositivos requeridos para la red inalámbrica.

En el mercado existe ya una amplia gama de productos que soporten la tecnología 802.11ac, sin embargo después de investigar a varios de estos, se procedió a escoger los que tienen mayores beneficios en su rendimiento así como el costo de cada uno. (Véase Tabla 4 y 6). También se extrajo la información de los "Data Sheet" de cada dispositivo encontrado colocados en el anexo 4.

Dispositivo	Descripción
Punto de acceso Linksys EA6900 AC1900 [15]	• Tecnología 802.11ac • Doble banda simultánea 2,4 + 5 GHZ • Hasta 50 usuarios simultáneos • Enfoca la señal inalámbrica que se envía a los dispositivos conectados • Cifrado inalámbrico WPA/WPA2 y firewall SPI.

Controlador Wireless Cisco WLC 2500 [16]	• Soporta 75 puntos de acceso • Estándares inalámbricos soportados: IEEE 802.11a, 802.11b, 802.11g, 802.11d, WMM/802.11e, 802.11h, 802.11k, 802.11n, 802.11r, 802.11u, 802.11w, 802.11ac • Autenticación basada en Web • Soporte para administración de usuarios TACACS.
Cisco Catalyst 4500X-32 SFP+ [17]	• 32 puertos de 10GE /10/100/1000-baseT • Switch administrable (QoS, VLAN, DHCP, ACL) • Voltaje de entrada (110 V AC 220 V AC) • Agregación de Enlaces.
Cisco Systems SG500X-24P [18]	• 24 puertos 10/100/1000 • Puertos de 10 Gigabit Ethernet SFP+ (1/5/10GE SFP+) • Potencia dedicada para PoE 375W • La potencia máxima suministrada por Puerto para PoE + es 30W • Permite ACLs, múltiples niveles de privilegios para usuarios en CLI, control de cuentas RADIUS/TACACS.
Cisco Catalyst 3560CX-12PD-S [19]	• PoE disponible 240W • 12 Puertos 10/100/1000 Gigabit Ethernet con PoE • 4000 ID VLAN • Unidad máxima de transmisión 9000 bytes. • La potencia máxima suministrada por Puerto para PoE + es 30W
Cisco Catalyst WS-C3560CX 8XPD-S [20]	• Potencia total dedicada a PoE: 240W • La potencia máxima suministrada por Puerto para PoE + es 30W • 6 Puertos GE PoE + • puertos MultiGE PoE + • Enlaces ascendentes: 2 puertos 10G SFP +
Adaptador 802.11ac	• USB - D-Link DWA-182

Tabla 4: Descripción de los dispositivos inalámbricos

Para agregar medidas de seguridad eficaces y facilidad en la administración de la infraestructura inalámbrica se utilizará 6 controladores considerando como solución el modo basado en controlador [21], que nos ofrece además de los beneficios del modo autónomo una administración centralizada.

Es necesario adquirir 16 dispositivos conmutadores con módulos SFP+ [22] que soporten hasta 10Gb cada uno de sus puertos, permitiendo establecer conexiones con los puntos de acceso, y así aprovechar los beneficios de la fibra óptica, tales como disminuir el efecto de ruidos e interferencias, mayor ancho de banda y evidentemente poder cubrir mayores distancias.

Este diseño de red utilizará 211 enrutadores inalámbricos, ubicados dependiendo de las medidas que tenga cada galpón para dar cobertura total a los mismos. Estos APs serán gestionados a través de controladores inalámbricos, optimizando la eficiencia de la red.

La tecnología 802.11ac tiene una cobertura de 30m a la redonda, lo que aporta a definir la ubicación y cuantos APs se necesitarán para cada galpón, dando como resultado lo siguiente:

BLOQUE	# Puntos de acceso	OBSERVACIONES	Potencia de la señal
Bloque B	40	1 AP por galpón	25m
Bloque C	21	6 AP por galpón excepto C-1 que contará con 3 AP	30m
Bloque D	40	1 AP por galpón	25m
Bloque E	16	2 AP por galpón	25m
Bloque F	24	4 AP por galpón	30m
Bloque G	30	1 AP por galpón	25m
Bloque H	30	1 AP por galpón	25m
Bloque M	10	1 AP por galpón excepto M-5 que contará con 2 AP	25m y 30m

Tabla 5: Cantidad y distribución de puntos de acceso

En base al tamaño de las bodegas se elaboró el diseño de la ubicación exacta de cada AP dentro de la misma y se estableció cuánto se reducirá la potencia de la señal para evitar que la señal llegue fuera de los galpones e intrusos puedan acceder a ella. Nuestro diseño comprende de 1 a 6 AP, superponiendo los radios de cobertura de cada AP para lograr itinerancia [23] y permitir la movilidad de los usuarios en todo el galpón sin perder conexión.

Se instalará un único AP en el centro de cada galpón perteneciente a los bloques B, D, H, y G (Véase Figura 2.4).

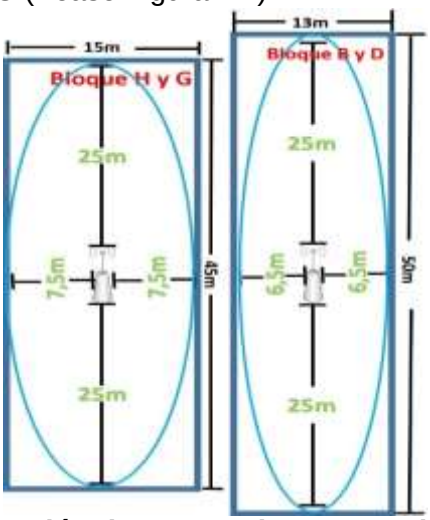

Figura 2.4: Ubicación de Puntos de acceso Bloque H, G, B y D

Los galpones que son parte del bloque M contendrán un AP en el centro, exceptuando al galpón 5 que alojará dos APs, las ubicaciones exactas son expuestas en la Figura 2.5.

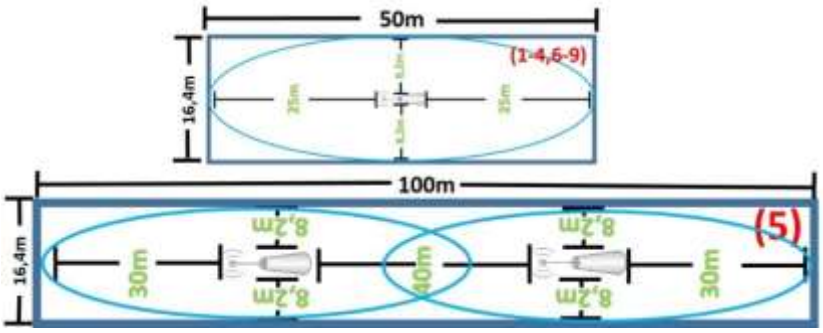

Figura 2.5: Ubicación de Puntos de acceso Bloque M

El bloque E será constituido por 2 APs en cada galpón, y para el bloque F serán establecidos 4 APs, mostrados en las siguientes figuras.

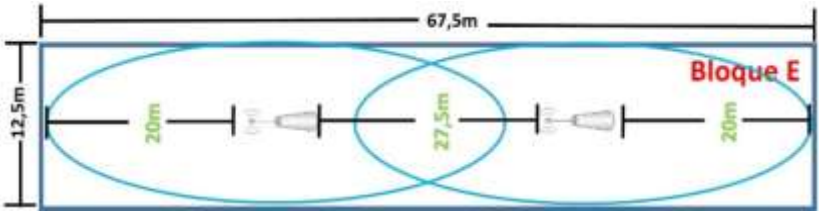

Figura 2.6: Ubicación de Puntos de acceso Bloque E

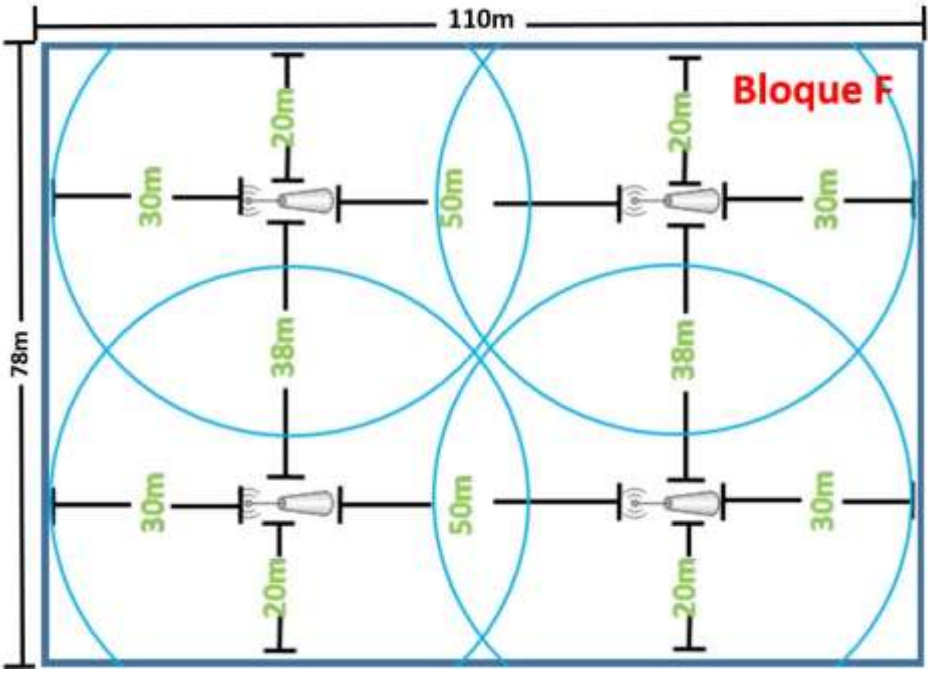

Figura 2.7: Ubicación de Puntos de acceso Bloque F

Existen 3 galpones, los más grandes del Parque, situados en el bloque C, que en su interior albergaran 6 APs, en el mismo bloque hay un galpón un poco más pequeño en el que se instalarán 3 APs, detallando lo descrito mediante la Figura 2.8.

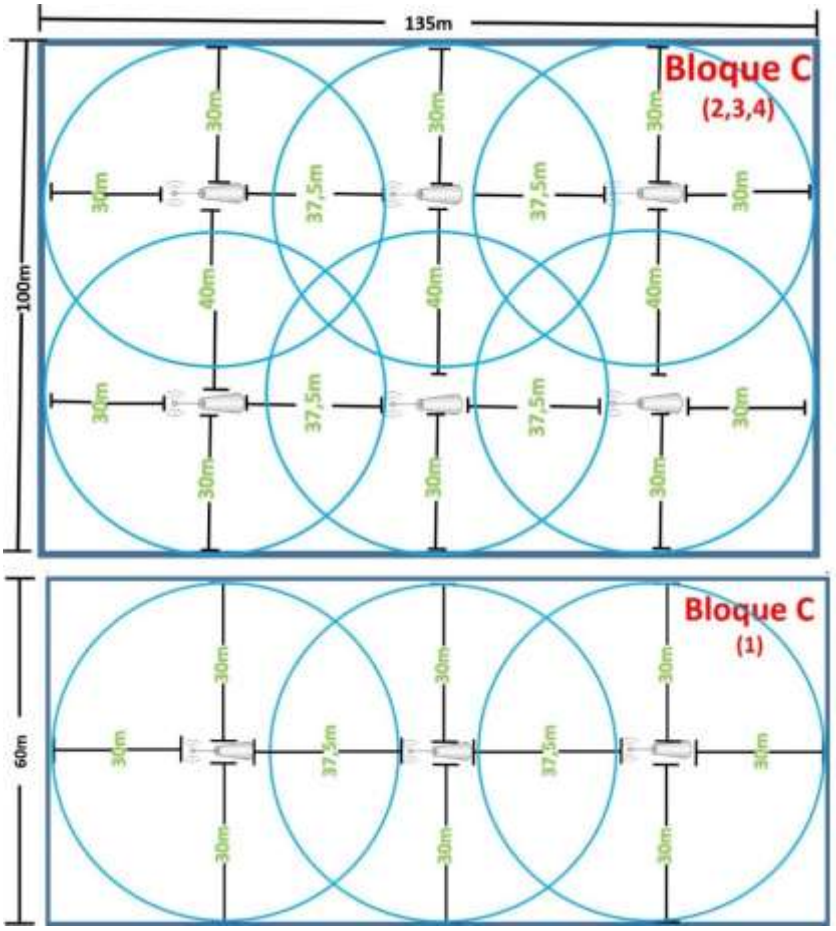

Figura 2.8: Ubicación de Puntos de acceso Bloque C

Por otro lado los conmutadores que serán agregados al diseño de esta red también se ubicarán en lugares propios para conseguir mejor utilidad, ya que estos proveerán de conexión a los APs por medio de cable UTP Cat. 6a y este limita su funcionamiento a 100m de distancia. Para ello de la misma manera que los APs en base a las medidas de cada área se concluye la ubicación de los conmutadores mostrada en el siguiente gráfico.

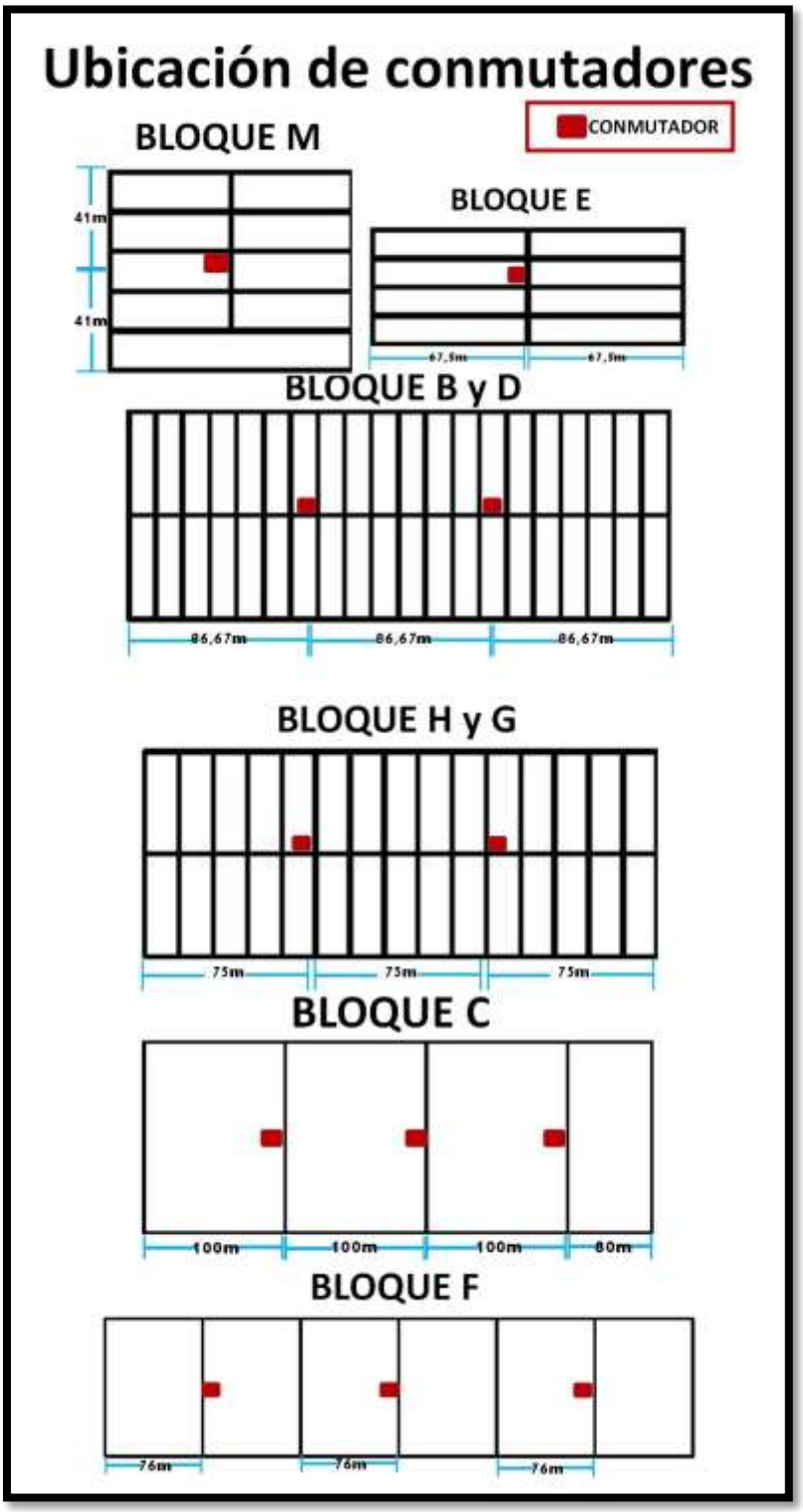

Figura 2.9: Ubicación de Conmutadores en todos los bloques

Es imprescindible disponer de un lugar para cuarto de telecomunicaciones que cuente con tomacorrientes para abastecer de energía eléctrica a todos los dispositivos que aloje; por su parte los conmutadores Cisco Systems SG500X-24P, Cisco Catalyst 3560CX-12PD-S, Cisco Catalyst WS-C3560CX 8XPD-S tienen la capacidad de suministrar una potencia máxima 30W por puerto PoE [24] (Power Over Ethernet), y con esto los puntos de acceso tienen energía suficiente para su funcionamiento.

2.3.3 Seguridad de la red inalámbrica.

El lugar donde serán albergados los equipos en cada galpón deberá ser facilitado por la empresa, pero para garantizar la seguridad física, dicho lugar debe tener acceso restringido y estar seguro ante consecuencias por desastres naturales o alteraciones en el entorno y un adecuado nivel de temperatura.

En el ámbito de seguridad lógica, dependiendo de las dimensiones de las bodegas se disminuirá la potencia de la señal de los APs y se establecerá una posición fija, limitándolos al tamaño de la bodega para evitar que los datos transmitidos sean expuestos a caer en manos de usuarios ajenos y mal intencionados.

Por otra parte se realizaran ajustes necesarios para los enrutadores inalámbricos, tales como:

- Cambiar el nombre predeterminado del SSID [25] por un nombre único y a su vez desactivar la difusión del mismo, siendo el administrador de la red y el representante de la empresa alojada los que tienen conocimiento del mismo.
- Utilizar WPA2 [26], que usa el algoritmo de cifrado AES [27], que nos posibilita el cifrado de los datos que se transmiten por la red garantizando la confidencialidad de la misma. Este proceso inicia al acceder a la red y se logra mediante una clave, lo suficiente robusta y será conocida exclusivamente el cliente del galpón, es recomendable que esta clave se cambie cada 30 días para evadir ataques.

2.3.4 Configuración de equipos de la red inalámbrica.

Una vez instalada la parte física de la red tanto APs y controladores inalámbricos, se debe proceder a la configuración de estos equipos para que puedan funcionar según los requerimientos de la empresa y adoptar las opciones escogidas precedentemente.

El conmutador administrable de la red inalámbrica estará conectado con el conmutador principal de la red existente mediante 4 enlaces de cobre físicos configurados como una única unidad lógica, con el objetivo ampliar el ancho de banda, proveer de redundancia y hacerlo tolerable a fallos ya que son principales en la red para mejorar su rendimiento.

Para una mejor administración se ha dispuesto establecer LAN virtuales [28], con el objetivo de separar los servicios, tanto de voz, datos y telefonía, para luego asignar recursos según la necesidad de cada uno, logrando una mejor utilización, principalmente al momento que el servidor DHCP [29] hace su función, este dependiendo del servicio que se vaya a utilizar asignará una dirección IP correspondiente.

El controlador inalámbrico posee una base de datos local donde se almacenará la información de los APs, esto permitirá tener una administración centralizada en la red inalámbrica, en base a la demanda que presenta la empresa, se utilizará 6 controladores que pueden gestionar hasta 50 APs cada uno.

El registro de los APs en cada controlador se realizará manualmente, ya que estarán previamente organizados por grupos y asignados a un controlador en particular.

Cada controlador al iniciar carga la configuración predeterminada, por esta razón estableceremos conexión con un ordenador mediante el puerto de consola y se accede al programa Hyperterminal para borrar dicha configuración.

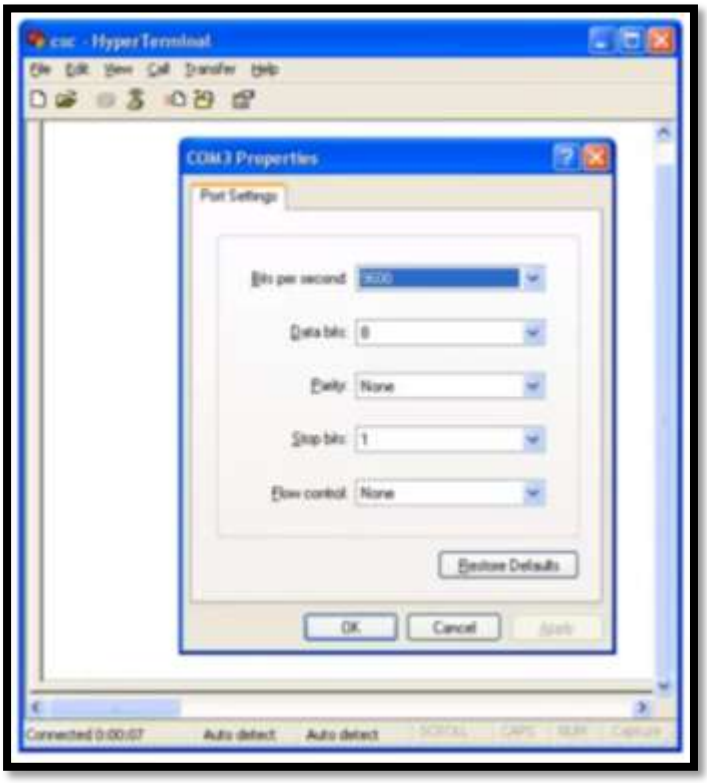

Figura 2.10: Acceso al Hyperterminal

Seguido de esto, se conectará el ordenador al puerto de servicio del controlador y se asignará una dirección IP que se encuentre en la misma subred que los demás dispositivos, posteriormente se accederá a la dirección IP del controlador mediante un navegador y se empezará la configuración del mismo verificando opciones como: un nombre representativo, un usuario y contraseña de administrador que cumpla con políticas de un alto nivel de seguridad, se asignará una dirección estática, la máscara de red, el Gateway y el código del país.

Figura 2.11: Asistente de Configuración

Figura 2.12: Asistente de Configuración

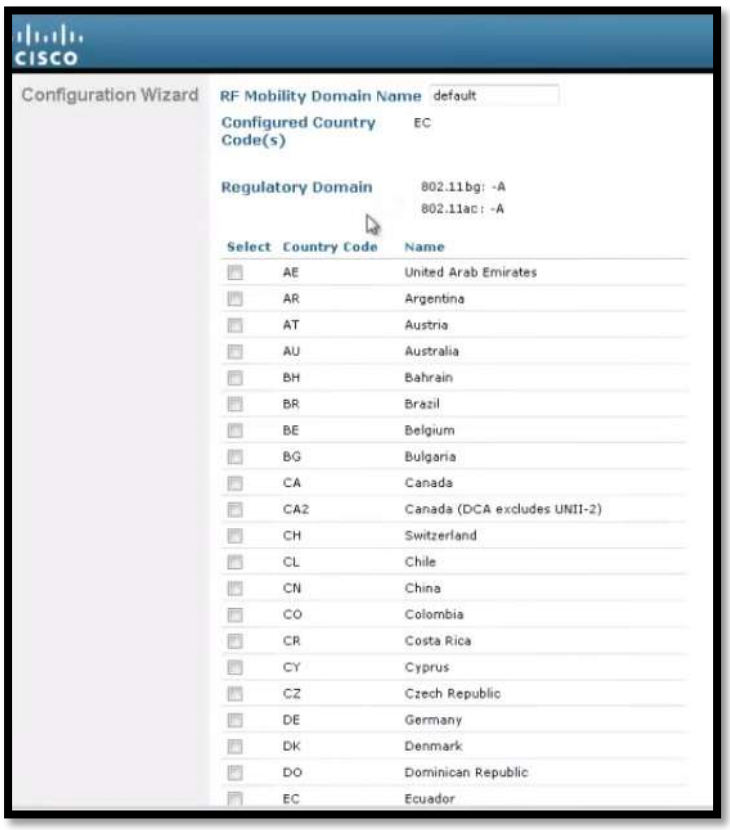

Figura 2.13: Asistente de Configuración

Por último se procederá a verificar que la configuración en los controladores esté correcta haciendo pruebas de funcionamiento.

CAPÍTULO 3

3. DISEÑO DEL PLAN DE EJECUCIÓN Y PRESUPUESTO DEL PROYECTO.

3.1 Planificación.

Para la implementación del presente proyecto se ha estimado un tiempo prudencial de 28 días mediante la mano de obra de colaboradores que serán debidamente supervisados en todo momento por parte de los jefes de proyecto contratados según él ámbito de trabajo.

Hay que considerar el tiempo que demanda el trabajo, puesto que el desmontaje y montaje de los elementos que forman parte del proceso de rediseño de la red cableada implicará una pérdida de operatividad obligatoria mientras se hace la instalación, cabe recalcar que estos días serán definidos por parte de la empresa. La planificación que se recomienda a la empresa es la descrita en la siguiente tabla.

	ID de día	Área a trabajar
Desmontaje	Día 1	Área administrativa, Bloque A
	Día 2	Bloque M y Bloque B
	Día 3	Bloque K y Bloque L
	Día 4	Bloque J
	Día 5	Bloque I
Montaje	Día 6	Área administrativa, Bloque L y Bloque M
	Día 7	Bloque A
	Día 8	Bloque K
	Día 9	Bloque J
	Día 6	Bloque B
	Día 7	Bloque I

Tabla 6: Planificación montaje y desmontaje recomendado

La importación de los dispositivos tomará alrededor de dos semanas y aprovechando el tiempo se comenzará un día después de realizado el pedido, se realizará el desmontaje del cableado y se procederá a medir y colocar guías en cada galpón señalando la ubicación de cada dispositivo de red inalámbrico. La parte cableada se adquirirá dentro del país, llegando a la empresa en 7 días después de hacer la petición, así que será lo que primero se instalará y configurará, y por su parte cuando se cuente con los dispositivos se empezará de inmediato con su implementación.

En este proyecto se ha dispuesto contratar a 2 Licenciados en Redes y Sistemas Operativos, 15 técnicos informáticos y 5 ayudantes de carga; trabajaran 8 horas diarias en los días designados en la planificación previa. El detalle de la planificación se muestra en ANEXO 2.

	Nombre de tarea	Duración	Comienzo	Fin	Predeces	Nombres de recursos
	Implementación del proyecto	**28 días**	**lun 11/01/16**	**mié 17/02/16**		
	Adquisición de dispositivos	15 días	lun 11/01/16	vie 29/01/16		Angela[50%]; Jessenia[50%]
	Adquisición de cableado	7 días	lun 11/01/16	mar 19/01/16		Angela[50%]; Jessenia[50%]
	Remover el cableado de red a cambiar	5 días	mar 12/01/16	lun 18/01/16		Técnico 1[10%]; Técnico 2[10%]; Técnico 3[10%];Técni
	Señalar la ubicación de los elementos de la red inalambrica en cada galpon	6 días	mar 19/01/16	mar 26/01/16	4	Técnico 1[5%]; Técnico 2[5%]; Técnico 3[5%]; Técnico 4[5%];Técnic
	Montaje y configuración del cableado de la red	6 días	mié 27/01/16	mié 03/02/16	5	Técnico 1[5%]; Técnico 2[5%]; Técnico 3[5%]; Técnico 4[5%];Técnic
	Verificación y pruebas de la red cableada	1 día	jue 04/02/16	jue 04/02/16	6	Ingeniero 1[50%]; Ingeniero 2[50%]
	Ubicación e instalación de los dispositivos para la red inalámbrica	5 días	vie 05/02/16	jue 11/02/16	7	Ingeniero 1[8%]; Ingeniero 2[11%]; Técnico 1[5%]; Técnico 2[5%];Técnic
	Configuración de dispositivos	2 días	vie 12/02/16	lun 15/02/16	8	Ingeniero 1[50%]; Ingeniero 2[50%]
	Verificación y pruebas de la red inalambrica	1 día	mar 16/02/16	mar 16/02/16	9	Ingeniero 1; Ingeniero 2
	Verificación y pruebas de la red en general	1 día	mié	mié 17/02/16	10	Ingeniero 1[50%]; Ingeniero 2[50%]

Figura 3.1: Plan de actividades

3.2 Presupuesto.

Contando con el total de elementos requeridos para la implementación de la red, es decir los solicitados para la parte cableada y la inalámbrica, se ha realizado un estudio que reflejará el valor monetario que cada uno de estos representa en la inversión que realizará Parque Industrial Guayaquil. Este detalle se presentará mediante una tabla demostrativa la cual incluye: precio, marca, y la cantidad a comprar, cada dispositivo será importado y es por eso que cada valor mostrado incluye impuestos.

Los colaboradores contratados trabajarán 8 horas diarias a excepción de los ayudantes de carga que se los solicitará en días concretos y solo trabajaran 4 horas diarias. El salario que ellos percibirán es en base a horas trabajadas, teniendo en consideración un salario mensual, en caso de los Licenciados en Redes y Sistemas Operativos $1000, los asistentes técnicos informáticos $550 y los ayudantes de carga $400, cada valor especificado para los 21 días laborables y 168 horas al mes.

PRESUPUESTO DE HARDWARE			
Producto/Marca	**Cant.**	**Precio Unitario**	**Precio total**
Red Cableada			
Cable UTP 6a 	34 Rollos (305m c/u)	$350	$11900,00
Conectores de red RJ45 	1500	$8 (las 100 unidades)	$120,00
Red inalámbrica			
Punto de acceso Linksys EA6900 AC1900 	211	$243,41	$ 51359,51

Controlador Wireless Cisco WLC 2500 	6	$5718,00	$34308,00
Cisco Catalyst 4500X-32 SFP+ 	1	$10.360,00	$10.360,00
Cisco Systems SG500X-24P 	9	$1.149.99	10349,91
Cisco Catalyst 3560CX-12PD-S 	1	$1.187,49	$1.187,49
Cisco Catalyst WS-C3560CX 8XPD-S 	6	$1.661,00	9.966,00
Adaptador 802.11ac USB - D-Link DWA-182 	450	47,99	$21595,50
TOTAL INVERSIÓN DE EQUIPOS			**$151146,41**
PRESUPUESTO DE PERSONAL Y SERVICIOS ADQUIRIDOS			
Recursos materiales			
Gastos de transportes			$40,00
Recursos materiales			
Personal	Cant. de personas	Días	Precio Por hora	Valor total
Personal de I.T	2	28	$5,95	$2380,00
Asistentes técnicos de IT	15	22	$3,27	$1440,00
Ayudantes de carga	5	2	$2,39	$19,12

Otros gastos (Anual)	
Servicios de soporte técnico y mantenimiento Preventivo.	$820,00
TOTAL DE INVERSIÓN DE PERSONAL Y MANTENIMIENTO	**$4699,12**
SUMA TOTAL DE TODA LA INVERSIÓN	**$155845,53**

Tabla 7: Presupuesto General

CONCLUSIONES Y RECOMENDACIONES

Conclusiones

1. Cuando tenemos una infraestructura con una barrera de alto potencial de interferencia, como lo es el hormigón, se concluye que la mejor solución es establecer la comunicación con los dispositivos de red inalámbricos de forma cableada.
2. Para una correcta implementación se ha definido estratégicamente la ubicación de los conmutadores que estaban limitados por la distancia máxima que el cable puede transmitir y los puntos de acceso por la tecnología escogida.
3. La red inalámbrica que se ha diseñado disminuyó los costos, ya que se puede aprovechar los recursos de red propios de la empresa y la tecnología seleccionada con sus beneficios, permitiendo compensar la inversión realizada a corto plazo.
4. Cuando tenemos una cantidad considerable de puntos de acceso es preferible gestionarlos a través de controladores inalámbricos que permiten una administración centralizada.
5. Con esta inversión Parque Guayaquil, logrará sus objetivos de forma competitiva, ya que incluye gran cantidad de beneficios operativos y económicos.

Recomendaciones

1. Al momento de integrar una red inalámbrica a una red cableada existente es necesario que los dispositivos y la tecnología que utilizan sean compatibles y soporten la tecnología inalámbrica que se va a emplear.
2. Esta propuesta aunque haya sido implementada para satisfacer un requerimiento específico de Parque Industrial Guayaquil puede ser usada en empresas con casos similares teniendo especial cuidado al administrar los puntos de acceso según el espacio de cobertura que se desea abarcar, tal como se muestra en este documento.

3. Muy aparte del mantenimiento que se dará a la red eventualmente según lo requiera, se debe establecer de manera clara y escrita el punto de marcación que señalará cual es la responsabilidad que tiene el arrendatario con los dispositivos y demás elementos instalados en cada galpón, de esta manera Parque Guayaquil evitará desacuerdos con sus clientes cuando ocurra una anomalía en el funcionamiento de los dispositivos de comunicación inalámbrica.

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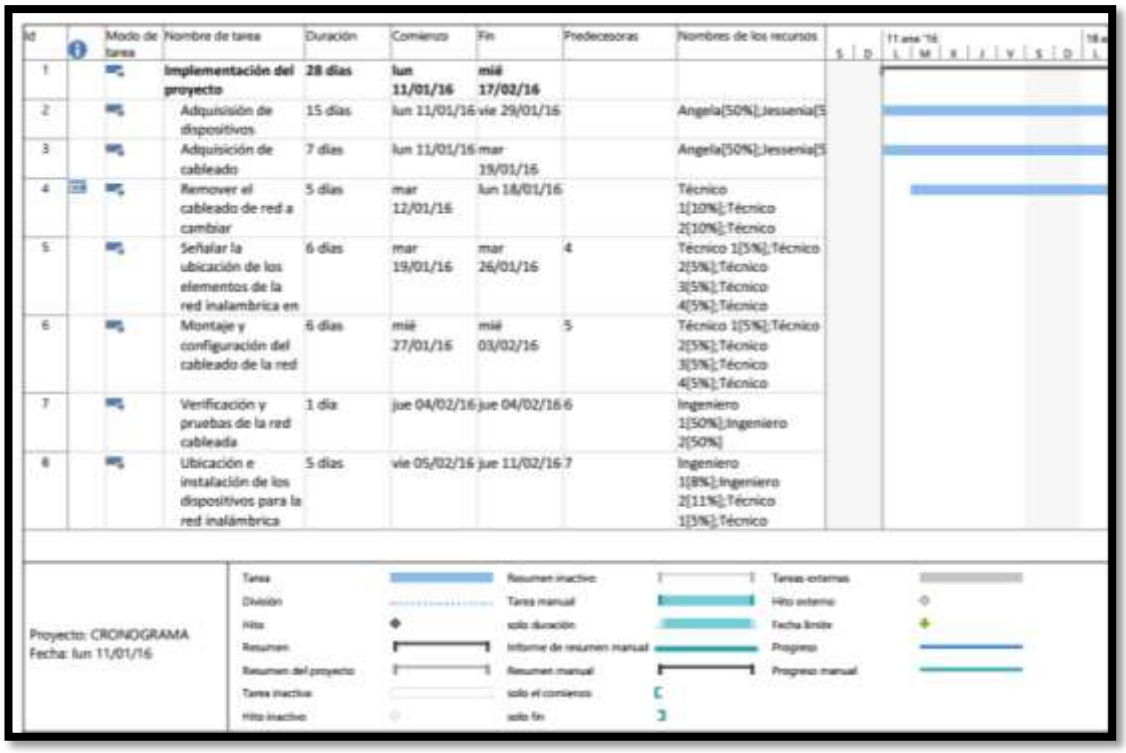
ANEXOS

ANEXO1: PANIFICACIÓN



Id	Modo de tarea	Nombre de tarea	Duración	Comienzo	Fin	Predecesoras	Nombres de los recursos
1		**Implementación del proyecto**	**28 días**	**lun 11/01/16**	**mié 17/02/16**		
2		Adquisición de dispositivos	15 días	lun 11/01/16	vie 29/01/16		Angela[50%];Jessenia[5
3		Adquisición de cableado	7 días	lun 11/01/16	mar 19/01/16		Angela[50%];Jessenia[5
4		Remover el cableado de red a cambiar	5 días	mar 12/01/16	lun 18/01/16		Técnico 1[10%];Técnico 2[10%];Técnico
5		Señalar la ubicación de los elementos de la red inalambrica en	6 días	mar 19/01/16	mar 26/01/16	4	Técnico 1[5%];Técnico 2[5%];Técnico 3[5%];Técnico 4[5%];Técnico
6		Montaje y configuración del cableado de la red	6 días	mié 27/01/16	mié 03/02/16	5	Técnico 1[5%];Técnico 2[5%];Técnico 3[5%];Técnico 4[5%];Técnico
7		Verificación y pruebas de la red cableada	1 día	jue 04/02/16	jue 04/02/16	6	Ingeniero 1[50%];Ingeniero 2[50%]
8		Ubicación e instalación de los dispositivos para la red inalámbrica	5 días	vie 05/02/16	jue 11/02/16	7	Ingeniero 1[8%];Ingeniero 2[11%];Técnico 1[5%];Técnico

Proyecto: CRONOGRAMA
Fecha: lun 11/01/16

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Id	Modo de tarea	Nombre de tarea	Duración	Comienzo	Fin	Predecesoras	Nombres de los recursos
9		Configuración de dispositivos	2 días	vie 12/02/16	lun 15/02/16	8	Ingeniero 1[50%];Ingeniero
10		Verificación y pruebas de la red inalambrica	1 día	mar 16/02/16	mar 16/02/16	9	Ingeniero 1,Ingeniero 2
11		Verificación y pruebas de la red en general	1 día	mié 17/02/16	mié 17/02/16	10	Ingeniero 1[50%];Ingeniero 2[50%]

Proyecto: CRONOGRAMA
Fecha: lun 11/01/16

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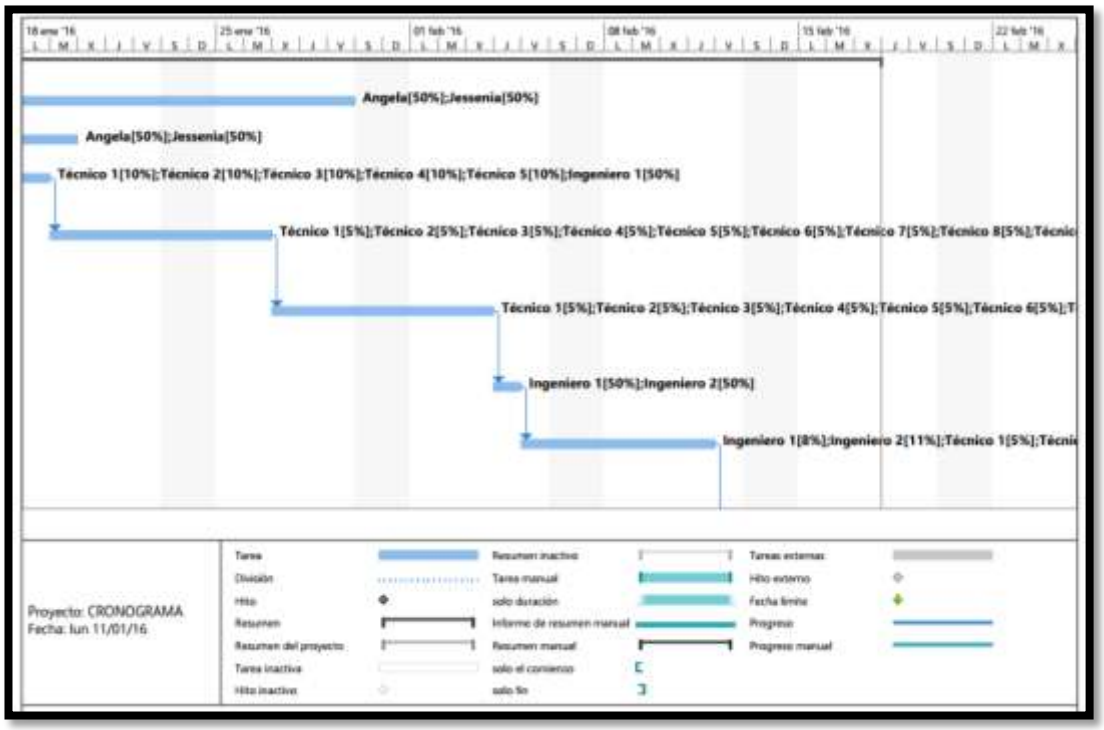
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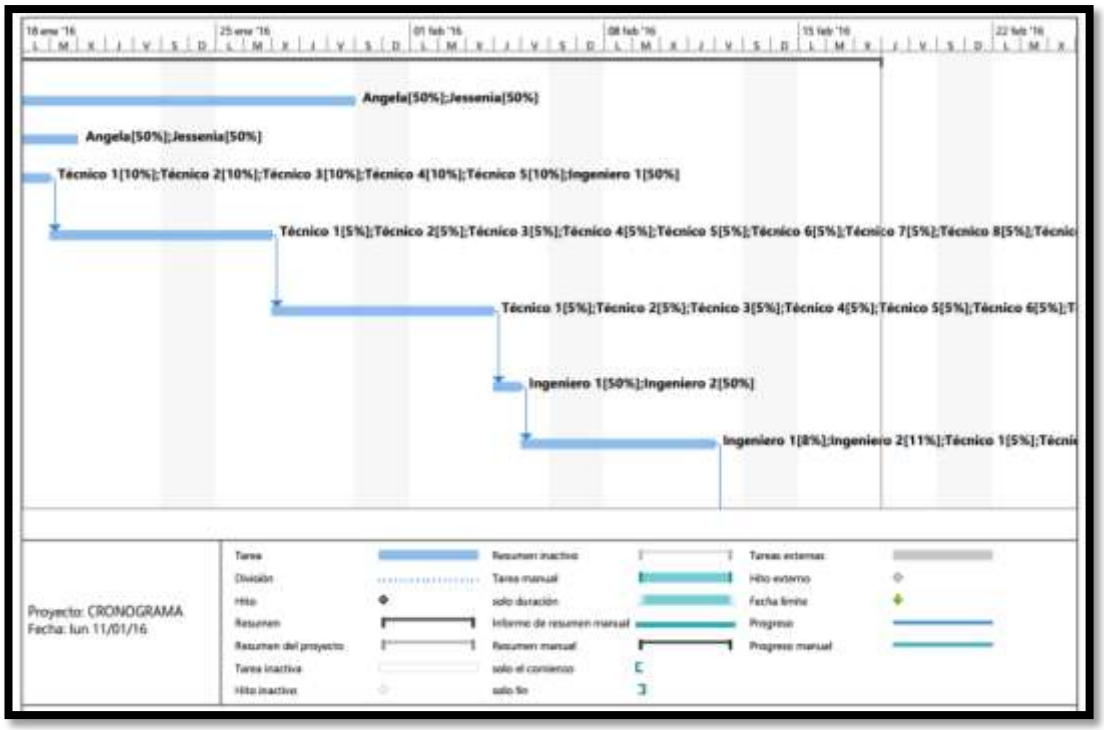
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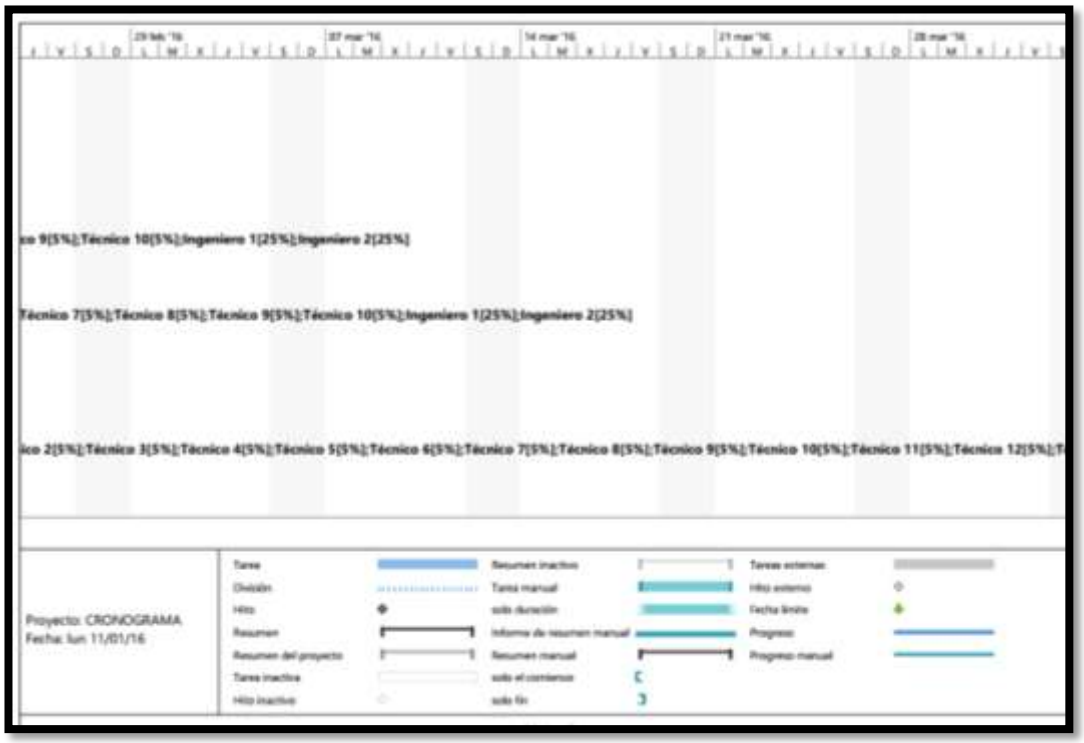
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ANEXO 3: GUÍA DE CONFIGURACIÓN CISCO WLC 2500

http://www.cisco.com/c/en/us/td/docs/wireless/controller/7-0MR1/configuration/guide/wlc_cg70MR1/cg_overview.html

ANEXO4:

DATASHEET:

- CISCO WLC 2500
- CISCO CATALYST 4500X-32 SFP+
- CISCO SYSTEMS SG500X-24P
- CISCO CATALYST 3560
- LINKSYS EA6900 AC1900

Cisco 2500 Series Wireless Controllers

Small to Medium-Sized Enterprise and Branch Office Controller

- Support for up to 75 access points and 1000 clients.
- 802.11n and 802.11ac ready support up to 1 Gbps.
- Payment Card Industry (PCI) support enables certification for scanner and kiosk deployments.

Licensing Flexibility and Investment Protection

- Additional access point licenses may be added over time.

Comprehensive Security

- Full Control and Provisioning of Wireless Access Points (CAPWAP) access point to controller encryption.
- Supports rogue access point detection and detection of denial-of-service attacks.
- Management frame protection detects malicious users and alerts network administrators.

Cisco CleanAir® Technology

- Detects, classifies, locates, and mitigates RF interference to provide performance protection for 802.11n and 802.11ac networks.

Cisco OfficeExtend Solution

- Secure, simple, cost-effective mobile teleworker solution.

Product Overview

The Cisco® 2500 Series Wireless Controller enables systemwide wireless functions in small to medium-sized enterprises and branch offices. Designed for 802.11n and 802.11ac performance, Cisco 2500 Series Wireless Controllers are entry-level controllers that provide real-time communications between Cisco Aironet® access points to simplify the deployment and operation of wireless networks (Figure 1).

Figure 1. Cisco 2500 Series Wireless Controller

As a component of the Cisco Unified Wireless Network, this controller delivers centralized security policies, wireless intrusion prevention system (wIPS) capabilities, award-winning RF management, and quality of service (QoS) for voice and video. Delivering 802.11ac performance and scalability, the Cisco 2500 Series provides low total cost of ownership and flexibility to scale as network requirements grow.

The Cisco 2504 Wireless Controller supports Cisco Application Visibility and Control (AVC), the technology that includes Cisco's Network-Based Application Recognition 2 (NBAR-2) engine. N-BAR-2 does deep packet inspection (DPI) to classify applications and tie into quality of service (QoS) to either drop or mark the traffic, thereby prioritizing business-critical applications in the network. Cisco AVC uses NetFlow Version 9 to export the flows to Cisco Prime™ Infrastructure or a third-party NetFlow Collector. The Cisco 2504 Wireless Controller also supports Bonjour Services Directory, which enables Bonjour (Apple) Services to be advertised and utilized in a separate Layer 3 network. Wireless Policy engine is a wireless profiler and policy feature on the Cisco 2500 Series Wireless Controller that enables profiling of wireless devices and enforcement of policies such as VLAN assignment, QoS, ACL, and time-of-day-based access.

Cisco 2500 Series Wireless Controller-based access point licensing offers flexibility with 5, 15, 25, or 50 access points. Additional access point support can be added in increments of 1, 5, or 25.

Table 1 lists the features and benefits of the Cisco 2500 Series Wireless Controllers.

Table 1. Cisco 2500 Series Wireless Controller Features and Benefits

Feature	Benefits
Scalability	• Supports up to 75 access points • Supports up to 1000 clients
Ease of Deployment	• For quick and easy deployment Access Points can be connected directly to 2504 Wireless LAN Controller via two PoE (Power over Ethernet) ports
High Performance	• Wired-network speed and nonblocking performance for 802.11n and 802.11ac networks. Supports up to 1 Gbps throughput
RF Management	• Provides both real-time and historical information about RF interference impacting network performance across controllers, via systemwide Cisco CleanAir® technology integration
Comprehensive End-to-End Security	• Offers CAPWAP-compliant Datagram Transport Layer Security (DTLS) encryption to help ensure full-line-rate encryption between access points and controllers across remote WAN/LAN links
End-to-end Voice	• Supports Unified Communications for improved collaboration through messaging, presence, and conferencing • Supports all Cisco Unified Wireless IP Phones for cost-effective, real-time voice services
High-Performance Video	• Integrates Cisco VideoStream technology as part of the Cisco medianet framework to optimize the delivery of video applications across the WLAN
PCI Integration	• Part of Payment Card Industry (PCI) certified architecture, and are well-suited for retail customers who deploy transactional data applications such as scanners and kiosks
OfficeExtend	• Supports corporate wireless service for mobile and remote workers with secure wired tunnels to the Cisco Aironet® 600, 1130, 1140 or 3500 Series Access Points • Extends the corporate network to remote locations with minimal setup and maintenance requirements • Improves productivity and collaboration at remote site locations • Separate service set identifier (SSID) tunnels allow both corporate and personal Internet access • Reduced carbon dioxide emissions from a decrease in commuting • Higher employee job satisfaction from ability to work at home • Improves business resiliency by providing continuous, secure connectivity in the event of disasters, pandemics, or inclement weather
Enterprise Wireless Mesh	• Allows access points to dynamically establish wireless connections without the need for a physical connection to the wired network • Available on select Cisco Aironet access points, Enterprise Wireless Mesh is ideal for warehouses, manufacturing floors, shopping centers, and any other location where extending a wired connection may prove difficult or aesthetically unappealing
Environmentally Responsible	• Organizations may choose to turn off access point radios to reduce power consumption during off-peak hours
Mobility, Security and Management for IPv6 & Dual-Stack Clients	• Secure, reliable wireless connectivity and consistent end-user experience • Increased network availability by proactive blocking of known threats • Equips administrators for IPv6 troubleshooting, planning, client traceability from a common wired and wireless management system
Guest Anchor and Wired Guest Access	• Supports up to 15 guest anchor Ethernet over IP (EoIP) tunnels for path isolation of guest traffic from enterprise data traffic • Extends the guest access services to the wired clients on par with other WLAN Controllers

Product Specifications

Table 2 lists the product specification for Cisco 2500 Series Wireless Controllers.

Table 2. Product Specifications for the Cisco 2500 Wireless Controller

Item	Specification
Wireless Standards	IEEE 802.11a, 802.11ac, 802.11b, 802.11g, 802.11d, WMM/802.11e, 802.11h, 802.11k, 802.11n, 802.11r, 802.11u, 802.11w, 802.11ac
Wired/Switching/Routing	IEEE 802.3 10BASE-T, IEEE 802.3u 100BASE-TX specification, 1000BASE-T, and IEEE 802.1Q VLAN tagging

Item	Specification
Data Request for Comments (RFCs)	• RFC 768 UDP • RFC 791 IP • RFC 2460 IPv6 (passthrough bridging mode only) • RFC 792 ICMP • RFC 793 TCP • RFC 826 ARP • RFC 1122 Requirements for Internet Hosts • RFC 1519 CIDR • RFC 1542 BOOTP • RFC 2131 DHCP • RFC 5415 CAPWAP Protocol Specification
Security Standards	• Wi-Fi Protected Access (WPA) • IEEE 802.11i (WPA2, RSN) • RFC 1321 MD5 Message-Digest Algorithm • RFC 1851 The ESP Triple DES Transform • RFC 2104 HMAC: Keyed Hashing for Message Authentication • RFC 2246 TLS Protocol Version 1.0 • RFC 2401 Security Architecture for the Internet Protocol • RFC 2403 HMAC-MD5-96 within ESP and AH • RFC 2404 HMAC-SHA-1-96 within ESP and AH • RFC 2405 ESP DES-CBC Cipher Algorithm with Explicit IV • RFC 2406 IP Encapsulating Security Payload (ESP) • RFC 2407 Interpretation for ISAKMP • RFC 2408 ISAKMP • RFC 2409 IKE • RFC 2451 ESP CBC-Mode Cipher Algorithms • RFC 3280 Internet X.509 PKI Certificate and CRL Profile • RFC 3602 The AES-CBC Cipher Algorithm and Its Use with IPsec • RFC 3686 Using AES Counter Mode with IPsec ESP • RFC 4347 Datagram Transport Layer Security • RFC 4346 TLS Protocol Version 1.1
Encryption	• WEP and Temporal Key Integrity Protocol-Message Integrity Check (TKIP-MIC): RC4 40, 104 and 128 bits (both static and shared keys) • Advanced Encryption Standard (AES): CBC, CCM, Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (CCMP) • DES: DES-CBC, 3DES • Secure Sockets Layer (SSL) and Transport Layer Security (TLS): RC4 128-bit and RSA 1024- and 2048-bit • DTLS: AES-CBC
Authentication, Authorization, and Accounting (AAA)	• IEEE 802.1X • RFC 2548 Microsoft Vendor-Specific RADIUS Attributes • RFC 2716 PPP EAP-TLS • RFC 2865 RADIUS Authentication • RFC 2866 RADIUS Accounting • RFC 2867 RADIUS Tunnel Accounting • RFC 3576 Dynamic Authorization Extensions to RADIUS • RFC 3579 RADIUS Support for EAP • RFC 3580 IEEE 802.1X RADIUS Guidelines • RFC 3748 Extensible Authentication Protocol • Web-based authentication • TACACS support for management users

Item	Specification
Management	SNMP v1, v2c, v3 RFC 854 Telnet RFC 1155 Management Information for TCP/IP-Based Internets RFC 1156 MIB RFC 1157 SNMP RFC 1213 SNMP MIB II RFC 1350 TFTP RFC 1643 Ethernet MIB RFC 2030 SNTP RFC 2616 HTTP RFC 2665 Ethernet-Like Interface types MIB RFC 2674 Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering, and Virtual Extensions RFC 2819 RMON MIB RFC 2863 Interfaces Group MIB RFC 3164 Syslog RFC 3414 User-Based Security Model (USM) for SNMPv3 RFC 3418 MIB for SNMP RFC 3636 Definitions of Managed Objects for IEEE 802.3 MAUs Cisco private MIBs
Management Interfaces	● Designed for use with Cisco Wireless Control System ● Web-based: HTTP/HTTPS individual device manager ● Command-line interface: Telnet, SSH, serial port
Interfaces and Indicators	● Console port: RJ-45 connector ● Network: Four 1 Gbps Ethernet (RJ-45) ● LED indicators: Link Activity (each 1 Gigabit Ethernet port), Power, Status, Alarm
Physical and Environmental	Dimensions: 1.73 x 8.00 x 6.75 in. (43.9 x 203.2 x 271.5mm) Weight: 3.5 lbs (with power supply) Temperature: ● Operating: 32 to 104 °F (0 to 40°C) ● Storage: -13 to 158°F (-25 to 70°C) Humidity: ● Operating humidity: 10 to 95 percent, noncondensing ● Storage humidity: Up to 95 percent Power adapter: Input power: 100 to 240 VAC; 50/60 Hz Heat dissipation: 72 BTU/hour
Regulatory Compliance	Safety: ● UL 60950-1, 2nd Edition ● EN 60950:2005 EMI and susceptibility (Class B): ● U.S.: FCC Part 15.107 and 15.109 ● Canada: ICES-003 ● Japan: VCCI ● Europe: EN 55022, EN 55024

Ordering Information

Tables 3 and 4 provide ordering information for the Cisco 2500 Series Wireless Controllers. To place an order, visit the Cisco ordering website: http://www.cisco.com/en/US/ordering/index.shtml.

Table 3. Ordering Information for Cisco 2500 Series Wireless Controllers

Part Number	Description	Cisco SMARTnet® 8x5xNBD
AIR-CT2504-5-K9	2500 Series Wireless Controller for up to 5 Cisco access points	CON-SNT-CT255
AIR-CT2504-15-K9	2500 Series Wireless Controller for up to 15 Cisco access points	CON-SNT-CT2515
AIR-CT2504-25-K9	2500 Series Wireless Controller for up to 25 Cisco access points	CON-SNT-CT2525
AIR-CT2504-50-K9	2500 Series Wireless Controller for up to 50 Cisco access points	CON-SNT-CT2550
AIR-CT2504-HA-K9*	Cisco 2500 Series Wireless Controller for High Availability	CON-SNT-CT2504HA

* Please note AIR-CT2504-HA-K9 does not support access point and client stateful switchover.

Table 4. Ordering Information for Cisco 2500 Series Wireless Controllers: Optional Accessories

Part Number	Product Name
AIR-CT2504-RMNT=	Cisco 2504 Wireless Controller Rack Mount Bracket
PWR-2504-AC=	Cisco 2504 Wireless Controller Spare Power Supply (not necessary with original order as 1 power supply is included)

Additive Capacity Upgrade Licenses

Tables 5 and 6 summarize additive capacity upgrade licenses that are available for the Cisco 2500 Series.

Table 5. Ordering Information for Cisco 2500 Series Wireless Controllers: Access Point Adder Licenses (e-Delivery PAKs)

Part Number	Description	Cisco SMARTnet 8x5xNBD
L-LIC-CT2504-UPG	Primary upgrade SKU: Pick any number or combination of the following options under this SKU to upgrade one or many controllers under one product authorization key	CON-SNT-LCT25UP
L-LIC-CT2504-1A	1 Access Point Adder License for Cisco 2504 Wireless Controller (e-Delivery)	CON-SNT-LICCT2504
L-LIC-CT2504-5A	5 Access Point Adder License for Cisco 2504 Wireless Controller (e-Delivery)	CON-SNT-LCT255A
L-LIC-CT2504-25A	25 Access Point Adder License for Cisco 2504 Wireless Controller (e-Delivery)	CON-SNT-LCT2525A

Table 6. Ordering Information for Cisco 2500 Series Wireless Controllers: Access Point Adder Licenses (Paper PAKs)

Part Number	Description	Cisco SMARTnet 8x5xNBD
LIC-CT2504-UPG	Primary upgrade SKU: Pick any number or combination of the following options under this SKU to upgrade one or many controllers under one product authorization key	CON-SNT-LCT25UP
LIC-CT2504-1A	1 Access Point Adder License for Cisco 2504 Wireless Controller (Paper Certificate - U.S. Mail)	CON-SNT-LICCT2504
LIC-CT2504-5A	5 Access Point Adder License for Cisco 2504 Wireless Controller (Paper Certificate - U.S. Mail)	CON-SNT-LCT255A
LIC-CT2504-25A	25 Access Point Adder License for Cisco 2504 Wireless Controller (Paper Certificate - U.S. Mail)	CON-SNT-LCT2525A

Table 7 shows the optional DTLS license for Cisco 2500 Series Wireless Controllers. When the customer orders the 2500 Series and chooses “none selected (the default) in the Optional Licenses tab, data DTLS encryption is disabled.

Datagram Transport Layer Security (DTLS) is required for all Cisco OfficeExtend deployments to encrypt the data plane traffic. To enable this functionality, you must obtain a $0 DTLS license. **Customers planning to install this device physically in Russia must obtain a physical PAK in order to enable a DTLS license and should not download the license from Cisco.com**. Please consult your local government regulations to ensure that data DTLS encryption is permitted.

The DTLS Paper PAK license is designated for customers who purchase a controller with DTLS disabled due to import restrictions but get permission to add DTLS support after initial purchase. This optional DTLS license is required for Cisco OfficeExtend deployment.

Table 7. Optional Licensing for Cisco 2500 Series Wireless Controllers (PAKs)

Part Number	Description
LIC-CT2504-UPG	Primary upgrade SKU: Pick any number or combination of the following options under this SKU to upgrade one or many controllers under one product authorization key
LIC-CT25-DTLS-K9	Cisco 2504 Controller DTLS License (Paper Certificate - U.S. Mail)
L-LIC-CT2504-UPG	Primary upgrade SKU: Pick any number or combination of the following options under this SKU to upgrade one or many controllers under one product authorization key
L-LIC-CT25-DTLS-K9	Cisco 2504 Controller DTLS License (electronic Certificate; must not be ordered by Russian customers)

Other customers can simply use the following procedure in order to download the DTLS license from Cisco.com.

To obtain/download a Data DTLS License:

Step 1. Browse to http://cisco.com/go/license.

Step 2. On the Product License Registration page, choose **Licenses Not Requiring a PAK**.

Step 3. Choose **Cisco Wireless Controllers DTLS License** under Wireless.

Step 4. Complete the remaining steps to generate the license file. The license will be provided online or via email.

Step 5. Copy the license file to your Trivial File Transfer Protocol (TFTP) server.

Step 6. Install the license by browsing to the WLC Web Administration page:

Management --> Software Activation --> Commands --> Action: Install License

Service and Support

Realize the full business value of your wireless network and mobility services investments faster with intelligent, customized services from Cisco and our partners. Backed by deep networking expertise and a broad ecosystem of partners, Cisco professional and technical services enable you to successfully plan, build, and run your network as a powerful business platform. Our services can help you successfully deploy the Cisco Wireless Controller 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 controllers, contact your local account representative or visit: http://www.cisco.com/en/US/products/ps6366/index.html.

For more information about the Cisco Unified Wireless Network framework, visit: http://www.cisco.com/go/unifiedwireless.

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Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
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The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Printed in USA C78-645111-10 03/15

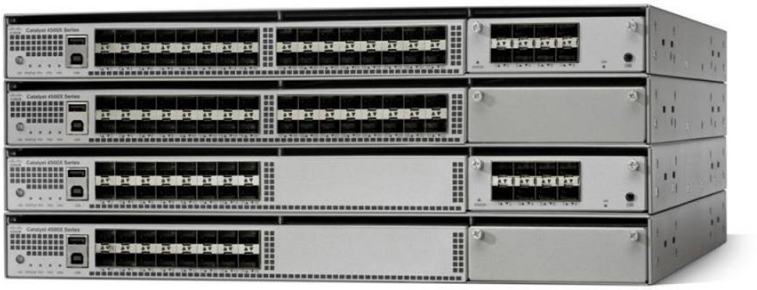
Cisco Catalyst 4500-X Series Fixed 10 Gigabit Ethernet Aggregation Switch

Product Overview

Cisco® Catalyst® 4500-X Series Switch (Figure 1) is a fixed aggregation switch that delivers best-in-class scalability, simplified network virtualization, and integrated network services for space-constrained environments in campus networks. It meets business growth objectives with unprecedented scalability, simplifies network virtualization with support for one-to-many (Cisco Easy Virtual Networks [EVN]) and many-to-one (Virtual Switching System [VSS]) virtual networks, and enables emerging applications by integrating many network services.

The Cisco Catalyst 4500-X Series offers key innovations, including:

- **Platform Scalability:** Delivers up-to 800 Gbps of switching capacity, capable of scaling up to 1.6-Tbps capacity with the VSS technology. Future-proof investment with modular uplink and auto-detect 10 Gigabit Ethernet and 1 Gigabit Ethernet ports.
- **High Availability:** Delivers the network availability demanded by business-critical enterprise applications through comprehensive high-availability capabilities, including VSS and EVN. Furthermore, innovative features such as redundant hot swappable fans and power supplies with AC to DC, and DC to AC failover remove single point of failure in network.
- **Application Monitoring:** Enhanced application monitoring through Flexible Netflow and eight ports of line rate bidirectional Switched Port Analyzer (SPAN)/Remote Switched Port Analyzer (RSPAN). In addition Cisco IOS® XE Software provides the ability to host third-party applications.
- **Security:** Support for Cisco TrustSec™ technology as well as robust control plane policing (CoPP) to address denial of service attacks.
- **Simplified Operations:** Support for Smart Install Director, providing a single point of management enabling zero-touch deployment for new switches and stacks in campus and branch networks.



Cisco Catalyst 4500-X Series Switch Family

Cisco Catalyst 4500-X Series provides scalable, fixed-campus aggregation solutions in space-constrained environments. The solution provides flexibility to build desired port density through two versions of base switches along with optional network module, providing line-rate 10GE capability. Both the 32-port and 16-port versions can be configured with optional network modules and offer similar features. The Small Form-Factor Pluggable Plus (SFP+) interface supports both 10 Gigabit Ethernet and 1 Gigabit Ethernet ports, allowing customers to use their investment in 1 Gigabit Ethernet SFP and upgrade to 10 Gigabit Ethernet when business demands change, without having to do a comprehensive upgrade of the existing deployment. The uplink module is hot swappable.

Following are key offering from this product family:

- 32 x 10 Gigabit Ethernet Port switch with optional module slot (Figure 1)
- 16 x 10 Gigabit Ethernet Port switch with optional module slot (Figure 2)
- 8 x 10 Gigabit Ethernet Port uplink module (Figure 3)

Figure 1. 32 x 10 Gigabit Ethernet Port Switch with Optional Uplink Module Slot

Figure 2. 16 x 10 Gigabit Ethernet Port Switch with Optional Uplink Module Slot

Figure 3. 8 x 10 Gigabit Ethernet Port Uplink Module

In addition, both 32 port and 16 port versions are available with front-to-back and back-to-front airflow. The front-to-back airflow switch comes with matching burgundy color fan and power supply handle to indicate warm side. Similarly, back-to-front airflow switch fan and power supply handles are color-coded in blue to indicate cool side. Figure 5 and Figure 6 show rear view of the switch with front-to-back and back-to-back airflow respectively.

Figure 4. Front-to-Back Airflow Rear View

Figure 5. Back-to-Front Airflow Rear View

Cisco Catalyst 4500-X switch provides redundant hot swappable fans and power supplies (Figure 7) for highest resiliency with no single point of failure.

Figure 6. Redundant Fan and Power Supply

Cisco Catalyst 4500-X Switch Series Feature Highlights

Cisco Catalyst 4500-X Series Switch provides nonblocking 10 Gigabit Ethernet per port bandwidth and Cisco IOS Flexible NetFlow for optimized application visibility. In addition to this, the enterprise-class Cisco Catalyst 4500-X offers the following:

- **Performance and scalability**
  - 800-Gbps switching capacity with up to 250 Mpps of throughput
  - External USB and SD card support for flexible storage options
  - 10/100/1000 RJ-45 console and management port
  - IPv6 support in hardware, providing wired-network-rate forwarding for IPv6 networks and support for dual stack with innovative resource utilization
  - Dynamic hardware forwarding-table allocations for ease of IPv4-to-IPv6 migration
  - Scalable routing (IPv4, IPv6, and multicast) tables, Layer 2 tables, and ACL and quality of service (QoS) entries to make use of eight queues per port and comprehensive security policies per port

- **Infrastructure services**
  - Cisco IOS XE Software, the modular open application platform for virtualized borderless services
  - Maximum resiliency with redundant components, Nonstop Forwarding/Stateful Switchover (NSF/SSO), and In-Service Software Upgrade (ISSU) support in a VSS enabled system
  - Network virtualization through Multi-VRF technology for Layer 3 segmentation
  - Automation through Embedded Event Manager (EEM), Cisco Smart Call Home, AutoQoS, and Auto SmartPorts for fast provisioning, diagnosis, and reporting
- **Cisco Borderless Networks services**
  - Optimized application performance through deep visibility with Flexible NetFlow supporting rich Layer 2/3/4 information (MAC, VLAN, TCP flags) and synthetic traffic monitoring with IP service-level agreement (SLA)
  - Medianet capabilities to simplify video quality of service, monitoring, and security. In addition, multicast features such as Protocol Independent Multicast (PIM) and Source-Specific Multicast (SSM) provide enterprise customers with the additional scalability to support multimedia applications
- **Investment protection and reduced TCO**

  Cisco Catalyst 4500-X Series eliminates the need for standalone solutions by integrating many network services. Customers can lower the total cost of ownership while streamlining management and accelerating deployment time. Integrated network services available on Cisco Catalyst 4500-X Series include:
  - Application visibility and control (Flexible NetFlow, Cisco IOS Embedded Event Manager)
  - Security with Cisco TrustSec[1]
  - Troubleshooting video or any User Datagram Protocol-based flows (Mediatrace)
  - Video network readiness assessment (built-in traffic simulator with IP SLA Video Operation)
  - Ability to run third-party applications (Wireshark)

Table 1 highlights the performance and scalability enhancements of the Cisco Catalyst 4500-X Series Switches.

Table 1. Cisco Catalyst 4500-X Switch Series Performance and Scalability Features

Product Number	Description
System	
Base System	Front to Back Airflow: • 32x10 GE SFP+/SFP - WS-C4500X-32SFP+ • 16x10 GE SFP+/SFP - WS-C4500X-16SFP+ Back to Front Airflow: • 32x10 GE SFP+/SFP - WS-C4500X-F-32SFP+ • 16x10 GE SFP+/SFP - WS-C4500X-F-16SFP+
Expansion Module (Optional)	8x10 GE SFP+/SFP - C4KX-NM-8SFP+
Management Port	10/100/1000 Base-T
USB Port	Type A (storage and boot) up-to 4 GB
Dual Power Supply	Yes
Field Replaceable Fans	Yes (5 fans)
Fan Redundancy	No performance impact with single fan failure
Scalability	
System Throughput	Up to 800 Gbps
IPv4 Routing in Hardware	Up to 250 Mpps

Product Number	Description
IPv6 Routing in Hardware	Up to 125 Mpps
L2 Bridging in Hardware	Up to 250 Mpps
Media Access Control (MAC) Entries	55K
Forwarding Entries	32x10 GE Port Base SKU: IPv4: 256K, IPv6: 128K 16x10 GE Port Base SKU: IPv4: 64K, IPv6: 32K
Flexible Netflow Entries	128K
Switched Port Analyzer (SPAN), Remote Switched Port Analyzer (RSPAN)	8 line rate bidirectional sessions (ingress and egress)
Total VLANs	4094
Total Switched Virtual Interfaces (SVIs)	4094
IGMP groups	32K
Multicast routes	32x10 GE Port Base SKU: IPv4: 32K, IPv6: 32K 16x10 GE Port Base SKU: IPv4: 24K, IPv6: 12K
Dynamic Host Configuration Protocol (DHCP) Snooping Entries	12K (DHCP snooping bindings)
ARP Entries	47K
Spanning Tree Protocol Instances	10K
Jumbo Frame Support for Bridged and Routed Packets	Up to 9216 bytes
High Availability and Resiliency	
High Availability Solution	Virtual Switching System (VSS)
Number of stackable switches in VSS	Up to 2
VSS Throughput	Up to 1.6 Tbps
Virtual Switch Link	1GE or 10GE
Max number of Virtual Switch Links	8
In-Service Software Upgrade	Across the switches
Nonstop Forwarding with Stateful Switchover	Across the switches
CPU and Memory	
Onboard Memory (SRAM DDR-II)	4 GB
Port Buffers	32-MB Shared Memory
CPU	Dual Core 1.5 GHz
NVRAM	2 GB
Optional External Memory (SD Card)	2 GB
QoS Features	
Port Queues	8 Queues/Port
CPU Queues	64
QoS Entries	128K (64K ingress and 64K in egress) Shared with ACL
Aggregate Rate-Limiting	Ingress port or VLAN and egress VLAN or Layer 3 port
Rate-Limiting Level Types	Committed Information Rate (CIR), Peak Information Rate (PIR)
Aggregate Traffic Rate-Limiting Policers (1K=1024)	16K

Product Number	Description
Flow-Based Rate-Limiting Method; Number of Rates	Supported using flow-records in the classification criteria and policing action
Qos Policy Enforcement	Per Port or Per Vlan or Per Port, Per VLAN Granularity
Class of Service (CoS)	Yes
Differentiated Services Code Point (DSCP)	Yes
Security Features	
Port Security	Yes
IEEE 802.1x and 802.1x Extensions	Yes
VLAN, Router, and Port ACLs	Yes
Security ACL Entries (1K=1024)	128K (64K ingress and 64K in egress) Shared with QoS
Unicast Reverse Path Forwarding (uRPF) Check in Hardware	Yes
CPU Rate Limiters (DoS Protection) Includes Control Plane Policing	Yes
Private VLANs	Yes
Micro Flow Policer	Yes. Supported using flow records in the class-map
CPU HW Rate Limiters by Packet Per Second (pps) and Bit Rate Policers (bps)	Supported in hardware control-plane policing (CoPP)
Control Plane Policing (CoPP) for Multicast	Yes
ACL Labels	Yes
Port ACL	Yes
Traffic Storm Control (formally known as Broadcast/Multicast Suppression)	Yes
Virtualization Features	
VRF-Lite Scalability	64
Easy Virtual Network (EVN) Scalability	32
Simplified Operations	
Smart Install	Smart Install Director[2]

[2] Smart Install Director support in VSS mode will be available in a future software release.

Continued Innovations Through Infrastructure Services

Modular Open Application Platform, Cisco IOS XE Software

Cisco IOS XE Software is the open service platform software operating system for the Cisco Catalyst 4500-X Series. Cisco continues to evolve Cisco IOS Software to support next-generation switching hardware and provide increased architectural flexibility to deliver Cisco Borderless Networks services. Cisco IOS XE Software provides the following customer benefits:

- Cisco IOS XE Software provides an enhanced operating system that can take advantage of the multicore CPU architecture of the Cisco Catalyst 4500-X system.
- Cisco IOS XE enables single software image, without the need to download a separate software image per license feature set.

- Cisco IOS XE Software provides customer investment protection in the existing Cisco IOS Software by keeping a consistent feature set and operational look and feel. This supports a transparent migration experience.
- Cisco IOS XE Software supports service virtualization capability that allows the Cisco Catalyst 4500-X to host third-party applications in parallel with Cisco IOS Software. The hosted application communicates with Cisco IOS Software to use its rich feature sets. This benefit keeps Cisco IOS Software simple and robust while allowing the customer to quickly adopt new technologies using proven code. Cisco IOS XE Software enables Cisco Catalyst 4500-X to be an open service platform and is a primary anchor for future Cisco Borderless Networks innovations.

Simplified Operations Through Automation

As campus switching has grown to support increasing enterprise demands, so has the need to deploy and manage new and evolving technologies. Simplified operations are critical in meeting these challenges and achieving increased operational efficiency through proactive management and reduction in unplanned network downtime. The Cisco Catalyst 4500-X offers the following rich set of capabilities for simplified operations:

- Auto Install and AutoQoS for fast deployment
- Smart Install Director support for plug-and-play configuration and image-management
- Flexible NetFlow and IP SLA for enhanced visibility
- EEM integration with NetFlow and third-party applications
- Smart Call Home, Generic Online Diagnostic (GOLD), and Digital Optical Monitoring (DOM) for simplified operations
- Cisco EnergyWise for simplified and effective power management
- ISSU, SSO, and NSF for simplified change management and high availability for VSS enabled deployment
- Configuration rollback for improved configuration management

Best-in-Class Resiliency

The Cisco Catalyst 4500-X Series is designed for excellent nonstop communications with non-interrupted hardware switching. With Cisco IOS XE Software, customers continue to reap the benefits of this best-in-class resiliency in various ways.

In addition to redundant power supplies and fans, the Cisco Catalyst 4500-X is Virtual Switching System (VSS).

Any two Cisco Catalyst 4500-X Series Switches can be pooled together into a VSS. The two switches are connected with 10 Gigabit Ethernet links called Virtual Switch Links (VSLs). Once a VSS is created, it acts as a single virtual Cisco Catalyst switch delivering the following benefits:

Operational Manageability

- Two Cisco Catalyst 4500-X Series Switches share a single point of management, single gateway IP address, and single routing instance.
- Eliminates the dependence on First Hop Redundancy Protocols (FHRP) and Spanning Tree Protocol.

Scales to 1.6 Tbps

- Scales system bandwidth capacity to 1.6 Tbps by activating all available bandwidth across redundant Cisco Catalyst 4500-X Series Switches.
- Provides up to 80 ports of 10 Gigabit Ethernet per system.

Enhanced Application Visibility with Flexible NetFlow

Cisco IOS Flexible NetFlow is the next generation in flow monitoring technology, allowing optimization of the network infrastructure resources, reducing operation costs, and improving capacity planning and security incident detection with increased flexibility and scalability. The Cisco Catalyst 4500-X Series provides 128K Flexible NetFlow entries. Based on a custom-built ASIC, Cisco Catalyst 4500-X Series delivers unprecedented flexibility and comprehensive flow visibility extending from Layer 2 (MAC, VLAN) to Layer 4 (TCP, UDP flags, and so on).

The flow data collected by Flexible NetFlow can be exported to an external collector for analysis and reporting or tracked by EEM. The Cisco Catalyst 4500-X Series enables powerful on-box and customizable event correlation and policy actions with EEM. This allows the switches to trigger customized event alarms or policy actions when the predefined condition is met. With no external appliance required, customers are able to use existing infrastructure to perform traffic monitoring, making traffic analysis economical even on large IP networks.

Additional details on Cisco Flexible NetFlow are available at: http://www.cisco.com/go/fnf.

Features at a Glance

- **Cisco IOS XE Software IP Base:** Includes all Layer 2 features and some basic Layer 3 features.
- **Cisco IOS XE Software Enterprise Services:** Upgradable with a Software Activation License (SAL); supports full Layer 3 protocols and advanced features such as complete routing scalability, Border Gateway Protocol (BGP), Virtual Routing and Forwarding, Policy-Based Routing, and so on.

These features can be enabled using the software-licensing mechanism. For details about software licensing, see “Licensing” section later in this document or visit http://www.cisco.com/go/sa.

Industry Standards

- Ethernet: IEEE 802.3
- 10 Gigabit Ethernet: IEEE 802.3ae
- IEEE 802.1D Spanning Tree Protocol
- IEEE 802.1w Rapid Reconfiguration of Spanning Tree
- IEEE 802.1s Multiple VLAN Instances of Spanning Tree
- IEEE 802.3ad LACP
- IEEE 802.1p CoS Prioritization
- IEEE 802.1Q VLAN
- IEEE 802.1X User Authentication
- IEEE 802.1x-Rev
- RMON I and II standards
- USGv6 and IPv6 Gold Logo certified

Supported Pluggables

For details about the different optical modules and the minimum Cisco IOS Software release required for each of the supported optical modules, visit: http://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.

Note: SFP-10G-ZR modules are not supported on ports 1 to 32 (or 1 to 16) in the back-to-front airflow configuration. They are supported on the uplink module ports instead. In the back-to-front airflow configuration, limit usage of ZR optics to the uplink module only.

Software Requirements

The Cisco Catalyst 4500-X Series is supported in Cisco IOS Software with minimum Cisco IOS XE Software Release 3.3.0SG. For VSS capability, minimum software requirement is Cisco IOS XE Software Release 3.4.0SG.

Environmental Conditions

Table 2 lists environmental conditions for Cisco Catalyst 4500-X Series.

Table 2. Environmental Conditions for the Cisco Catalyst 4500-X Series

Parameter	Performance Range
Operating Temperature	0°C to 40°C (RH to 90%)
Storage Temperature	-40°C to 70°C (RH 93%)
Operating Altitude	60m below sea level to 3000m above sea level
Relative Humidity	Nonoperating Humidity: 95% RH
Acoustic Noise Measured per ISO 7779 and Declared per ISO 9296 Bystander Positions Operating to an Ambient Temperature of 25°C	Industrial Product: 65 dBA maximum
RoHS	Reduction of Hazardous Substances (ROHS) 5

Power Information

Table 3 lists power information for Cisco Catalyst 4500-X Series.

Table 3. Power Supply Information for Cisco Catalyst 4500-X Series

Power Supply Feature	Support in the 4500-X Series
AC Power Max Rating	750W
System Power Consumption	330W nominal/400W max
Input-Voltage Range and Frequency	AC 100 to 240 VAC 50-60 Hz/DC -72 VDC to -40 VDC
DC Power Max Rating	750W
AC to DC failover and vice versa	Yes
Total Output BTU (Note: 1000 BTU/hr = 293W)	1122 BTU/hr (330 W) nominal/1365 BTU/hr (400 W) max
Input Current	AC 11A @ 110VAC, 6 A @ 200VAC/DC 25A Max
Output Ratings	12V @ 62A & 3.3V @ 3A
Output Holdup Time	AC = 16 ms; DC = 4 ms @ maximum load
Power-Supply Input Receptacles	AC IEC 60320 C15/DC Custom detachable screw terminal (supplied)
Power Cord Rating	AC 15A/DC 25A

MTBF Information

Table 4 lists mean-time-between-failures (MTBF) information for Cisco Catalyst 4500-X Series.

Table 4. MTBF Information for Cisco Catalyst 4500-X Series

Product Number	Description
WS-C4500X-16SFP+	209,330
WS-C4500X-24X-ES	209,330
WS-C4500X-32SFP+	199,720
WS-C4500X-40X-ES	199,720
C4KX-NM-8SFP+	2,286,500
WS-C4500X-F-16SFP+	209,330
WS-C4500X-F-32SFP+	199,720
C4KX-FAN-F	L10 Life 60,000 at 40C[1]
C4KX-FAN-R	L10 Life 60,000 at 40C
C4KX-PWR-750AC-F	1,045,265
C4KX-PWR-750AC-R	1,045,265
C4KX-PWR-750DC-F	443,423
C4KX-PWR-750DC-R	443,423

[1] Since fan is an electro-mechanical device it doesn't follow electronics failure mode. L10 life means the time 10% of total PS population will fail at a particular temperature.

Regulatory Standards Compliance

Table 5 shows regulatory standards compliance information, and Table 6 provides ordering information.

Table 5. Cisco Catalyst 4500-X Regulatory Standards Compliance

Standard	Specification
Regulatory Compliance	CE marking
EMI and EMC Compliance	47CFR Part 15 (CFR 47) Class A AS/NZS CISPR22 Class A CISPR22 Class A EN55022 Class A ICES003 Class A VCCI Class A EN61000-3-2 EN61000-3-3 KN22 Class A CNS13438 Class A EN55024 CISPR24 EN300386 KN24
Safety Certifications	UL 60950-1 Second Edition CAN/CSA-C22.2 No. 60950-1 Second Edition EN 60950-1 Second Edition IEC 60950-1 Second Edition AS/NZS 60950-1
Industry EMC, Safety, and Environmental Standards	GR-63-Core Network Equipment Building Systems (NEBS) Level 3 GR-1089-Core Level 3

Table 6. Ordering Information

Product Number	Description
Base Switch PIDs	
WS-C4500X-16SFP+	Catalyst 4500-X 16 Port 10GE IP Base, Front-to-Back Cooling, No P/S
WS-C4500X-24X-IPB	Catalyst 4500-X 24 Port 10GE IP Base, Front-to-Back Cooling, No P/S
WS-C4500X-24X-ES	Catalyst 4500-X 24 Port 10GE Enterprise Services, Front-to-Back Cooling, No P/S
WS-C4500X-32SFP+	Catalyst 4500-X 32 Port 10GE IP Base, Front-to-Back Cooling, No P/S
WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10GE Enterprise Services, Front-to-Back Cooling, No P/S
C4KX-NM-8SFP+	Catalyst 4500-X 8 Port 10GE Network Module
WS-C4500X-F-16SFP+	Catalyst 4500-X 16 Port 10GE IP Base, Back-to-Front Cooling, No P/S
WS-C4500X-F-32SFP+	Catalyst 4500-X 32 Port 10GE IP Base, Back-to-Front Cooling, No P/S
FRU and OIR FANs	
C4KX-FAN-F	Catalyst 4500-X Back-to-Front Cooling Fan
C4KX-FAN-R	Catalyst 4500-X Front-to-Back Cooling Fan
Power Supply	
C4KX-PWR-750AC-F	Catalyst 4500-X 750W AC Back-to-Front Cooling Power Supply
C4KX-PWR-750AC-R	Catalyst 4500-X 750W AC Front-to-Back Cooling Power Supply
C4KX-PWR-750DC-F	Catalyst 4500-X 750W DC Back-to-Front Cooling Power Supply
C4KX-PWR-750DC-R	Catalyst 4500-X 750W DC Front-to-Back Cooling Power Supply
Accessories	
CAB-CON-C4K-RJ45	Console Cable 6ft with RJ-45-to-RJ-45
SD-X45-2GB-E	Cisco Catalyst 4500 2-GB SD card
USB-X45-4GB-E	Cisco Catalyst 4500 4-GB USB device
Software	
S45XU-33-1511SG	Cisco IOS Software XE Release 3.3.0 SG non-crypto universal image for Cisco Catalyst 4500-X 32-port and 40-port models
S45XUK9-33-1511SG	Cisco IOS Software XE Release 3.3.0 SG crypto universal image for Cisco Catalyst 4500-X 32-port and 40-port models
S45XU-331-1511SG	Cisco IOS Software XE Release 3.3.1 SG non-crypto universal image for Cisco Catalyst 4500-X 16-port and 24-port models
S45XUK9-331-1511SG	Cisco IOS Software XE Release 3.3.1 SG crypto universal image for Cisco Catalyst 4500-X 16-port and 24-port models
S45XU-34-1512SG	Cisco IOS Software XE Release 3.4.0 SG non-crypto universal image for all Cisco Catalyst 4500-X models
S45XUK9-34-1512SG	Cisco IOS Software XE Release 3.4.0 SG crypto universal image for all Cisco Catalyst 4500-X models
C4500X-LIC=	Base product ID for software upgrade licenses on Catalyst 4500-X (paper delivery)
C4500X-IPB	Catalyst 4500-X IP BASE software license (paper delivery)
C4500X-16P-IP-ES	Catalyst 4500-X IP BASE to Enterprise Services upgrade license (paper delivery) for 16-port and 24-port models
C4500X-IP-ES	Catalyst 4500-X IP BASE to Enterprise Services upgrade license (paper delivery) for 32-port and 40-port models
L-C4500X-LIC=	Catalyst 4500-X Base product ID for software upgrade licenses (electronic delivery)
L-C4500X-IPB	Catalyst 4500-X IP BASE software license (electronic delivery)
L-C4500X-16P-IP-ES	Catalyst 4500-X IP BASE to Enterprise Services upgrade license (electronic delivery) for 16-port and 24-port models
L-C4500X-IP-ES	Catalyst 4500-X IP BASE to Enterprise Services upgrade license (electronic delivery) for 32-port and 40-port models

Licensing

Software Activation Licensing

The Cisco Catalyst 4500-X Series enables software activation licensing. Each Cisco Catalyst 4500-X Series ships with a universal image containing all feature sets, IP Base and Enterprise Services. The level of functionality is determined by the license applied.

The software activation licensing enables customers to:

- Speed deployment and roll out new Cisco software activation feature sets across global networks
- Centrally and more accurately manage and track software and license compliance
- Easily conduct software compliance audits to meet regulations without affecting network operations

Additional benefits of Cisco activation licensing include:

- Operational simplicity
  - Simplified upgrades and license transfers save time and improve productivity. You can add new capabilities simply by using a license file.
  - You can easily track software assets, licenses, and feature set status.
  - A single software image improves service delivery.
- Ease of ordering:
  - “Try and buy” lets you use a temporary license to try and evaluate new Cisco IOS Software functionality before purchasing.
  - Pay-as-you-grow software key enables new features incrementally without service calls.

For more information about Cisco software licensing, visit: http://www.cisco.com/go/sa.

Cisco ONE Software

Cisco ONE Software for Access Switching is available for the Cisco Catalyst 4500-X Series Switches.

Cisco ONE Software is a new way for customers to purchase and use our infrastructure software. It offers a simplified consumption model, centered on common customer scenarios in the data center, WANs, and LANs.

Cisco ONE Software and services provide customers with four primary benefits:

- Software suites that address typical customer use scenarios at an attractive price
- Investment protection of their software purchase through software services-enabled license portability
- Access to ongoing innovation and new technology with Cisco Software Support Service (SWSS)
- Flexible licensing models to smoothly distribute customer's software spend over time

For ordering information for Cisco ONE Software for the Cisco Catalyst 4500-X Series Switches, go to http://www.cisco.com/c/en/us/products/software/one-access/switching-part-numbers.html.

Cisco Limited Lifetime Hardware Warranty

The Cisco limited lifetime hardware warranty (LLW) includes 10-day advance hardware replacement for as long as the original end user owns the product. Table 7 describes the Cisco limited lifetime hardware warranty.

The formal warranty statement, including the warranty applicable to Cisco software, appears in the Cisco information packet that accompanies your Cisco product. We encourage you to review carefully the warranty statement shipped with your specific product before use.

For additional information on warranty terms, visit: http://www.cisco.com/go/warranty.

Table 7. Cisco Limited Lifetime Hardware Warranty

Warranty Terms	Description[1]
Warranty Duration	As long as the original end user continues to own or use the product.
EoL Policy	In the event of discontinuance of product manufacture, Cisco warranty support is limited to 5 years from the announcement of discontinuance.
Hardware Replacement	Cisco or its service center will use commercially reasonable efforts to ship a replacement part within 10 business days after receipt of the RMA request and confirmation that a replacement part is the appropriate response. Actual delivery times may vary depending on customer location.
Effective Date	Hardware warranty commences from the date of shipment to the customer (and in case of resale by a Cisco reseller, not more than 90 days after original shipment by Cisco).
Cisco Technical Assistance Center (TAC) Support	None.
Cisco.com Access	Warranty allows guest access only to Cisco.com.

[1] Cisco reserves the right to refund the purchase price as its exclusive warranty remedy.

Adding a Cisco Technical Services contract to your device coverage provides benefits not available through the warranty, including access to the Cisco Technical Assistance Center (TAC), a variety of hardware replacement options to meet critical business needs, updates for licensed Cisco IOS Software, and registered access to the extensive Cisco.com knowledge base and support tools. Choose from a flexible suite of support services designed to meet your business needs and help you maintain high-quality network performance while controlling operational costs. Table 8 describes the benefits and features of Cisco Technical Services. For more information about Cisco Technical Services, visit: http://www.cisco.com/go/ts.

Table 8. Cisco Technical Services for Cisco Catalyst 4500-X Series Switches

Technical Services
Cisco SMARTnet™ Service • Around-the-clock, global access to the Cisco TAC • Unrestricted access to the extensive Cisco.com resources, communities, and tools • Next-business-day, 8x5x4, 24x7x4, and 24x7x2 advance hardware replacement[2] and onsite parts replacement and installation available • Ongoing operating system software updates within the licensed feature set[1] • Proactive diagnostics and real-time alerts on Smart Call Home-enabled devices
Cisco Smart Foundation Service • Next-business day advance hardware replacement as available • Business hours access to small and medium-sized business (SMB) TAC (access levels vary by region) • Access to Cisco.com SMB knowledge base • Online technical resources through Cisco Smart Foundation Portal • Operating system software bug fixes and patches

Technical Services
Cisco Focused Technical Support Services Three levels of premium, high-touch services are available: • Cisco High-Touch Operations Management Service • Cisco High-Touch Technical Support Service • Cisco High-Touch Engineering Service Valid Cisco SMARTnet Service or service provider base contracts on all network equipment are required.

Footnotes:

[1] Cisco operating system updates include the following: maintenance releases, minor updates, and major updates within the licensed feature set.

[2] Advance hardware replacement is available in various service-level combinations. For example, 8x5xNBD indicates that shipment will be initiated during the standard 8-hour business day, 5 days a week (the generally accepted business days within the relevant region), with next business day (NBD) delivery. Where NBD is not available, same day ship is provided. Restrictions apply; please review the appropriate service descriptions for details.

Cisco and Partner Services

Enable the innovative, secure, intelligent edge in Cisco Borderless Network Architecture using personalized services from Cisco and our partners. Through a discovery process that begins with understanding your business objectives, we help you integrate the next-generation Cisco Catalyst 4500-X Series Switches into your architecture and incorporate network services onto that platform. Sharing knowledge and leading practices, we support your success every step of the way as you deploy, absorb, manage, and scale new technology.

For additional information about Cisco services, visit: http://www.cisco.com/go/services.

Cisco Capital

Financing to Help You Achieve Your Objectives

Cisco Capital can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx. Accelerate your growth. Optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.

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Cisco 500 Series Stackable Managed Switches

Advanced Features for Demanding Environments, at an Affordable Price

Your business is growing, and that means more customers, more opportunities, and more attention on your company. The only problem: Your network was built for a smaller operation. As you add more devices, applications, and users, your IT environment will become increasingly difficult and expensive to manage. Even worse, as the network becomes more complex and overloaded, your users are likely to see sluggish performance and even outages.

With more customers and employees depending on your business than ever before, a slow or unreliable network is simply not an option. You need an IT backbone that provides excellent performance, nonstop availability, and advanced security. The ideal network will be easy to manage, even as it supports more advanced features, and will be designed to grow with your company. And it is available at a price you can afford.

Cisco 500 Series Stackable Managed Switches

The Cisco® 500 Series Stackable Managed Switches (Figure 1) are a new line of stackable managed Ethernet switches that provide the advanced capabilities you need to support a more demanding network environment, at an affordable price. These switches provide 24 or 48 ports of Fast Ethernet and 24 to 52 ports of Gigabit Ethernet connectivity with optional 10 Gigabit uplinks, providing a solid foundation for your current business applications, as well as those you are planning for the future. At the same time, these switches are easy to deploy and manage, without a large IT staff.

Figure 1. Cisco 500 Series Stackable Managed Switches

Cisco 500 Series switches are designed to protect your technology investment as your business grows. Unlike switches that claim to be stackable but have elements which are administered and troubleshot separately, the Cisco 500 Series provides true stacking capability, allowing you to configure, manage, and troubleshoot multiple physical switches as a single device and more easily expand your network. The Cisco 500 Series switch offer models which are fanless making it one of the industry's first in stackable switches, thereby delivering increased reliability, power efficiency, and minimizing noise.

A true stack delivers a unified data and control plane, in addition to management plane, providing flexibility, scalability, and ease of use since the stack of units operate as a single entity constituting all the ports of the stack members. The switches also protect your technology investment with an enhanced warranty, dedicated technical support, and the ability to upgrade equipment in the future and receive credit for your Cisco 500 Series switch. Overall, the Cisco 500 Series provides the ideal technology foundation for a growing business.

Features and Benefits

Cisco 500 Series switches provide the advanced feature set that growing businesses require, and that high-bandwidth applications and technologies demand. These switches can improve the availability of your critical applications, protect your business information, and optimize your network bandwidth to more effectively deliver information and support applications. The switches provide the following benefits.

Easy Deployment and Use

Cisco 500 Series switches are designed to be easy to use and manage by small businesses or the partners that serve them. They feature:

- Simple-to-use graphical interfaces reduce the time required to deploy, troubleshoot, and manage the network and allow you to support sophisticated capabilities without increasing IT head count.
- The switches also support Textview, a full command-line interface (CLI) option for partners that prefer it.
- Using Auto Smartports intelligence, the switch can detect a network device connected to any port and automatically configure the optimal security, quality of service (QoS), and availability on that port.
- Cisco Discovery Protocol (CDP) discovers Cisco devices and allows devices to share critical configuration information, simplifying network setup and integration.
- Support for Simple Network Management Protocol (SNMP) allows you to set up and manage your switches and other Cisco devices remotely from a network management station, improving IT workflow and mass configurations.
- The Cisco FindIT utility, which works through a simple toolbar on the user's web browser, discovers Cisco devices in the network and displays basic information, such as serial numbers and IP addresses, to aid in configuration and deployment. (For more information, and to download this free utility, please visit http://www.cisco.com/go/findit.)

High Reliability and Resiliency

In a growing business where 24x7 availability is critical, you need to assure that employees can always access the data and resources they need. In these environments, stackable switches can play an important role in eliminating downtime and improving network resiliency. For example, if a switch within a Cisco 500 Series stack fails, another switch immediately takes over, keeping your network up and running. You can also replace individual devices in the stack without taking your network offline or affecting employee productivity.

The Cisco 500X models provide an additional layer of resiliency with support for the Virtual Router Redundancy Protocol (VRRP). VRRP lets you extend the same resiliency that stacking provides for individual switches to complete network domains. By running VRRP between two stacks, you can instantly cut over from one stack to another in the event of a problem, and continue operating even after a failure.

The Cisco 500 Series also supports dual images, allowing you to perform software upgrades without having to take the network offline or worry about the network going down during the upgrade.

Simplified IT Operation

Cisco 500 Series switches help optimize your IT operations with built-in features that simplify and streamline day-to-day network operation:

- True stacking allows you to troubleshoot, configure, and manage multiple physical switches as a single entity.
- Unlike other stacking switches that require uniform configurations, the Cisco 500 Series allows you to mix Fast Ethernet, Gigabit Ethernet, and 10 Gigabit Ethernet models in a single stack, providing total flexibility without sacrificing manageability.
- Cisco switches use common chipsets/software across all switching portfolios, so all Cisco switches within a category support the same feature set - making it easier to manage and support all switches across the network.

True Stacking

Some switches claim to support stacking but in practice support only “clustering” - meaning that each switch must still be managed and configured individually. Cisco 500 Series switches provide true stacking capability, allowing you to configure, manage, and troubleshoot all switches in a stack as a single unit, with a single IP address.

A true stack delivers a unified data and control plane, in addition to management plane, providing flexibility, scalability, and ease of use since the stack of units operate as a single entity constituting all the ports of the stack members. This capability can radically reduce complexity in a growing network environment while improving the resiliency and availability of network applications. True stacking also provides other cost savings and administrative benefits through features such as cross-stack QoS, VLANs, and port mirroring, which clustered switches can’t support.

Strong Security

Cisco 500 Series switches provide the advanced security features you need to protect your business data and keep unauthorized users off the network:

- Embedded Secure Sockets Layer (SSL) encryption protects management data traveling to and from the switch.
- Extensive access control lists (ACLs) restrict sensitive portions of the network to keep out unauthorized users and guard against network attacks.
- Guest VLANs let you provide Internet connectivity to nonemployee users while isolating critical business services from guest traffic.
- Support for advanced network security applications such as IEEE 802.1X port security tightly limits access to specific segments of your network. Web based authentication provides a consistent interface to authenticate all types of host devices and operating systems, without the complexity of deploying IEEE 802.1X clients on each endpoint.
- Advanced defense mechanisms, including dynamic Address Resolution Protocol (ARP) inspection, IP Source Guard, and Dynamic Host Configuration Protocol (DHCP) snooping, detect and block deliberate network attacks. Combinations of these protocols are also referred to as IPMB (IP-MAC- port binding).

- IPv6 First Hop Security extends the advanced threat protection to IPv6. This comprehensive security suite includes ND inspection, RA guard, DHCPv6 guard and neighbor binding integrity check, providing unparalleled protection against a vast range of address spoofing and man in the middle attack on IPv6 networks.
- Time based ACLs and Port Operation restrict access to the network during predesignated times, such as business hours.
- Uniform MAC address-based security can be applied automatically to mobile users as they roam between wireless access points.
- Secure Core Technology (SCT) helps ensure that the switch is able to process management traffic in the face of a denial of service attack.
- Private VLAN Edge (PVE) provides Layer 2 isolation between devices on the same VLAN.
- Storm control can be applied to broadcast, multicast, and unknown unicast traffic.
- Protection of management sessions using Radius, TACACS+ and local database authentication as well as secure management sessions over SSL, SSH, and SNMPv3.
- DoS (denial-of-service) attack prevention maximizes network uptime in the presence of an attack.

Networkwide Automatic Voice Deployment

Using a combination of CDP, LLDP-MED, Auto Smartports, and VSDP (Voice Services Discovery Protocol - a unique Cisco protocol), customers can deploy an end-to-end voice network dynamically. The switches in the network automatically converge around a single voice VLAN and QoS parameters and then propagate them out to the phones on the ports where they are discovered. For example, automated voice VLAN capabilities let you plug any IP phone (including third-party phones) into your IP telephony network and receive an immediate dial tone. The switch automatically configures the device with the right VLAN and QoS parameters to prioritize voice traffic.

High-Power Power over Ethernet Plus (PoE+)

Cisco 500 Series switches support the Power over Ethernet Plus (PoE+) standard (IEEE 802. at), providing up to 30 watts per port. The power is managed in a smart fashion such that only the amount of power the endpoint needs is delivered to it and not wasted. As a result, the switches can support devices that require more power, such as dual-band 802.11n wireless access points, video-based IP phones, surveillance cameras, and more.

PoE capabilities simplify the deployment of advanced technologies by allowing you to connect and power network endpoints over a single Ethernet cable, without having to install separate power supplies. Cisco 500 Series switches are also fully backwards compatible with IEEE 802.11af PoE and previous- generation Cisco legacy PoE protocols.

IPv6 Support

As the IP address scheme evolves to accommodate a growing number of network devices, the Cisco 500 Series can support the transition to the next generation of networking and operating systems such as Windows 7, Vista, and Linux. These switches continue to support previous-generation IPv4, allowing you to evolve to the new IPv6 standard at your own pace, and helping ensure that your current network will continue to support your business applications in the future. Cisco 500 Series switches have successfully completed rigorous IPv6 testing and have received the USGv6 and IPv6 Gold certification.

Advanced Layer 3 Traffic Management

The Cisco 500 Series enables a more advanced set of traffic management capabilities to help growing businesses organize their networks more effectively and efficiently. For example, the switches provide static LAN Layer 3 routing, allowing you to segment your network into workgroups and communicate across VLANs without degrading application performance.

With these capabilities, you can boost the efficiency of your network by offloading internal traffic-handling tasks from your router and allowing it to manage primarily external traffic and security.

Cisco 500X models go even farther, providing dynamic Layer 3 routing features. With these capabilities, you can minimize the need to manually configure routing devices and simplify the ongoing operation of the network.

Power Efficiency

The Cisco 500 Series integrates a variety of power-saving features across all models, providing the industry's most extensive energy-efficient switching portfolio. These switches are designed to conserve energy by optimizing power use, which helps protects the environment and reduce your energy costs. They provide an eco-friendly network solution without compromising performance. Cisco 500 Series switches feature:

- Support for the Energy Efficient Ethernet (IEEE 802.3az) standard, which reduces energy consumption by monitoring the amount of traffic on an active link and putting the link into a sleep state during quiet periods
- The latest application-specific integrated circuits (ASICs), which use low-power 65-nanometer technology and low power high performance ARM CPUs
- Automatic power shutoff on ports when a link is down
- LEDs can be turned off to save power
- Embedded intelligence to adjust signal strength based on the length of the connecting cable

Expandability

The Cisco 500 Series provides more ports per Gigabit Ethernet switch than traditional switch models, giving you more flexibility to connect and empower your business. Gigabit Ethernet models feature 28- and 52-port switches, versus traditional devices that offer 20 or 44 ports, with 4 shared ports giving you more value. The Cisco 500 models offer 1G and 1G/5G Ethernet expansion slots, and the Cisco 500X models offer 10 Gigabit Ethernet expansion slots. As your business adds new applications, devices, and more bandwidth, you retain the flexibility to expand and interconnect your network infrastructure intelligently and efficiently, and reduce bottlenecks.

Peace of Mind and Investment Protection

Cisco 500 Series switches offer the reliable performance and peace of mind you expect from a Cisco switch. When you invest in the Cisco 500 Series, you gain the benefit of:

- Limited lifetime warranty with next-business-day (NBD) advance replacement (where available, otherwise same day ship)
- A solution that has been rigorously tested to help ensure optimal network uptime to keep employees connected to key resources and productive
- A solution designed and tested to easily and fully integrate with other Cisco voice, unified communications, security, and networking products, as part of a comprehensive technology platform for your business

Cisco Limited Lifetime Hardware Warranty

Cisco 500 Series switches offer a limited lifetime hardware warranty with NBD advance replacement (where available; otherwise same day ship) and a limited lifetime warranty for fans and power supplies.

In addition, Cisco offers software application updates for bug fixes for the warranty term, and telephone technical support at no charge for the first 12 months following the date of purchase. To download software updates, go to http://www.cisco.com/cisco/web/download/index.html.

Product warranty terms and other information applicable to Cisco products are available at http://www.cisco.com/go/warranty.

World-Class Service and Support

Your time is valuable, especially when you have a problem affecting your business. Cisco 500 Series switches are backed by the Cisco Small Business Support Service, which provides affordable peace-of- mind coverage. This subscription-based service helps you protect your investment and derive maximum value from Cisco Small Business products. Delivered by Cisco and backed by your trusted partner, this comprehensive service includes software updates and access to the Cisco Small Business Support Center, and it extends technical service to three years.

Cisco Small Business products are supported by professionals in the Cisco Small Business Support Center, a dedicated resource for small business customers and networks, with locations worldwide that are specifically trained to understand your needs. You also have access to extensive technical and product information through the Cisco Small Business Support Community, an online forum that enables you to collaborate with your peers and reach Cisco technical experts for support information.

Product Specifications

Table 1. Product Specifications

Feature	Description		
Performance			
Switching capacity and forwarding rate **All switches are wire-speed and non-blocking.**	**Product Name**	**Capacity in mpps (64-byte packets)**	**Switching Capacity (Gbps)**
	SF500-24	9.52	28.8
	SF500-24P	9.52	28.8
	SF500-24MP	9.52	28.8
	SF500-48	13.10	33.6
	SF500-48P	13.10	33.6
	SF500-48MP	13.10	33.6
	SG500-28	41.67	72
	SG500-28P	41.67	72
	SG500-28MPP	41.67	72
	SG500-52	77.38	120
	SG500-52P	77.38	120
	SG500-52MP	77.38	120
	SG500X-24	95.24	128
	SG500X-24P	95.24	128
	SG500X-24MPP	95.24	128

Feature	Description		
	SG500X-48	130.95	176
	SG500X-48P	130.95	176
	SG500X-48MP	130.95	176
	SG500XG-8F8T	238.1	320
Layer 2 Switching			
Spanning Tree Protocol	Standard 802.1d Spanning Tree Support Fast convergence using 802.1w (Rapid Spanning Tree [RSTP]), enabled by default Multiple spanning tree instances using 802.1s (MSTP). 16 instances are supported		
Port grouping/link aggregation	Support for IEEE 802.3ad Link Aggregation Control Protocol (LACP) • Up to 32 groups • Up to 8 ports per group with 16 candidate ports for each (dynamic) 802.3ad LAG		
VLAN	Support for up to 4096 VLANs simultaneously Port-based and 802.1Q tag-based VLANs MAC-based VLAN Management VLAN PVE (Private VLAN Edge), also known as Protected Port, with multiple uplinks Guest VLAN Unauthenticated VLAN Protocol-based VLAN CPE VLAN Dynamic VLAN assignment via Radius server along with 802.1x client authentication		
Voice VLAN	Voice traffic is automatically assigned to a voice-specific VLAN and treated with appropriate levels of QoS. Auto voice capabilities deliver network-wide zero touch deployment of voice endpoints and call control devices.		
Multicast TV VLAN	Multicast TV VLAN allows the single multicast VLAN to be shared in the network while subscribers remain in separate VLANs. This feature is also known as Multicast VLAN Registration (MVR).		
Q-in-Q	VLANs transparently cross over a service provider network while isolating traffic among customers.		
GVRP/GARP	Generic VLAN Registration Protocol (GVRP) and Generic Attribute Registration Protocol (GARP) enable automatic propagation and configuration of VLANs in a bridged domain.		
Unidirectional Link Detection (UDLD)	UDLD monitors physical connection to detect unidirectional links caused by incorrect wiring or port faults to prevent forwarding loops and blackholing of traffic in switched networks		
DHCP Relay at Layer 2	Relay of DHCP traffic to DHCP server in a different VLAN. Works with DHCP Option 82.		
IGMP (versions 1, 2, and 3) snooping	Internet Group Management Protocol (IGMP) limits bandwidth-intensive multicast traffic to only the requesters; supports 1K (1024) and 4K (for SG500X in native mode) multicast groups (source-specific multicasting is also supported).		
IGMP querier	IGMP querier is used to support a Layer 2 multicast domain of snooping switches in the absence of a multicast router.		
HOL blocking	Head-of-line (HOL) blocking.		
Jumbo Frames	Frames up to 9K (9216) bytes in length.		
Layer 3			
IPv4 routing	Wirespeed routing of IPv4 packets Up to 2K (2048) static routes and up to 256 IP interfaces		
Wirespeed IPv6 Static Routing	Up to 2K (2048) static routes and up to 128 IPv6 interfaces		
Layer 3 Interface	Configuration of layer 3 interface on physical port, LAG, VLAN interface or Loopback interface		
CIDR	Support for Classless Inter-Domain Routing		
RIP v2 (on 500X)	Support for Routing Information Protocol version 2, for dynamic routing		
VRRP (on 500X)	Virtual Router Redundancy Protocol (VRRP) delivers improved availability in a Layer 3 network by providing redundancy of the default gateway servicing hosts on the network. VRRP versions 2 and 3 are supported. Up to 255 virtual routers are supported.		
DHCP Server	Switch functions as an IPv4 DHCP Server serving IP addresses for multiple DHCP pools/scopes Support for DHCP options		
DHCP Relay at Layer 3	Relay of DHCP traffic across IP domains.		
User Datagram Protocol (UDP) Relay	Relay of broadcast information across Layer 3 domains for application discovery or relaying of BOOTP/DHCP packets.		

Feature	Description
Stacking	
Hardware stack	Up to 8 units in a stack. Up to 416 ports managed as a single system with hardware failover.
High availability	Fast stack failover delivers minimal traffic loss.
Plug-and-play stacking configuration/management	Master/backup for resilient stack control Auto-numbering Hot swap of units in stack Ring and chain stacking options Auto stacking port speed Flexible stacking port options
High-speed stack interconnects	Cost-effective 5G copper and high-speed 10G Fiber and Copper interfaces.
Hybrid stack	A mix of SF500, SG500, and SG500X in the same stack (10/100, Gigabit, and 10 Gigabit).
Security	
SSH	SSH is a secure replacement for Telnet traffic. SCP also uses SSH. SSH versions 1 and 2 are supported.
SSL	Secure Sockets Layer (SSL) encrypts all HTTPS traffic, allowing secure access to the browser-based management GUI in the switch.
IEEE 802.1X (Authenticator role)	RADIUS authentication and accounting, MD5 hash, guest VLAN, unauthenticated VLAN, single/multiple host mode and single/multiple sessions Supports time-based 802.1X Dynamic VLAN assignment
Web Based Authentication	Web based authentication provides network admission control through web browser to any host devices and operating systems.
STP BPDU Guard	A security mechanism to protect the networks from invalid configurations. A port enabled for Bridge Protocol Data Unit (BPDU) Guard is shut down if a BPDU message is received on that port. This avoids accidental topology loops.
STP Root Guard	This prevents edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes.
DHCP snooping	Filters out DHCP messages with unregistered IP addresses and/or from unexpected or untrusted interfaces. This prevents rogue devices from behaving as a DHCP Server.
IP Source Guard (IPSG)	When IP Source Guard is enabled at a port, the switch filters out IP packets received from the port if the source IP addresses of the packets have not been statically configured or dynamically learned from DHCP snooping. This prevents IP Address Spoofing.
Dynamic ARP Inspection (DAI)	The switch discards ARP packets from a port if there are no static or dynamic IP/MAC bindings or if there is a discrepancy between the source or destination address in the ARP packet. This prevents man-in-the-middle attacks.
IP/Mac/Port Binding (IPMB)	The features (DHCP Snooping, IP Source Guard, and Dynamic ARP Inspection) above work together to prevent DoS attacks in the network, thereby increasing network availability
Secure Core Technology (SCT)	Ensures that the switch will receive and process management and protocol traffic no matter how much traffic is received.
Secure Sensitive Data (SSD)	A mechanism to manage sensitive data (such as passwords, keys, etc.) securely on the switch, populating this data to other devices, and secure autoconfig. Access to view the sensitive data as plaintext or encrypted is provided according to the user configured access level and the access method of the user.
Layer 2 isolation (PVE) with community VLAN[1]	Private VLAN Edge provides security and isolation between switch ports, which helps ensure that users cannot snoop on other users' traffic; supports multiple uplinks.
Port security	Ability to lock Source MAC addresses to ports, and limit the number of learned MAC addresses.
RADIUS/TACACS+	Supports RADIUS and TACACS authentication. Switch functions as a client.
RADIUS accounting	The RADIUS accounting functions allow data to be sent at the start and end of services, indicating the amount of resources (such as time, packets, bytes, and so on) used during the session.
Storm control	Broadcast, multicast, and unknown unicast.
DoS prevention	Denial-of-Service (DoS) attack prevention.
Multiple user privilege levels in CLI	Levels 1, 7, and 15 privilege levels.
ACLs	Support for up to 2K (2048) rules on 500 Series and 3K (3072) on 500X series. Drop or rate limit based on source and destination MAC, VLAN ID or IP address, protocol, port, DSCP/IP precedence, TCP/User Datagram Protocol (UDP) source and destination ports, 802.1p priority, Ethernet type, Internet Control Message Protocol (ICMP) packets, Internet Group Management Protocol (IGMP) packets, TCP flag. Time-based ACLs supported.

Feature	Description	
Quality of Service		
Priority levels	8 hardware queues	
Scheduling	Strict Priority and weighted round-robin (WRR)	
Class of service	Port based; 802.1p VLAN priority based; IPv4/v6 IP precedence/ToS/DSCP based; DiffServ; classification and re-marking ACLs, Trusted QoS Queue assignment based on differentiated services code point (DSCP) and class of service (802.1p/CoS)	
Rate limiting	Ingress policer; egress shaping and ingress rate control; per VLAN, per port, and flow based	
Congestion avoidance	A TCP congestion avoidance algorithm is required to minimize and prevent global TCP loss synchronization.	
Standards		
Standards	IEEE 802.3 10BASE-T Ethernet, IEEE 802.3u 100BASE-TX Fast Ethernet, IEEE 802.3ab 1000BASE- T Gigabit Ethernet, IEEE 802.3ad Link Aggregation Control Protocol, IEEE 802.3z Gigabit Ethernet, IEEE 802.3x Flow Control, IEEE 802.3 ad LACP, IEEE 802.1D (STP, GARP and GVRP), IEEE 802.1Q/p VLAN, IEEE 802.1w Rapid STP, IEEE 802.1s Multiple STP, IEEE 802.1X Port Access Authentication, IEEE 802.3af, IEEE 802.3at, RFC 768, RFC 783, RFC 791, RFC 792, RFC 793, RFC 813, RFC 879, RFC 896, RFC 826, RFC 854, RFC 855, RFC 856, RFC 858, RFC 894, RFC 919, RFC 922, RFC 920, RFC 950, RFC 951, RFC 1042, RFC 1071, RFC 1123, RFC 1141, RFC 1155, RFC 1157, RFC 1350, RFC 1533, RFC 1541, RFC 1542, RFC 1624, RFC 1700, RFC 1867, RFC 2030, RFC 2616, RFC 2131, RFC 2132, RFC 3164, RFC 3411, RFC 3412, RFC 3413, RFC 3414, RFC 3415, RFC 2576, RFC 4330, RFC 1213, RFC 1215, RFC 1286, RFC 1442, RFC 1451, RFC 1493, RFC 1573, RFC 1643, RFC 1757, RFC 1907, RFC 2011, RFC 2012, RFC 2013, RFC 2233, RFC 2618, RFC 2665, RFC 2666, RFC 2674, RFC 2737, RFC 2819, RFC 2863, RFC 1157, RFC 1493, RFC 1215, RFC 3416	
IPv6		
IPv6	IPv6 Host Mode IPv6 over Ethernet Dual IPv6/IPv4 stack IPv6 Neighbor and Router Discovery (ND) IPv6 Stateless Address Autoconfiguration Path MTU Discovery Duplicate Address Detection (DAD) ICMPv6 IPv6 over IPv4 network with ISATAP tunnel support USGv6 and IPv6 Gold Logo certified	
IPv6 QoS	Prioritize IPv6 packets in hardware	
IPv6 ACL	Drop or Rate Limit IPv6 packets in hardware	
IPv6 First Hop Security	RA guard ND inspection DHCPv6 guard Neighbor binding table (Snooping and static entries) Neighbor binding integrity check	
Multicast Listener Discovery (MLD v1/2) snooping	Deliver IPv6 multicast packets only to the required receivers	
IPv6 applications	Web/SSL, Telnet Server/SSH, Ping, Traceroute, SNTP, TFTP, SNMP, RADIUS, Syslog, DNS client, DHCP Client, DHCP Autoconfig, IPv6 DHCP Relay, TACACS	
IPv6 RFC supported	RFC 4443 (which obsoletes RFC 2463) - ICMPv6 RFC 4291 (which obsoletes RFC 3513) - IPv6 Address Architecture RFC 4291 - IP Version 6 Addressing Architecture RFC 2460 - IPv6 Specification RFC 4861 (which obsoletes RFC 2461) - Neighbor Discovery for IPv6 RFC 4862 (which obsoletes RFC 2462) - IPv6 Stateless Address Auto-configuration RFC 1981 - Path MTU Discovery RFC 4007 - IPv6 Scoped Address Architecture RFC 3484 - Default address selection mechanism RFC 5214 (which obsoletes RFC 4214) - ISATAP tunneling RFC 4293 - MIB IPv6: Textual Conventions and General Group RFC 3595 - Textual Conventions for IPv6 Flow Label	
Management		
Web user interface	Built-in switch configuration utility for easy browser-based device configuration (HTTP/HTTPS). Supports configuration, system dashboard, system maintenance and monitoring.	
SNMP	SNMP versions 1, 2c, and 3 with support for traps, and SNMP v3 User-based Security Model (USM)	
Standard MIBs	lldp-MIB lldpextdot1-MIB lldpextdot3-MIB	rfc2665-MIB rfc2668-MIB rfc2737-MIB

Feature	Description	
	lldpextmed-MIB	rfc3621-MIB
	rfc2674-MIB	rfc4668-MIB
	rfc2575-MIB	rfc4670-MIB
	rfc2573-MIB	trunk-MIB
	rfc2233-MIB	tunnel-MIB
	rfc2013-MIB	udp-MIB
	rfc2012-MIB	draft-ietf-bridge-8021x-MIB
	rfc2011-MIB	draft-ietf-bridge-rstpmib-04-MIB
	RFC-1212	draft-ietf-hubmib-etherif-mib-v3-00-MIB
	RFC-1215	ianaaddrfamnumbers-MIB
Standard MIBs (continued)	SNMPv2-CONF	ianaifty-MIB
	SNMPv2-TC	ianaprot-MIB
	p-bridge-MIB	inet-address-MIB
	q-bridge-MIB	ip-forward-MIB
	rfc1389-MIB	ip-MIB
	rfc1493-MIB	RFC1155-SMI
	rfc1611-MIB	RFC1213-MIB
	rfc1612-MIB	SNMPv2-MIB
	rfc1850-MIB	SNMPv2-SMI
	rfc1907-MIB	SNMPv2-TM
	rfc2571-MIB	RMON-MIB
	rfc2572-MIB	rfc1724-MIB
	rfc2574-MIB	dcb-raj-DCBX-MIB-1108-MIB
	rfc2576-MIB	rfc1213-MIB
	rfc2613-MIB	rfc1757-MIB
Private MIBs	CISCOSB-lldp-MIB	CISCOSB-iprouter-MIB
	CISCOSB-brgmulticast-MIB	CISCOSB-ipv6-MIB
	CISCOSB-bridgemibobjects-MIB	CISCOSB-mnginf-MIB
	CISCOSB-bonjour-MIB	CISCOSB-lcli-MIB
	CISCOSB-dhcpcl-MIB	CISCOSBlocalization-MIB
	CISCOSB-MIB	CISCOSB-mcmngr-MIB
	CISCOSB-wrandomtaildrop-MIB	CISCOSB-mng-MIB
	CISCOSB-traceroute-MIB	CISCOSB-physdescription-MIB
	CISCOSB-telnet-MIB	CISCOSB-PoE-MIB
	CISCOSB-stormctrl-MIB	CISCOSB-protectedport-MIB
	CISCOSBssh-MIB	CISCOSB-rmon-MIB
	CISCOSB-socket-MIB	CISCOSB-rs232-MIB
	CISCOSB-sntp-MIB	CISCOSB-SecuritySuite-MIB
	CISCOSB-smon-MIB	CISCOSB-snmp-MIB
	CISCOSB-phy-MIB	CISCOSB-specialbpdu-MIB
	CISCOSB-multisessionterminal-MIB	CISCOSB-banner-MIB
	CISCOSB-mri-MIB	CISCOSB-syslog-MIB
	CISCOSB-jumboframes-MIB	CISCOSB-TcpSession-MIB
	CISCOSB-gvrp-MIB	CISCOSB-traps-MIB
	CISCOSB-endofmib-MIB	CISCOSB-trunk-MIB
	CISCOSB-dot1x-MIB	CISCOSB-tuning-MIB
	CISCOSB-deviceparams-MIB	CISCOSB-tunnel-MIB
	CISCOSB-cli-MIB	CISCOSB-udp-MIB
	CISCOSB-cdb-MIB	CISCOSB-vlan-MIB
	CISCOSB-brgmacswitch-MIB	CISCOSB-ipstdacl-MIB
	CISCOSB-3sw2swtables-MIB	CISCOSB-eee-MIB
	CISCOSB-smartPorts-MIB	CISCOSB-ssl-MIB
	CISCOSB-tbi-MIB	CISCOSB-digitalkeymanage-MIB
	CISCOSB-macbaseprio-MIB	CISCOSB-qosclimib-MIB
	CISCOSB-env_mib-MIB	CISCOSB-vrrp-MIB
	CISCOSB-policy-MIB	CISCOSB-tbp-MIB

Feature	Description	
	CISCOSB-sensor-MIB	CISCOSB-stack-MIB
	CISCOSB-aaa-MIB	CISCOSMB-MIB
	CISCOSB-application-MIB	CISCOSB-secsd-MIB
	CISCOSB-bridgesecurity-MIB	CISCOSB-draft-ietf-entmib-sensor-MIB
	CISCOSB-copy-MIB	CISCOSB-draft-ietf-syslog-device-MIB
	CISCOSB-CpuCounters-MIB	CISCOSB-rfc2925-MIB
	CISCOSB-Custom1BonjourService-MIB	CISCOSB-vrrpv3-MIB
	CISCOSB-dhcp-MIB	CISCO-SMI-MIB
Private MIBs (continued)	CISCOSB-dlf-MIB	CISCOSB-DebugCapabilities-MIB
	CISCOSB-dnscl-MIB	CISCOSB-CDP-MIB
	CISCOSB-embweb-MIB	CISCOSB-vlanVoice-MIB
	CISCOSB-fft-MIB	CISCOSB-EVENTS-MIB
	CISCOSB-file-MIB CISCOSB-greeneth-MIB	CISCOSB-sysmng-MIB
	CISCOSB-interfaces-MIB	CISCOSB-sct-MIB
	CISCOSB-interfaces_recovery-MIB	CISCO-TC-MIB
	CISCOSB-ip-MIB	CISCO-VTP-MIB
		CISCO-CDP-MIB
RMON	Embedded RMON software agent supports 4 RMON groups (history, statistics, alarms, and events) for enhanced traffic management, monitoring, and analysis	
IPv4 and IPv6 Dual Stack	Coexistence of both protocol stacks to ease migration	
Firmware upgrade	• Web browser upgrade (HTTP/HTTPS) and TFTP and SCP • Upgrade can be initiated through console port as well • Dual images for resilient firmware upgrades	
Port mirroring	Traffic on a port can be mirrored to another port for analysis with a network analyzer or RMON probe. Up to 8 source ports can be mirrored to one destination port.	
VLAN mirroring	Traffic from a VLAN can be mirrored to a port for analysis with a network analyzer or RMON probe. Up to 8 source VLANs can be mirrored to one destination port.	
DHCP (Options 12, 66, 67, 82, 129, and 150)	DHCP options facilitate tighter control from a central point (DHCP Server), to obtain IP address, auto configuration (with configuration file download), DHCP Relay, and host name.	
Auto configuration with Secure Copy (SCP) file download	Enables secure mass deployment with protection of sensitive data.	
Text-editable configs	Config files can be edited with a text editor and downloaded to another switch, facilitating easier mass deployment.	
Smartports	Simplified configuration of QoS and security capabilities.	
Auto Smartports	Automatically applies the intelligence delivered through the Smartports roles to the port based on the devices discovered over Cisco Discovery Protocol or LLDP-MED. This facilitates zero touch deployments.	
Secure Copy (SCP)	Securely transfer files to and from the switch.	
Textview CLI	Scriptable CLI. A full CLI as well as a menu CLI is supported.	
Cloud Services	Support for Cisco Small Business and Cisco OnPlus.	
Localization	Localization of GUI and documentation into multiple languages.	
Login banner	Configurable multiple banners for web as well as CLI.	
Time-based port operation	Link up or down based on user-defined schedule (when the port is administratively up).	
Other management	Traceroute; single IP management; HTTP/HTTPS; SSH; RADIUS; port mirroring; TFTP upgrade; DHCP client; BOOTP; Simple Network Time Protocol (SNTP); Xmodem upgrade; cable diagnostics; Ping; syslog; Telnet client (SSH secure support); Automatic time settings from Management Station.	
Green (Power Efficiency)		
Energy Detect	Automatically turns power off on Gigabit Ethernet RJ-45 port when detecting link down. Active mode is resumed without loss of any packets when the switch detects the link is up.	
Cable length detection	Adjusts the signal strength based on the cable length. Reduces the power consumption for cable shorter than 10m. Supported on Gigabit Ethernet models.	
EEE compliant (802.3az)	Supports IEEE 802.3az on all Gigabit copper ports.	
Disable port LEDs	LEDs can be manually turned off to save on energy.	

Feature	Description
General	
Jumbo frames	Frame sizes up to 9K (9216) bytes. Supported on 10/100 and Gigabit Ethernet interfaces. The default MTU is 2K.
MAC table	16K (16384) MAC addresses.
Discovery	
Bonjour	The switch advertises itself using the Bonjour protocol.
LLDP (802.1ab) with LLDP-MED extensions	Link Layer Discovery Protocol (LLDP) allows the switch to advertise its identification, configuration, and capabilities to neighboring devices that store the data in a MIB. LLDP-MED is an enhancement to LLDP that adds the extensions needed for IP phones.
Cisco Discovery Protocol (CDP)	The switch advertises itself using the Cisco Discovery Protocol (CDP). It also learns the connected device and its characteristics via CDP.
Product Specifications	
Power over Ethernet (PoE)	
IEEE 802.3af and 802.3at PoE delivered over any of the RJ-45 ports within the listed power budgets	Switches support 802.2af, 802.3at, and Cisco pre-standard (legacy) PoE. Maximum power of 30W to any 10/100 or Gigabit base port until the PoE budget for the switch is reached. The total power available for PoE per switch is:

Model Name	Power Dedicated to PoE	Number of Ports That Support PoE
SF500-24	N/A	0
SF500-24P	180W	24
SF500-24MP	375W	24
SF500-48	N/A	0
SF500-48P	375W	48
SF500-48MP	740W	48
SG500-28	N/A	0
SG500-28P	180W	24
SG500-28MPP	740W	24
SG500-52	N/A	0
SG500-52P	375W	48
SG500-52MP	740W	48
SG500X-24	N/A	0
SG500X-24P	375W	24
SG500X-24MPP	740W	24
SG500X-48	N/A	0
SG500X-48P	375W	48
SG500-48MP	740W	48
SG500XG-8F8T	N/A	0

Power consumption (worst case)

Model Name	Green Power (mode)	System Power Consumption	Power Consumption (with PoE)	Heat Dissipation (BTU/hr)
SF500-24	Energy Detect	110V=13.7W 220V=14.8W	N/A	46.5
SF500-24P	Energy Detect	110V=26.1W 220V=27W	110V=216W 220V=211W	719.96
SF500-24MP	Energy Detect	110V=39.31W 220V=39.79W	110V=380W 220V=429.67W	1466
SF500-48	Energy Detect	110V=24.3W 220V=24.8W	N/A	77.9

Feature	Description				
	SF500-48P	Energy Detect	110V=46.8W 220V=47.5W	110V=437W 220V=429.5W	1465.51
	SF500-48MP	Energy Detect	110V=60.48W 220V=60.21W	110V=853.04W 220V=826.62W	2910
	SG500-28	EEE + Short Reach + Energy Detect	110V=23.2W 220V=23.6W	N/A	74.2
	SG500-28P	EEE + Short Reach + Energy Detect	110V=35W 220V=35.9W	110V=227W 220V=221.5W	755.79
	SG500-28MPP	EEE + Short Reach + Energy Detect	110V=40.38W 220V=41.0W	110V=803.6W 220V=808.6W	2729.06
	SG500-52	EEE + Short Reach + Energy Detect	110V=47W 220V=47W	N/A	147.7
	SG500-52P	EEE + Short Reach + Energy Detect	110V=63.7W 220V=64.7W	110V=460.5W 220V=452W	1542.29
	SG500-52MP	EEE + Short Reach + Energy Detect	110V=70.3W 220V=70.5W	110V=873.5W 220V=857.3W	2807.51
	SG500X-24	EEE + Short Reach + Energy Detect	110V=36.5W 220V=36.2W	N/A	114.7
	SG500X-24P	EEE + Short Reach + Energy Detect	110V=57.2W 220V=57.9W	110V=456W 220V=438W	1494.52
	SG500X-24MPP	EEE + Short Reach + Energy Detect	110V=64.75W 220V=65.13W	110V=851.08W 220V=825.91W	2904
	SG500X-48	EEE + Short Reach + Energy Detect	110V=60.3W 220V=60.3W	N/A	189.5
	SG500X-48P	EEE + Short Reach + Energy Detect	110V=74.4W 220V=75W	110V=474W 220V=462W	1576.41
	SG500X-48MP	EEE + Short Reach + Energy Detect	110V=87.33W 220V=85.43W	110V=880.75W 220V=855.13W	3006
	SG500XG-8F8T	EEE + Short Reach + Energy Detect	110V=93.7W 220V=94.33W	N/A	321.87
Ports	**Model Name**	**Total System Ports**	**RJ-45 Ports**	**Combo Ports (RJ-45 + SFP)**	
	SF500-24	24FE + 4 GE (5G Stacking)	24 FE	2 combo GE + 2 1G/5G SFP	
	SF500-24P	24FE + 4 GE (5G Stacking)	24 FE	2 combo GE + 2 1G/5G SFP	
	SF500-24MP	24FE + 4 GE (5G Stacking)	24 FE	2 combo GE + 2 1G/5G SFP	
	SF500-48	48FE + 4 GE (5G Stacking)	48 FE	2 combo GE + 2 1G/5G SFP	
	SF500-48P	48FE + 4 GE (5G Stacking)	48 FE	2 combo GE + 2 1G/5G SFP	
	SF500-48MP	48FE + 4 GE (5G Stacking)	48 FE	2 combo GE + 2 1G/5G SFP	
	SG500-28	24GE + 4 GE (5G Stacking)	24 GE	2 combo GE + 2 1G/5G SFP	
	SG500-28P	24GE + 4 GE (5G Stacking)	24 GE	2 combo GE + 2 1G/5G SFP	
	SG500-28MPP	24GE + 4 GE (5G Stacking)	24 GE	2 combo GE + 2 1G/5G SFP	
	SG500-52	48GE + 4 GE (5G Stacking)	48 GE	2 combo GE + 2 1G/5G SFP	
	SG500-52P	48GE + 4 GE (5G Stacking)	48 GE	2 combo GE + 2 1G/5G SFP	
	SG500-52MP	48GE + 4 GE (5G Stacking)	48 GE	2 combo GE + 2 1G/5G SFP	
	SG500X-24	24GE + 4 10GE	24 GE	4 XG SFP+ (Two combo 5G SFP slots)	
	SG500X-24P	24GE + 4 10GE	24 GE	4 XG SFP+ (Two combo 5G SFP slots)	

Feature	Description			
	SG500X-24MPP	24GE + 4 10GE	24 GE	4 XG SFP+ (Two combo 5G SFP slots)
	SG500X-48	48GE + 4 10GE	48 GE	4 XG SFP+ (Two combo 5G SFP slots)
	SG500X-48P	48GE + 4 10GE	48 GE	4 XG SFP+ (Two combo 5G SFP slots)
	SG500X-48MP	48GE + 4 10GE	48 GE	4 XG SFP+ (Two combo 5G SFP slots)
	SG500XG-8F8T	8 XG Copper + 8 XG SFP+ plus 1 GE Management	8 XG + 1 GE Mgmt	8 XG SFP+
Buttons	Reset button			
Cabling type	Unshielded twisted pair (UTP) Category 5 or better; Fiber options (SMF and MMF); Coaxial SFP+ for stacking purposes			
LEDs	LED power savings, System, Link/Act, PoE, Speed			
Flash	32 MB			
800 MHz ARM CPU memory	256 MB			
Packet buffer	All numbers are aggregate across all ports, as the buffers are dynamically shared:			
	Model Name		**Packet Buffer**	
	SF500-24		8Mb	
	SF500-24P		8Mb	
	SF500-24MP		8Mb	
	SF500-48		2*8Mb	
	SF500-48P		2*8Mb	
	SF500-48MP		2*8Mb	
	SG500-28		8Mb	
	SG500-28P		8Mb	
	SG500-28MPP		8Mb	
	SG500-52		2*8Mb	
	SG500-52P		2*8Mb	
	SG500-52MP		2*8Mb	
	SG500X-24		12Mb	
	SG500X-24P		12Mb	
	SG500X-24MPP		12Mb	
	SG500X-48		2*12Mb	
	SG500X-48P		2*12Mb	
	SG500X-48MP		2*12Mb	
	SG500XG-8F8T		16Mb	
Supported SFP/SFP+ Modules **Note: Gigabit (MGBxxx) and 10-Gigabit (SFP-xxx) modules also work in the SG500XG-8F8T Ten Gigabit switch model.**	**SKU**	**Media**	**Speed**	**Maximum Distance**
	MFEFX1	Multi-mode fiber	100 Mbps	2 km
	MFELX1	Single-mode fiber	100 Mbps	15 km
	MFEBX1	Single-mode fiber	100 Mbps	20 km
	MGBBX1	Single-mode fiber	1000 Mbps	10 km
	MGBSX1	Multi-mode fiber	1000 Mbps	500 m
	MGBLH1	Single-mode fiber	1000 Mbps	40 km
	MGBLX1	Single-mode fiber	1000 Mbps	10 km

Feature	Description			
	MGBT1	UPT cat 5	1000 Mbps	100 m
	SFP-H10GB-CU1M	Copper coax	5G (Sx500)/10G (SG500X)	1 m
	SFP-H10GB-CU3M	Copper coax	5G (Sx500)/10G (SG500X)	3 m
	SFP-H10GB-CU5M	Copper coax	5G (Sx500)/10G (SG500X)	5 m
	SFP-10G-SR	Multi-mode fiber	10 Gig	400 m
	SFP-10G-LR	Single-mode fiber	10 Gig	10 km
	SFP-10G-LRM	Single-mode/multi-mode fiber	10 Gig	300 m
Stack Connection Options				
	500		**500X**	
500	5G copper - SFP-H10GB-CUxM 1G fiber or copper - MGBxxx 1G Base-T - embedded RJ45 (S1/S2)		5G copper - SFP-H10GB-CUxM 1G fiber or copper - MGBxxx	
500X	5G copper - SFP-H10GB-CUxM 1G fiber or copper - MGBxxx		10G copper - SFP-H10GB-CUxM 10G Fiber - SFP-10G-xx 1G fiber or copper - MGBxxx	
Environmental				
Unit Dimensions (W x H x D)	**Model Name**		**Unit Dimensions**	
	SF500-24		440 x 44 x 257 mm	
	SF500-24P		440 x 44 x 257 mm	
	SF500-24MP		440 x 44 x 257 mm	
	SF500-48		440 x 44 x 257 mm	
	SF500-48P		440 x 44 x 350 mm	
	SF500-48MP		440 x 44 x 350 mm	
	SG500-28		440 x 44 x 257 mm	
	SG500-28P		440 x 44 x 257 mm	
	SG500-28MPP		440 x 44 x 350 mm	
	SG500-52		440 x 44 x 257 mm	
	SG500-52P		440 x 44 x 350 mm	
	SG500-52MP		440 x 44 x 350 mm	
	SG500X-24		440 x 44 x 257 mm	
	SG500X-24P		440 x 44 x 350 mm	
	SG500X-24MPP		440 x 44 x 350 mm	
	SG500X-48		440 x 44 x 257 mm	
	SG500X-48P		440 x 44 x 350 mm	
	SG500X-48MP		440 x 44 x 350 mm	
	SG500XG-8F8T		440 x 44 x 350 mm	
Unit weight	**Model Name**		**Unit Weight**	
	SF500-24		3.09 kg	
	SF500-24P		3.73 kg	
	SF500-24MP		4.35 kg	
	SF500-48		3.43 kg	
	SF500-48P		5.61 kg	
	SF500-48MP		5.52 kg	

Feature	Description			
	SG500-28		3.4 kg	
	SG500-28P		3.95 kg	
	SG500-28MPP		5.28 kg	
	SG500-52		3.95 kg	
	SG500-52P		5.61 kg	
	SG500-52MP		5.6 kg	
	SG500X-24		3.45 kg	
	SG500X-24P		5.25 kg	
	SG500X-24MPP		4.61 kg	
	SG500X-48		4.01 kg	
	SG500X-48P		5.74 kg	
	SG500X-48MP		5.43 kg	
	SG500XG-8F8T		5.25 kg	
Power	100-240V 47-63 Hz, internal, universal			
Certification	UL (UL 60950), CSA (CSA 22.2), CE mark, FCC Part 15 (CFR 47) Class A			
Operating temperature	SF500-24, SF500-24P, SF500-48, SF500-48P, SG500-28, SG500-28P, SG500-52, SG500-52P, SG500X-24, SG500X-24P, SG500X-48, SG500X-48P 32°to 104°F (0°to 40°C) SG500-28MPP, SG500-52MP, SG500XG-8F8T, SF500-24MP, SF500-48MP, SG500X-24MPP, SG500X-48MP 32°to 122°F (0°to 50°C)			
Storage temperature	-4°to 158°F (-20°to 70°C)			
Operating humidity	10% to 90%, relative, noncondensing			
Storage humidity	10% to 90%, relative, noncondensing			
Acoustic noise and mean time between failures (MTBF)	**Model Name**	**Fan (Number)**	**Acoustic Noise**	**MTBF @ 40°C (Hours)**
	SF500-24	No fan	N/A	210,801.7
	SF500-24P	2 pcs/6300rpm No fan speed control	41 dB	260,626.2
	SF500-24MP	2pcs	44 dB	514157 (at 50C)
	SF500-48	No fan	N/A	131,127.2
	SF500-48P	3 pcs/9500rpm and fan speed control	30°C=43dB 40°C=54.5dB	147,998.3
	SF500-48MP	3 pcs	46.9 dB	322111 (at 50C)
	SG500-28	No fan	N/A	141,161.0
	SG500-28P	2 pcs/6300rpm No fan speed control	41.2 dB	253,175.1
	SG500-28MPP	2 pcs/6300rpm No fan speed control	41.2 dB	188,722 (at 50C)
	SG500-52	2 pcs/5000rpm No fan speed control	41.3dB	154,250.1
	SG500-52P	4 pcs/9500rpm and fan speed control	30°C=41.1dB 40°C=54.8dB	143,124.8
	SG500-52MP	4 pcs/9500rpm and fan speed control	30°C=41.1dB 40°C=54.8dB	186,968 (at 50C)
	SG500X-24	1 pcs/6300rpm No fan speed control	40.2dB	246,188.2
	SG500X-24P	3 pcs/9500rpm and fan speed control	30°C=40.1dB 40°C=52.2dB	132,225.7

Feature	Description			
	SG500X-24MPP	3pcs	46.4 dB	428,088 (at 50C)
	SG500X-48	2 pcs/5000rpm No fan speed control	41.1dB	166,796.4
	SG500X-48P	4 pcs/9500rpm and fan speed control	30°C=40.9dB 40°C=54.2dB	137,246.1
	SG500X-48MP	4 pcs	46.4 dB	307978 (at 50C)
	SG500XG-8F8T	4 pcs/9500rpm and fan speed control	30°C=41.7dB 40°C=55.3dB	131,290 (at 50C)
Warranty	Limited lifetime with next-business-day advance replacement (where available, otherwise same day ship)			

Package Contents
• Cisco Small Business 500/500X Series Stackable Managed Switch • Power cord • Mounting kit included with all models • Serial cable • CD-ROM with user documentation (PDF) included • Quick Start Guide
Minimum Requirements
• Web browser: Mozilla Firefox version 8 or later; Microsoft Internet Explorer version 7 or later, Safari, Chrome • Category 5 Ethernet network cable • TCP/IP, network adapter, and network operating system (such as Microsoft Windows, Linux, or Mac OS X) installed

Ordering Information

Table 2. Cisco 500 Series Switches Ordering Information

Model Name	Product Order ID Number	Description
Fast Ethernet		
SF500-24	SF500-24-K9	• 24 10/100 ports • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet + 2 1GE/5GE SFP)
SF500-24P	SF500-24P-K9	• 24 10/100 PoE+ ports • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet + 2 1GE/5GE SFP)
SF500-24MP	SF500-24MP-K9	• 24 10/100 POE+ ports with 370W power budget • 4 Gigabit Ethernet (2 combo Gigabit Ethernet + 2 1GE/5GE SFP)
SF500-48	SF500-48-K9	• 48 10/100 ports • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet + 2 1GE/5GE SFP)
SF500-48P	SF500-48P-K9	• 48 10/100 PoE+ ports • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet + 2 1GE/5GE SFP)
SF500-48MP	SF500-48MP-K9	• 48 10/100 POE+ ports with 740W power budget • 4 Gigabit Ethernet (2 combo Gigabit Ethernet + 2 1GE/5GE SFP)
Gigabit Ethernet		
SG500-28	SG500-28-K9	• 24 10/100/1000 ports • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet + 2 1GE/5GE SFP)
SG500-28P	SG500-28P-K9	• 24 10/100/1000 PoE+ ports with 180W power budget • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet+ 2 1GE/5GE SFP)
SG500-28MPP	SG500-28MPP-K9	• 24 10/100/1000 PoE+ ports with 740W power budget • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet+ 2 1GE/5GE SFP)
SG500-52	SG500-52-K9	• 48 10/100/1000 ports • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet + 2 1GE/5GE SFP)

Model Name	Product Order ID Number	Description
SG500-52P	SG500-52P-K9	• 48 10/100/1000 PoE+ ports with 375W power budget • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet+ 2 1GE/5GE SFP)
SG500-52MP	SG500-52MP-K9	• 48 10/100/1000 PoE+ ports with 740W power budget • 4 Gigabit Ethernet (2 combo* Gigabit Ethernet+ 2 1GE/5GE SFP)
Gigabit Ethernet with 10 Gigabit Uplinks		
SG500X-24	SG500X-24-K9	• 24 10/100/1000 ports • 4*10 Gigabit Ethernet SFP+ (2*10 GE+ 2*10GE/5GE-Stacking Combo)
SG500X-24P	SG500X-24P-K9	• 24 10/100/1000 PoE+ ports with 375W power budget • 4*10 Gigabit Ethernet SFP+ (2*10 GE+ 2*10GE/5GE-Stacking Combo)
SG500X-24MPP	SG500X-24MPP-K9	• 24 10/100/1000 PoE+ ports with 740W power budget • 4*10 Gigabit Ethernet SFP+ (2*10 GE+ 2*10GE/5GE-Stacking Combo)
SG500X-48	SG500X-48-K9	• 48 10/100/1000 ports • 4*10 Gigabit Ethernet SFP+ (2*10 GE+ 2*10GE/5GE-Stacking Combo)
SG500X-48P	SG500X-48P-K9	• 48 10/100/1000 PoE+ ports with 375W power budget • 4*10 Gigabit Ethernet SFP+ (2*10 GE+ 2*10GE/5GE-Stacking Combo)
SG500X-48MP	SG500X-48MP-K9	• 48 10/100/1000 PoE+ ports with 740W power budget • 4*10 Gigabit Ethernet SFP+ (2*10 GE+ 2*10GE/5GE-Stacking Combo)
10 Gigabit Ethernet		
SG500XG-8F8T	SG500XG-8F8T-K9	• 8*10 Gigabit Ethernet 10GBase-T copper port • 8*10 Gigabit Ethernet SFP+ (dedicated) • 1 Gigabit Ethernet management port

* Each combo mini-GBIC port has one 10/100/1000 copper Ethernet port and one mini-GBIC/SFP Gigabit Ethernet slot, with one port active at a time.

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To find out more about the Cisco 500 Series, visit http://www.cisco.com/go/500switches.

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Cisco Catalyst 3560 Series Switches

Product Overview

The Cisco® Catalyst® 3560 Series is a line of fixed-configuration, enterprise-class switches that include IEEE 802.3af and Cisco prestandard Power over Ethernet (PoE) functionality in Fast Ethernet and Gigabit Ethernet configurations. The Cisco Catalyst 3560 is an ideal access layer switch for small enterprise LAN access or branch-office environments, combining both 10/100/1000 and PoE configurations for maximum productivity and investment protection while enabling the deployment of new applications such as IP telephony, wireless access, video surveillance, building management systems, and remote video kiosks. Customers can deploy networkwide intelligent services-such as advanced quality of service (QoS), rate limiting, access control lists (ACLs), multicast management, and high-performance IP routing-while maintaining the simplicity of traditional LAN switching. Available for the Cisco Catalyst 3560 Series at no charge, the Cisco Network Assistant is a centralized management application that simplifies the administration tasks for Cisco switches, routers, and wireless access points. Cisco Network Assistant provides configuration wizards that greatly simplify the implementation of converged networks and intelligent network services.

The Cisco Catalyst 3560 is part of a larger and more scalable family of Cisco Catalyst switches that includes the Cisco Catalyst 3560-E Series switches, the Cisco Catalyst 3750 and 3750-E Series switches with Cisco StackWise™ technology, and the Cisco Catalyst 4500 and Catalyst 6500 modular switches. United by Cisco IOS® Software, the entire family offers industry-leading availability, integrated security, optimized delivery, and manageability.

Configurations

The Cisco Catalyst 3560 Series comprises the following switches (refer to Figure 1):

Figure 1. Cisco Catalyst 3560 Switches

- Cisco Catalyst 3560-8PC: 8 Ethernet 10/100 ports with PoE and 1 dual-purpose 10/100/1000 and SFP port; compact form factor with no fan
- Cisco Catalyst 3560-12PC: 12 Ethernet 10/100 ports with PoE and 1 dual-purpose 10/100/1000 and SFP port; compact form factor with no fan
- Cisco Catalyst 3560-24TS: 24 Ethernet 10/100 ports and 2 Small Form-Factor Pluggable (SFP)-based Gigabit Ethernet ports; 1 rack unit (RU)

- Cisco Catalyst 3560-48TS: 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560-24PS: 24 Ethernet 10/100 ports with PoE and 2 SFP-based Gigabit Ethernet ports; 1 RU
- Cisco Catalyst 3560-48PS: 48 Ethernet 10/100 ports with PoE and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560G-24TS: 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560G-48TS: 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560G-24PS: 24 Ethernet 10/100/1000 ports with PoE and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560G-48PS: 48 Ethernet 10/100/1000 ports with PoE and 4 SFP-based Gigabit Ethernet ports; 1RU

The Cisco Catalyst 3560 Series can be purchased with the IP Base or IP Services licenses pre-installed. The IP Base license offers advanced QoS, rate limiting, ACLs, and basic static and Routing Information Protocol (RIP) routing functions. The IP Services license provides a richer set of enterprise-class features, including advanced hardware-based IPv6 unicast and IPv6 Multicast routing as well as policy-based routing (PBR). The IP Services license upgrades Cisco Catalyst 3560 Series switches to include IPv6 routing support. Upgrade licenses are available to upgrade a switch from the IP Base license to the IP Services license.

The SFP-based GE ports accommodate a range of SFP transceivers, including the Cisco 1000BASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX, and CWDM SFP transceivers. These ports also support the Cisco Catalyst 3560 SFP Interconnect Cable for establishing a low-cost Gigabit Ethernet point-to-point connection.

Power over Ethernet

The Cisco Catalyst 3560 Series can provide a lower total cost of ownership (TCO) for deployments that incorporate Cisco IP phones, Cisco Aironet® wireless LAN (WLAN) access points, or any IEEE 802.3af-compliant end device. PoE removes the need for wall power to each PoE-enabled device and eliminates the cost for additional electrical cabling that would otherwise be necessary in IP phone and WLAN deployments. The Cisco Catalyst 3560 8-port PoE and 24-port PoE configurations can support 8 and 24 simultaneous full-powered PoE ports at 15.4W for maximum powered-device support. The Cisco Catalyst 3560 12-port PoE can support 8 ports at 15.4W or 12 ports at 10W or any combination in between. Taking advantage of Cisco Catalyst Intelligent Power Management, the 48-port PoE configurations can deliver the necessary power to support 24 ports at 15.4W, 48 ports at 7.7W, or any combination in between. Maximum power availability for a converged voice and data network is attainable when a Cisco Catalyst 3560 switch is combined with the Cisco RPS 2300 Redundant Power System for transparent protection against internal power supply failures and an uninterruptible power supply (UPS) system to safeguard against power outages.

Gigabit Ethernet

At speeds of 1000 Mbps, Gigabit Ethernet provides the bandwidth to meet new and evolving network demands, alleviate bottlenecks, and boost performance while increasing the return on existing infrastructure investments. Today's workers are placing higher demands on networks,

running multiple, concurrent applications. For example, a worker joins a team conference call through an IP videoconference, sends a 10-MB spreadsheet to meeting participants, broadcasts the latest marketing video for the team to evaluate, and queries the customer-relationship-management database for the latest real-time feedback. Meanwhile, a multigigabyte system backup starts in the background and the latest virus updates are delivered to the client. The Cisco Catalyst 3560 provides a means to intelligently scale the network beyond 100 Mbps over existing Category 5 copper cabling and simultaneously support PoE for maximum productivity and investment protection.

Intelligence in the Network

Networks of today are evolving to address four new developments at the network edge:

- Increase in desktop computing power
- Introduction of bandwidth-intensive applications
- Expansion of highly sensitive data on the network
- Presence of multiple device types, such as IP phones, WLAN access points, and IP video cameras

These new demands are contending for resources with many existing mission-critical applications. As a result, IT professionals must view the edge of the network as critical to effectively manage the delivery of information and applications.

As companies increasingly rely on networks as the strategic business infrastructure, it is more important than ever to help ensure their high availability, security, scalability, and control. By adding Cisco intelligent functions for LAN access, customers can now deploy networkwide intelligent services that consistently address these requirements from the desktop to the core and through the WAN.

With Cisco Catalyst Intelligent Ethernet switches, Cisco Systems® helps enable companies to realize the full benefits of adding intelligent services into their networks. Deployment of capabilities that make the network infrastructure highly available to accommodate time-critical needs, scalable to accommodate growth, secure enough to protect confidential information, and capable of differentiating and controlling traffic flows is critical to further optimizing network operations.

Cisco EnergyWise Technology

Cisco EnergyWise is an innovative architecture, added to the Cisco Catalyst 3560 switches, promoting companywide sustainability by reducing energy consumption across an entire corporate infrastructure and affecting more than 50 percent of global greenhouse gas emissions created by worldwide building infrastructure, a much greater effect than the 2 percent generated by the IT industry. Cisco EnergyWise enables companies to measure the power consumption of network infrastructure and network-attached devices and manage power consumption with specific policies, reducing power consumption to realize increased cost savings, potentially affecting any powered device.

EnergyWise encompasses a highly intelligent network based approach to communicate messages that measure and control energy between network devices and endpoints. The network discovers Cisco EnergyWise manageable devices, monitors their power consumption, and takes action based on business rules to reduce power consumption. EnergyWise uses a unique domain-naming system to query and summarize information from large sets of devices, making it simpler than traditional network management capabilities. Cisco EnergyWise's management interfaces allow

facilities and network management applications to communicate with endpoints and each other using the network as a unifying fabric. The management interface uses standard SNMP or SSL to integrate Cisco and third-party management systems.

Cisco EnergyWise extends the network as a platform for power control plane for gathering, managing, and reducing power consumption of all devices, resulting in companywide optimized power delivery and reduced energy costs.

Enhanced Security

With the wide range of security features that the Cisco Catalyst 3560 Series offers, businesses can protect important information, keep unauthorized people off the network, guard privacy, and maintain uninterrupted operation.

Cisco Identity Based Networking Services (IBNS) provides authentication, access control, and security policy administration to secure network connectivity and resources. Cisco IBNS in the Cisco Catalyst 3560 Series prevents unauthorized access and helps ensure that users get only their designated privileges. It provides the ability to dynamically administer granular levels of network access. Using the 802.1x standard and the Cisco Access Control Server (ACS), users can be assigned a VLAN or an ACL upon authentication, regardless of where they connect to the network. This setup allows IT departments to enable strong security policies without compromising user mobility-and with minimal administrative overhead.

To guard against denial-of-service and other attacks, ACLs can be used to restrict access to sensitive portions of the network by denying packets based on source and destination MAC addresses, IP addresses, or TCP/UDP ports. ACL lookups are done in hardware, so forwarding performance is not compromised when implementing ACL-based security.

Port security can be used to limit access on an Ethernet port based on the MAC address of the device to which it is connected. It also can be used to limit the total number of devices plugged into a switch port, thereby protecting the switch from a MAC flooding attack as well as reducing the risks of rogue wireless access points or hubs.

With Dynamic Host Configuration Protocol (DHCP) snooping, DHCP spoofing can be thwarted by allowing only DHCP requests (but not responses) from untrusted user-facing ports. Additionally, the DHCP Interface Tracker (Option 82) helps enable granular control over IP address assignment by augmenting a host IP address request with the switch port ID. Building further on the DHCP snooping capabilities, IP address spoofing can be thwarted using Dynamic ARP Inspection and IP Source Guard.

The MAC Address Notification feature can be used to monitor the network and track users by sending an alert to a management station so that network administrators know when and where users entered the network. The Private VLAN feature isolates ports on a switch, helping ensure that traffic travels directly from the entry point to the aggregation device through a virtual path and cannot be directed to another port.

Secure Shell (SSH) Protocol Version 2, Kerberos, and Simple Network Management Protocol Version 3 (SNMPv3) encrypt administrative and network-management information, protecting the network from tampering or eavesdropping. TACACS+ or RADIUS authentication enables centralized access control of switches and restricts unauthorized users from altering the configurations. Alternatively, a local username and password database can be configured on the switch itself. Fifteen levels of authorization on the switch console and two levels on the Web-based

management interface provide the ability to give different levels of configuration capabilities to different administrators.

Availability and Scalability

The Cisco Catalyst 3560 Series is equipped with a robust set of features that allow for network scalability and higher availability through IP routing as well as a complete suite of Spanning Tree Protocol enhancements aimed to maximize availability in a Layer 2 network.

The Cisco Catalyst 3560 switches deliver high-performance, hardware-based IP routing. The Cisco Express Forwarding-based routing architecture allows for increased scalability and performance. This architecture allows for very high-speed lookups while also helping ensure the stability and scalability necessary to meet the needs of future requirements. In addition to dynamic IP unicast routing, the Cisco Catalyst 3560 Series is perfectly equipped for networks requiring multicast support. Protocol Independent Multicast (PIM) and Internet Group Management Protocol (IGMP) snooping in hardware make the Cisco Catalyst 3560 Series switches ideal for intensive multicast environments.

Implementing routed uplinks to the core improves network availability by enabling faster failover protection and simplifying the Spanning Tree Protocol algorithm by terminating all Spanning Tree Protocol instances at the aggregator switch. If one of the uplinks fails, quicker failover to the redundant uplink can be achieved with a scalable routing protocol such as Open Shortest Path First (OSPF) or Enhanced Interior Gateway Routing Protocol (EIGRP) rather than relying on standard Spanning Tree Protocol convergence. Redirection of a packet after a link failure using a routing protocol results in faster failover than a solution that uses Layer 2 spanning-tree enhancements. Additionally, routed uplinks allow better bandwidth use by implementing equal cost routing (ECR) on the uplinks to perform load balancing. Routed uplinks optimize the utility of uplinks out of the LAN Access by eliminating unnecessary broadcast data flows into the network backbone.

The Cisco Catalyst 3560 also offers dramatic bandwidth savings as a wiring-closet switch in a multicast environment. Using routed uplinks to the network core eliminates the requirement to transmit multiple streams of the same multicast from the upstream content servers to LAN access switches. For example, if three users are assigned to three separate VLANs and they all want to view multicast ABC, then three streams of multicast ABC must be transmitted from the upstream router to the wiring-closet switch-assuming the wiring-closet switch is not capable of routed uplinks. Deploying IP routing to the core with Cisco Catalyst 3560 switches allows users to create a scalable, multicast-rich network. The Cisco IP Services license offers IPv6 routing , including support for simultaneous IPv4 and IPv6 forwarding. IPv6 protocol support includes OSPFv3, and EIGRPv6. IPv6 management and MLD Snooping are supported on all Cisco Catalyst 3560 software images.

Enhancements to the standard Spanning Tree Protocol, such as Per-VLAN Spanning Tree Plus (PVST+), Uplink Fast, and PortFast, maximize network uptime. PVST+ allows for Layer 2 load sharing on redundant links to efficiently use the extra capacity inherent in a redundant design. Uplink Fast, PortFast, and BackboneFast all greatly reduce the standard 30- to 60-second Spanning Tree Protocol convergence time. Loop guard and bridge-protocol-data-unit (BPDU) guard provide Spanning Tree Protocol loop avoidance.

Advanced QoS

The Cisco Catalyst 3560 offers superior multilayer, granular QoS features to help ensure that network traffic is classified and prioritized, and that congestion is avoided in the best possible manner. Configuration of QoS is greatly simplified through automatic QoS (Auto QoS), a feature that detects Cisco IP phones and automatically configures the switch for the appropriate classification and egress queuing. This optimizes traffic prioritization and network availability without the challenge of a complex configuration.

The Cisco Catalyst 3560 can classify, reclassify, police, mark, queue, and schedule incoming packets, and can queue and schedule packets at egress. Packet classification allows the network elements to discriminate between various traffic flows and enforce policies based on Layer 2 and Layer 3 QoS fields.

To implement QoS, the Cisco Catalyst 3560 Series Switch first identifies traffic flows or packet groups, and classifies or reclassifies these groups using the Differentiated Services Code Point (DSCP) field or the 802.1p Class of Service (CoS) field. Classification and reclassification can be based on criteria as specific as the source or destination IP address, source or destination MAC address, or the Layer 4 TCP or UDP port. At the ingress, the Cisco Catalyst 3560 also polices to determine whether a packet is in or out of profile, marks to change the classification label, passes through or drops out of profile packets, and queues packets based on classification. Control- and data-plane ACLs are supported on all ports to help ensure proper treatment on a per-packet basis.

The Cisco Catalyst 3560 supports four egress queues per port, allowing the network administrator to be more discriminating and specific in assigning priorities for the various applications on the LAN. At egress, the switch performs scheduling and congestion control. Scheduling is an algorithm or process that determines the order in which the queues are processed. The Cisco Catalyst 3560 Series Switch supports shaped round robin (SRR) and strict priority queuing. The SRR algorithm helps ensure differential prioritization.

These QoS features allow network administrators to prioritize mission-critical and bandwidth-intensive traffic, such as enterprise resource planning (ERP) (Oracle, etc.), voice (IP telephony traffic), and computer-aided design (CAD) or computer-aided manufacturing (CAM) over less-time-sensitive applications such as FTP or e-mail. For example, it would be highly undesirable to have a large file download destined to one port on a wiring-closet switch and have quality implications such as increased latency in voice traffic destined to another port on this switch. This condition is avoided by making sure that voice traffic is properly classified and prioritized throughout the network. Other applications, such as Web browsing, can be treated as low priority and handled on a best-effort basis.

The Cisco Catalyst 3560 Series can perform rate limiting through its support of the Cisco Committed Information Rate (CIR) function. Through CIR, bandwidth can be guaranteed in increments as low as 8 kbps. Bandwidth can be allocated based on several criteria, including MAC source address, MAC destination address, IP source address, IP destination address, and TCP or UDP port number. Bandwidth allocation is essential when network environments require service-level agreements or when it is necessary for the network manager to control the bandwidth given to certain users.

Management

The new Cisco Express Setup feature simplifies the initial configuration of a switch. Users now have the option to set up the switch through a Web browser, eliminating the need for more complex terminal-emulation programs and knowledge of the command-line interface (CLI). Cisco Express Setup reduces the cost of deployment by helping less-skilled personnel quickly and simply set up switches.

Cisco Network Assistant is a PC-based network-management application optimized for LANs of small and medium-sized businesses with up to 250 users. Cisco Network Assistant offers centralized management of Cisco switches, routers, and WLAN access points. It supports a wide range of Cisco Catalyst intelligent switches from Cisco Catalyst 2950 through Cisco Catalyst 4506. Through a user-friendly GUI, users can configure and manage a wide array of switch functions and start the device manager of Cisco routers and Cisco wireless access points. A few mouse clicks enable the Cisco recommended security, availability, and QoS features without the need to consult a detailed design guide. The Security wizard automatically restricts unauthorized access to servers with sensitive data. Smartports and wizards save hours of time for network administrators, eliminate human errors, and help ensure that the configuration of the switch is optimized for these applications. Available at no cost, Cisco Network Assistant can be downloaded from Cisco.com.

In addition to the Cisco Network Assistant, the Cisco Catalyst 3560 Series switches provide for extensive management using SNMP network-management platforms such as CiscoWorks LAN Management Solution (LMS). LMS is a suite of powerful management tools that simplify the configuration, administration, monitoring, and troubleshooting of Cisco networks. It integrates these capabilities into a world-class solution for improving the accuracy and efficiency of your operations staff, while increasing the overall availability of your network. LMS supports over 400 different device types providing:

- Network discovery, topology views, end-station tracking, and VLAN management
- Real-time network fault analysis with easy-to-deploy device specific best-practice templates
- Hardware and software inventory management, centralized configuration tools, and syslog monitoring
- Network response time and availability monitoring and tracking
- Real-time device, link, and port traffic management, analysis, and reporting

Cisco Catalyst 3560 SFP Interconnect Cable

The Cisco Catalyst 3560 SFP Interconnect Cable (see Figure 2) provides for a low-cost point-to-point Gigabit Ethernet connection between Cisco Catalyst 3560 switches. The 50cm cable is an alternative to using SFP transceivers when interconnecting Cisco Catalyst 3560 switches through their SFP ports over a short distance.

Figure 2. Cisco Catalyst 3560 SFP Interconnect Cable

Table 1 gives the features and benefits of the Cisco Catalyst 3560 Series. Table 2 gives the hardware specifications, and Table 3 gives the power specifications. Table 4 lists the management and standards support, and Table 5 provides the safety and compliance information.

Table 1. Features and Benefits of Cisco Catalyst 3560 Series

Feature	Benefit
Ease of Use and Deployment	• Cisco Express Setup simplifies initial configuration with a Web browser, eliminating the need for more complex terminal emulation programs and CLI knowledge. • IEEE 802.3af and Cisco prestandard PoE support comes with automatic discovery to detect a Cisco prestandard or IEEE 802.3af endpoint and provide the necessary power without any user configuration. • DHCP autoconfiguration of multiple switches through a boot server eases switch deployment. • Automatic QoS (Auto QoS) simplifies QoS configuration in voice-over-IP (VoIP) networks by issuing interface and global switch commands to detect Cisco IP phones, classify traffic, and enable egress queue configuration. • Autosensing on each 10/100 port detects the speed of the attached device and automatically configures the port for 10- or 100-Mbps operation, easing switch deployment in mixed 10- and 100-Mbps environments. • Autonegotiating on all ports automatically selects half- or full-duplex transmission mode to optimize bandwidth. • Dynamic Trunking Protocol (DTP) helps enable dynamic trunk configuration across all switch ports. • Port Aggregation Protocol (PAgP) automates the creation of Cisco Fast EtherChannel® groups or Gigabit EtherChannel groups to link to another switch, router, or server. • Link Aggregation Control Protocol (LACP) allows the creation of Ethernet channeling with devices that conform to IEEE 802.3ad. This feature is similar to Cisco EtherChannel technology and PAgP. • DHCP Server enables a convenient deployment option for the assignment of IP addresses in networks that do not have a dedicated DHCP server. • DHCP Relay allows a DHCP relay agent to broadcast DHCP requests to the network DHCP server. • IEEE 802.3z-compliant 1000BASE-SX, 1000BASE-LX/LH, 1000BASE-ZX, 1000BASE-T, and coarse wavelength-division multiplexing (CWDM) physical interface support through a field-replaceable SFP module provides unprecedented flexibility in switch deployment. • Support for the Cisco Catalyst 3560 SFP Interconnect Cable facilitates a low-cost, point-to-point gigabit connection between Cisco Catalyst 3560 Series switches. • The default configuration stored in Flash memory helps ensure that the switch can be quickly connected to the network and can pass traffic with minimal user intervention. • Automatic medium-dependent interface crossover (Auto-MDIX) automatically adjusts transmit and receive pairs if an incorrect cable type (crossover or straight-through) is installed on a 10/100 port. • Time Domain Reflectometry (TDR) to diagnose and resolve cabling problems on copper Ethernet 10/100/1000 ports.
Cisco EnergyWise	• Cisco EnergyWise for greenhouse gas emissions and operational cost optimization by measuring, reporting, and reducing energy consumption across the entire corporate infrastructure, well beyond the scope of IT.

Availability and Scalability	
Superior Redundancy for Fault Backup	• Cisco Uplink Fast and BackboneFast technologies help ensure quick failover recovery, enhancing overall network stability and reliability. • IEEE 802.1w Rapid Spanning Tree Protocol (RSTP) provides rapid spanning-tree convergence independent of spanning-tree timers and the benefit of distributed processing. • Per-VLAN Rapid Spanning Tree Plus (PVRST+) allows rapid spanning-tree reconvergence on a per-VLAN spanning-tree basis, without requiring the implementation of spanning-tree instances. • Cisco Hot Standby Router Protocol (HSRP) is supported to create redundant, fail-safe routing topologies. • Command-switch redundancy enabled in Cisco Network Assistant software allows designation of a backup command switch that takes over cluster-management functions if the primary command switch fails. • Unidirectional Link Detection Protocol (UDLD) and Aggressive UDLD allow unidirectional links to be detected and disabled to avoid problems such as spanning-tree loops. • Switch port autorecovery (errdisable) automatically attempts to reenable a link that is disabled because of a network error. • Cisco RPS 2300 support provides superior internal power-source redundancy, resulting in improved fault tolerance and network uptime. • Equal cost routing (ECR) provides load balancing and redundancy. • Bandwidth aggregation up to 8 Gbps through Cisco Gigabit EtherChannel technology and up to 800 Mbps through Cisco Fast EtherChannel technology enhances fault tolerance and offers higher-speed aggregated bandwidth between switches and to routers and individual servers.
High-Performance IP Routing	• Cisco Express Forwarding hardware routing architecture delivers extremely high-performance IP routing. • Basic IP unicast routing protocols (static, RIPv1, RIPv2 and RIPng) are supported for small-network routing applications. • Advanced IP unicast routing protocols (OSPF, Interior Gateway Routing Protocol [IGRP], EIGRP, Border Gateway Protocol Version 4 [BGPv4] and IS-ISv4) are supported for load balancing and constructing scalable LANs. The IP Services license is required. • IPv6 routing capability (OSPFv3, EIGRPv6) is support. IP Services license is required. • Policy-Based Routing (PBR) allows superior control by enabling flow redirection regardless of the routing protocol configured. • Inter-VLAN IP routing provides for full Layer 3 routing between two or more VLANs. • Protocol Independent Multicast (PIM) for IP Multicast routing is supported, including PIM sparse mode (PIM-SM), PIM dense mode (PIM-DM), and PIM sparse-dense mode. The IP Services license is required. • Fallback bridging forwards non-IP traffic between two or more VLANs.
Integrated Cisco IOS Software Features for Bandwidth Optimization	• Per-port broadcast, multicast, and unicast storm control prevents faulty end stations from degrading overall systems performance. • IEEE 802.1d Spanning Tree Protocol support for redundant backbone connections and loop-free networks simplifies network configuration and improves fault tolerance. • PVST+ allows for Layer 2 load sharing on redundant links to efficiently use the extra capacity inherent in a redundant design. • IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) allows a spanning-tree instance per VLAN, enabling Layer 2 load sharing on redundant links. • ECR provides load balancing and redundancy. • VPN routing/forwarding (VRF)-Lite enables a service provider to support two or more VPNs, with overlapping IP addresses. • Local Proxy Address Resolution Protocol (ARP) works in conjunction with Private VLAN Edge to minimize broadcasts and maximize available bandwidth. • VLAN1 minimization allows VLAN1 to be disabled on any individual VLAN trunk link. • VLAN Trunking Protocol (VTP) pruning limits bandwidth consumption on VTP trunks by flooding broadcast traffic only on trunk links required to reach the destination devices. • Internet Group Management Protocol v3 (IGMP) Snooping for IPv4 and IPv6 MLD v1 and v2 Snooping provide fast client joins and leaves of multicast streams and limits bandwidth-intensive video traffic to only the requestors. • IGMP filtering provides multicast authentication by filtering out nonsubscribers and limits the number of concurrent multicast streams available per port. • Multicast VLAN registration (MVR) continuously sends multicast streams in a multicast VLAN while isolating the streams from subscriber VLANs for bandwidth and security reasons.

QoS and Control	
Advanced QoS	• Standard 802.1p CoS and DSCP field classification are provided, using marking and reclassification on a per-packet basis by source and destination IP address, source and destination MAC address, or Layer 4 TCP or UDP port number. • Cisco control- and data-plane QoS ACLs on all ports help ensure proper marking on a per-packet basis. • Four egress queues per port enable differentiated management of up to four traffic types. • SRR scheduling helps ensure differential prioritization of packet flows by intelligently servicing the ingress and egress queues. • Weighted tail drop (WTD) provides congestion avoidance at the ingress and egress queues before a disruption occurs. • Strict priority queuing guarantees that the highest-priority packets are serviced ahead of all other traffic. • There is no performance penalty for highly granular QoS functions.
Granular Rate Limiting	• The Cisco Committed Information Rate (CIR) function guarantees bandwidth in increments as low as 8 kbps. • Rate limiting is provided based on source and destination IP address, source and destination MAC address, Layer 4 TCP and UDP information, or any combination of these fields, using QoS ACLs (IP ACLs or MAC ACLs), class maps, and policy maps. • Asynchronous data flows upstream and downstream from the end station or on the uplink are easily managed using ingress policing and egress shaping. • Up to 64 aggregate or individual policers are available per Fast Ethernet or Gigabit Ethernet port.
Security	
Networkwide Security Features	• IEEE 802.1x allows dynamic, port-based security, providing user authentication. • IEEE 802.1x with VLAN assignment allows a dynamic VLAN assignment for a specific user regardless of where the user is connected. • IEEE 802.1x with voice VLAN permits an IP phone to access the voice VLAN irrespective of the authorized or unauthorized state of the port. • IEEE 802.1x and port security are provided to authenticate the port and manage network access for all MAC addresses, including those of the client. • IEEE 802.1x with an ACL assignment allows for specific identity-based security policies regardless of where the user is connected. • IEEE 802.1x with Guest VLAN allows guests without 802.1x clients to have limited network access on the guest VLAN. • Web authentication for non-802.1x clients allows non-802.1x clients to use an SSL-based browser for authentication. • Multi-Domain Authentication allows an IP phone and a PC to authenticate on the same switch port while placing them on appropriate Voice and Data VLAN. • MAC Auth Bypass (MAB) for voice allows third-party IP phones without an 802.1x supplicant to get authenticated using their MAC address. • Cisco security VLAN ACLs (VACLs) on all VLANs prevent unauthorized data flows from being bridged within VLANs. • Cisco standard and extended IP security router ACLs (RACLs) define security policies on routed interfaces for control- and data-plane traffic. • Port-based ACLs (PACLs) for Layer 2 interfaces allow application of security policies on individual switch ports. • Unicast MAC filtering prevents the forwarding of any type of packet with a matching MAC address. • Unknown unicast and multicast port blocking allows tight control by filtering packets that the switch has not already learned how to forward. • SSHv2, Kerberos, and SNMPv3 provide network security by encrypting administrator traffic during Telnet and SNMP sessions. SSHv2, Kerberos, and the cryptographic version of SNMPv3 require a special cryptographic software image because of U.S. export restrictions. • Private VLAN Edge provides security and isolation between switch ports, helping ensure that users cannot snoop on other users' traffic. • Private VLANs restrict traffic between hosts in a common segment by segregating traffic at Layer 2, turning a broadcast segment into a nonbroadcast multi-access-like segment. • Bidirectional data support on the Switched Port Analyzer (SPAN) port allows the Cisco Secure Intrusion Detection System (IDS) to take action when an intruder is detected. • TACACS+ and RADIUS authentication enable centralized control of the switch and restrict unauthorized users from altering the configuration. • MAC address notification allows administrators to be notified of users added to or removed from the network. • Dynamic ARP Inspection (DAI) helps ensure user integrity by preventing malicious users from exploiting the insecure nature of the ARP protocol.

	• DHCP snooping allows administrators to help ensure consistent mapping of IP to MAC addresses. This can be used to prevent attacks that attempt to poison the DHCP binding database, and to rate limit the amount of DHCP traffic that enters a switch port. • IP source guard prevents a malicious user from spoofing or taking over another user's IP address by creating a binding table between the client's IP and MAC address, port, and VLAN. • DHCP Interface Tracker (Option 82) augments a host IP address request with the switch port ID. • Port security secures the access to an access or trunk port based on MAC address. • After a specific timeframe, the aging feature removes the MAC address from the switch to allow another device to connect to the same port. • Trusted Boundary provides the ability to trust the QoS priority settings if an IP phone is present and to disable the trust setting if the IP phone is removed, thereby preventing a malicious user from overriding prioritization policies in the network. • Multilevel security on console access prevents unauthorized users from altering the switch configuration. • The user-selectable address-learning mode simplifies configuration and enhances security. • BPDU Guard shuts down Spanning Tree Protocol PortFast-enabled interfaces when BPDUs are received to avoid accidental topology loops. • Spanning-Tree Root Guard (STRG) prevents edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes. • IGMP filtering provides multicast authentication by filtering out nonsubscribers and limits the number of concurrent multicast streams available per port. • Dynamic VLAN assignment is supported through implementation of VLAN Membership Policy Server (VMPS) client functions to provide flexibility in assigning ports to VLANs. Dynamic VLAN helps enable the fast assignment of IP addresses. • Cisco Network Assistant software security wizards ease the deployment of security features for restricting user access to a server as well as to a portion of or the entire network. • Two thousand access control entries (ACEs) are supported.
Manageability	
Superior Manageability	• Cisco IOS CLI support provides a common user interface and command set with all Cisco routers and Cisco Catalyst desktop switches. • Cisco Discovery Protocol version 2 (CDPv2) allows the Cisco Catalyst 3560 Series Switch to negotiate a more granular power setting when connecting to a Cisco powered device, such as IP phones or access points, than what is provided by IEEE classification. • The PoE MIB provides proactive visibility into power usage and allows customers to set different power level thresholds. • Switching Database Manager templates for access, routing, and VLAN deployment scenarios allow the administrator to easily maximize memory allocation to the desired features based on deployment-specific requirements. • Generic On-Line Diagnostic (GOLD) checks the health of hardware components and verifies proper operation of the system data and control plane at run time and boot time. • VLAN trunks can be created from any port, using either standards-based 802.1Q tagging or the Cisco Inter-Switch Link (ISL) VLAN architecture. • Up to 1024 VLANs and up to 128 spanning-tree instances per switch are supported. • Four thousand VLAN IDs are supported. • Voice VLAN simplifies telephony installations by keeping voice traffic on a separate VLAN for easier administration and troubleshooting. • Cisco VTP supports dynamic VLANs and dynamic trunk configuration across all switches. • IGMPv3 snooping provides fast client joins and leaves of multicast streams and limits bandwidth-intensive video traffic to only the requestors. • Remote SPAN (RSPAN) allows administrators to remotely monitor ports in a Layer 2 switch network from any other switch in the same network. • For enhanced traffic management, monitoring, and analysis, the Embedded Remote Monitoring (RMON) software agent supports four RMON groups (history, statistics, alarms, and events). • Layer 2 traceroute eases troubleshooting by identifying the physical path that a packet takes from source to destination. • All nine RMON groups are supported through a SPAN port, which permits traffic monitoring of a single port, a group of ports from a single network analyzer or RMON probe. • Domain Name System (DNS) provides IP address resolution with user-defined device names. • Trivial File Transfer Protocol (TFTP) reduces the cost of administering software upgrades by downloading from a centralized location. • Network Timing Protocol (NTP) provides an accurate and consistent timestamp to all intranet switches.

	• Multifunction LEDs per port for port status; half-duplex and full-duplex mode; and 10BASE-T, 100BASE-TX, and 1000BASE-T indication as well as switch-level status LEDs for system, redundant power supply, and bandwidth use provide a comprehensive and convenient visual management system.
Cisco Network Assistant Software	• Cisco Network Assistant is a free, Windows-based application that simplifies the administration of networks of up to 250 users. It supports a wide range of Cisco Catalyst intelligent switches from Cisco Catalyst 2950 through Cisco Catalyst 4506. With Cisco Network Assistant, users can manage Cisco Catalyst switches plus launch the device managers of Cisco integrated services routers (ISRs) and Cisco Aironet WLAN access points. • The easy-to-use graphical interface provides both a topology map and front-panel view of the switch. • Cisco AVVID (Architecture for Voice, Video and Integrated Data) wizards need just a few user inputs to automatically configure the switch to optimally handle different types of traffic: voice, video, multicast, and high-priority data. • A security wizard is provided to restrict unauthorized access to applications, servers, and networks. • Upgrading the Cisco IOS Software on Cisco Catalyst switches is a simple matter of pointing and clicking, with one-click upgrades. • Cisco Network Assistant supports multilayer feature configurations such as routing protocols, ACLs, and QoS parameters. • Multidevice and multiport configuration capabilities allow administrators to save time by configuring features across multiple switches and ports simultaneously. • The user-personalized interface allows modification of polling intervals, table views, and other settings. • Alarm notification provides automated e-mail notification of network errors and alarm thresholds.
Cisco Express Setup	• Cisco Express Setup simplifies initial configuration of a switch through a Web browser, eliminating the need for more complex terminal emulation programs and CLI knowledge. • The Web interface helps less-skilled personnel quickly and simply set up switches, thereby reducing the cost of deployment.
CiscoWorks Support	• CiscoWorks network-management software provides management capabilities on a per-port and per-switch basis, providing a common management interface for Cisco routers, switches, and hubs. • SNMP v1, v2c, and v3 and Telnet interface support delivers comprehensive in-band management, and a CLI-based management console provides detailed out-of-band management. • Cisco Discovery Protocol Versions 1 and 2 help enable a CiscoWorks network-management station for automatic switch discovery. • The CiscoWorks LAN Management Solution supports the Cisco Catalyst 3560 Series.

Table 2. Cisco Catalyst 3560 Series Switch Hardware

Description	Specification
Performance	• 32 Gbps forwarding bandwidth • Forwarding rate based on 64-byte packets: • 38.7 Mpps (Cisco Catalyst 3560G-48TS, Catalyst 3560G-48PS, Catalyst 3560G-24TS, and Catalyst 3560G-24PS); • 13.1 Mpps (Cisco Catalyst 3560-48TS and Catalyst 3560-48PS); • 6.5 Mpps (Cisco Catalyst 3560-24TS and Catalyst 3560-24PS); • 3.2 Mpps (Cisco Catalyst 3560-12PC) • 2.7 Mpps (Cisco Catalyst 3560-8PC) • 128 MB DRAM • 32 MB Flash memory (Cisco Catalyst 3560G-24TS, Catalyst 3560G-24PS, Catalyst 3560G-48TS, Catalyst 3560G-48PS, Catalyst 3560-24TS, Catalyst 3560-48TS, and Catalyst 3560-8PC); • 16-MB Flash memory (Cisco Catalyst 3560-48PS and Catalyst 3560-24PS) • Configurable up to 12,000 MAC addresses • Configurable up to 11,000 unicast routes • Configurable up to 1000 IGMP groups and multicast routes • Configurable maximum transmission unit (MTU) of up to 9000 bytes, with a maximum Ethernet frame size of 9018 bytes (Jumbo frames), for bridging on Gigabit Ethernet ports, and up to 1546 bytes for bridging of Multiprotocol Label Switching (MPLS) tagged frames on 10/100 ports
Connectors and Cabling	• 10BASE-T ports: RJ-45 connectors, two-pair Category 3, 4, or 5 unshielded twisted-pair (UTP) cabling • 10BASE-T PoE ports: RJ-45 connectors, two-pair Category 3, 4, or 5 UTP cabling power pins 1,2 (negative) and 3,6 (positive)

	• 100BASE-TX ports: RJ-45 connectors, two-pair Category 5 UTP cabling • 100BASE-TX PoE ports: RJ-45 connectors, two-pair Category 5 UTP cabling, power on pins 1,2 (negative) and 3,6 (positive) • 1000BASE-T ports: RJ-45 connectors, four-pair Category 5 UTP cabling • 1000BASE-T SFP-based ports: RJ-45 connectors, four-pair Category 5 UTP cabling • 1000BASE-SX, -LX/LH, -ZX, and CWDM SFP-based ports: LC fiber connectors (single/multimode fiber) • Cisco Catalyst 3560 SFP Interconnect Cable: two-pair shielded cabling, 50 cm • Management console port: RJ-45-to-DB-9 cable for PC connections; for terminal connections, use RJ-45-to-DB-25 female data-terminal-equipment (DTE) adaptor (can be ordered separately from Cisco; part number ACS-DSBUASYN=)
Power Connectors	• Customers can provide power to a switch by using either the internal power supply or the Cisco RPS 2300. The connectors are located at the back of the switch. Note: The Cisco Catalyst 3560-8PC and Catalyst 3560-12PC do not have an RPS port. • Internal-Power-Supply Connector • The internal power supply is an autoranging unit. • The internal power supply supports input voltages between 100 and 240 VAC. • Use the supplied AC power cord to connect the AC power connector to an AC power outlet. • Cisco RPS Connector • The connector offers connection for an optional Cisco RPS 2300 that uses AC input and supplies DC output to the switch. • The connector supports up to six external network devices and provides power to two failed devices at a time. • The connector automatically senses when the internal power supply of a connected device fails and provides power to the failed device, preventing loss of network traffic. • Only the Cisco RPS 2300 (model PWR-RPS2300) should be attached to the redundant-power-supply receptacle.
Indicators	• Per-port status LEDs: Link integrity, disabled, activity, speed, full-duplex indications, PoE applied, PoE error, and PoE disabled indications • System-status LEDs: System, RPS, link status, link duplex, link speed, and PoE indications
Dimensions (H x W x D)	• Cisco Catalyst 3560-8PC: 1.73 x 10.6 x 9.1 in. (4.4 x 27 x 23 cm) • Cisco Catalyst 3560-12PC: 1.73 x 10.6 x 9.1 in. (4.4 x 27 x 23 cm) • Cisco Catalyst 3560-24TS: 1.73 x 17.5 x 11.8 in. (4.4 x 44.5 x 30 cm) • Cisco Catalyst 3560-48TS: 1.73 x 17.5 x 11.8 in. (4.4 x 44.5 x 30 cm) • Cisco Catalyst 3560-24PS: 1.73 x 17.5 x 11.8 in. (4.4 x 44.5 x 30 cm) • Cisco Catalyst 3560-48PS: 1.73 x 17.5 x 14.9 in. (4.4 x 44.5 x 37.8 cm) • Cisco Catalyst 3560G-24TS: 1.73 x 17.5 x 14.9 in. (4.4 x 44.5 x 37.8 cm) • Cisco Catalyst 3560G-48TS: 1.73 x 17.5 x 16.1 in. (4.4 x 44.5 x 40.9 cm) • Cisco Catalyst 3560G-24PS: 1.73 x 17.5 x 14.9 in. (4.4 x 44.5 x 37.8 cm) • Cisco Catalyst 3560G-48PS: 1.73 x 17.5 x 16.1 in. (4.4 x 44.5 x 40.9 cm)
Weight	• Cisco Catalyst 3560-8PC: 5 lb (2.3 kg) • Cisco Catalyst 3560-12PC: 5 lb (2.3 kg) • Cisco Catalyst 3560-24TS: 8.5 lb (3.9 kg) • Cisco Catalyst 3560-48TS: 9.1 lb (4.1 kg) • Cisco Catalyst 3560-24PS: 11.3 lb (5.1 kg) • Cisco Catalyst 3560-48PS: 13.2 lb (6.0 kg) • Cisco Catalyst 3560G-24TS: 12 lb (5.4 kg) • Cisco Catalyst 3560G-24PS: 13.5 lb (6.1 kg) • Cisco Catalyst 3560G-48TS: 14.0 lb (6.4 kg) • Cisco Catalyst 3560G-48PS: 15.5 lb (7.0 kg)
Environmental Ranges	• Operating temperature: 32 to 113ºF (0 to 45ºC) • Storage temperature: -13 to 158ºF (-25 to 70ºC) • Operating relative humidity: 10 to 85% (noncondensing) • Operating altitude: Up to 10,000 ft (3049m) • Storage altitude: Up to 15,000 ft (4573m)
Acoustic Noise	• ISO 7779: Bystander position operating to an ambient temperature of 25°C • Cisco Catalyst 3560-8PC: 0 dBa (no fan) • Cisco Catalyst 3560-12PC: 0 dBa (no fan) • Cisco Catalyst 3560-24TS: 42 dBa • Cisco Catalyst 3560-48TS: 42 dBa • Cisco Catalyst 3560-24PS: 42 dBa

	• Cisco Catalyst 3560-48PS: 42 dBa • Cisco Catalyst 3560G-24TS: 42 dBa • Cisco Catalyst 3560G-48TS: 48 dBa • Cisco Catalyst 3560G-24PS: 38-44 dBa • Cisco Catalyst 3560G-48PS: 52-58 dBa
Mean Time Between Failure (MTBF)	• Cisco Catalyst 3560-8PC: 367,586 hours • Cisco Catalyst 3560-12PC: 406,470 hours • Cisco Catalyst 3560-24TS: 326,100 hours • Cisco Catalyst 3560-48TS: 280,900 hours • Cisco Catalyst 3560-24PS: 224,100 hours • Cisco Catalyst 3560-48PS: 173,500 hours • Cisco Catalyst 3560G-24TS: 230,700 hours • Cisco Catalyst 3560G-24PS: 186,300 hours • Cisco Catalyst 3560G-48TS: 173,400 hours • Cisco Catalyst 3560G-48PS: 147,000 hours

Table 3. Power Specifications for Cisco Catalyst 3560 Series Switch

Description	Specification		
Power Supply Rated Maximum	• 204W (Cisco Catalyst 3560-8PC, Catalyst 3560-12PC) • Dissipated power: 80W, 273 BTUs per hour • PoE: 124W • 45W (Cisco Catalyst 3560-24TS) • 485W (Cisco Catalyst 3560-24PS) • Dissipated power: 115W, 393 BTUs per hour • PoE: 370W • 65W (Cisco Catalyst 3560-48TS) • 530W (Cisco Catalyst 3560-48PS) • Dissipated power: 160W, 546 BTUs per hour • PoE: 370W • 100W (Cisco Catalyst 3560G-24TS) • 540W (Cisco Catalyst 3560G-24PS) • Dissipated power: 170W, 534 BTUs per hour • PoE: 370W • 160W (Cisco Catalyst 3560G-48TS) • 590W (Cisco Catalyst 3560G-48PS) • Dissipated power: 220W, 690 BTUs per hour • PoE: 370W		
Measured 100% Throughput Power Consumption	**Cisco Catalyst 3560 Series**	**Switch Power**	**Total Output BTU**
	3560-8PC	19W	64 BTU/hour
	3560-12PC	22W	73 BTU/hour
	3560-24TS	27W	89 BTU/hour
	3560-48TS	45W	153 BTU/hour
	3560-24PS	43W	144 BTU/hour
	3560-48PS	86W	293 BTU/hour
	3560G-24TS	74W	249 BTU/hour
	3560G-24PS	96W	325 BTU/hour
	3560G-48TS	124W	422 BTU/hour
	3560G-48PS	130W	443 BTU/hour
Measured 5% Throughput Power Consumption	**Cisco Catalyst 3560 Series**	**Switch Power**	**Total Output BTU**
	3560-8PC	18W	60 BTU/hour
	3560-12PC	20W	68 BTU/hour
	3560-24TS	24W	82 BTU/hour
	3560-48TS	41W	138 BTU/hour
	3560-24PS	40W	134 BTU/hour

	3560-48PS	72W		245 BTU/hour
	3560G-24TS	66W		225 BTU/hour
	3560G-24PS	86W		293 BTU/hour
	3560G-48TS	113W		386 BTU/hour
	3560G-48PS	123W		418 BTU/hour
Measured 100% Throughput Power Consumption (with maximum possible PoE loads)	**Cisco Catalyst 3560 Series**	**Switch Power**	**PoE Power**	**Total Output BTU**
	3560-8PC	145W	124W	70 BTU/hour
	3560-12PC	145W	124W	72 BTU/hour
	3560-24PS	449W	370W	267 BTU/hour
	3560-48PS	483W	370W	383 BTU/hour
	3560G-24PS	496W	370W	429 BTU/ hour
	3560G-48PS	534W	370W	559 BTU/hour
Measured 5% Throughput Power Consumption (with 50% PoE loads)	**Cisco Catalyst 3560 Series**	**Switch Power**	**PoE Power**	**Total Output BTU**
	3560-8PC	82W	62W	69 BTU/hour
	3560-12PC	86W	63W	76 BTU/hour
	3560-24PS	247W	188W	197 BTU/hour
	3560-48PS	275W	184W	311 BTU/hour
	3560G-24PS	287W	186W	345 BTU/ hour
	3560G-48PS	328W	189	474 BTU/hour
AC Input Voltage and Current	• 100-240 VAC (autoranging), 2.5-1.3A, 50-60 Hz (Cisco Catalyst 3560-8PC) • 100-240 VAC (autoranging), 2.5-1.3A, 50-60 Hz (Cisco Catalyst 3560-12PC) • 100-240 VAC (autoranging), 450-190mA, 50-60 Hz (Cisco Catalyst 3560-24TS) • 100-240 VAC (autoranging), 650-270mA, 50-60 Hz (Cisco Catalyst 3560-48TS) • 100-240 VAC (autoranging), 5.5-2.8A, 50-60 Hz (Cisco Catalyst 3560-24PS and Catalyst 3560-48PS) • 100-240 VAC (autoranging), 3.0-1.5A, 50-60Hz (Cisco Catalyst 3560G-24TS and Catalyst 3560G-48TS) • 100-240 VAC (autoranging), 8.0-4.0A, 50-60Hz (Cisco Catalyst 3560G-24PS and Catalyst 3560G-48PS)			
Power Rating	• Cisco Catalyst 3560-8PC: 0.2 kVA • Cisco Catalyst 3560-12PC: 0.2 kVA • Cisco Catalyst 3560-24TS: 0.075 kVA • Cisco Catalyst 3560-48TS: 0.110 kVA • Cisco Catalyst 3560-24PS: 0.485 kVA • Cisco Catalyst 3560-48PS: 0.530 kVA • Cisco Catalyst 3560G-24TS: 0.10 kVA • Cisco Catalyst 3560G-48TS: 0.16 kVA • Cisco Catalyst 3560G-24PS: 0.52 kVA • Cisco Catalyst 3560G-48PS: 0.56 kVA			
DC Input Voltages (RPS Input)	• +12V at 5A (Cisco Catalyst 3560-24TS and Catalyst 3560-48TS); 7.5A (Cisco Catalyst 3560-24PS and Catalyst 3560-48PS); 10.5A (Cisco Catalyst 3560G-24TS); 17.5A (Cisco Catalyst 3560G-48TS); 14A (Cisco Catalyst 3560G-24PS and Catalyst 3560G-48PS) • -48V at 7.8A (PoE switches)			
PoE	• Maximum power supplied per port: 15.4W • Total power dedicated to PoE: 370W • Total power dedicated to PoE: 124W (Cisco Catalyst 3560-8PC, Catalyst 3560-12PC)			

Note:

Disclaimer: All power consumption numbers were measured under controlled laboratory conditions and are provided as an estimate.

The wattage rating on the power supply does not represent actual power draw. It indicates the maximum power draw possible by the power supply. This rating can be used for facility capacity

planning. For PoE switches, cooling requirements are smaller than the actual power consumption as a significant portion of PoE loads are dissipated in the endpoints.

Non-PoE Power Consumption

100 Percent Throughput Switch Power Consumption

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar, and relative humidity from 30 to 75 percent. Typically such power draws are only seen when encountering a 100 percent traffic load made up entirely of 64-byte packets on the switch and the uplinks.

5 Percent Throughput Switch Power Consumption

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar, and relative humidity from 30 to 75 percent. The numbers below indicate a 5 percent traffic load on the switch and its uplinks.

PoE Power Consumption

100 Percent Throughput Switch Power Consumption (no PoE loads)

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar, and relative humidity from 30 to 75 percent. Typically such power draws are only seen when encountering a 100 percent traffic load made up entirely of 64-byte packets with no PoE loads on the switch and uplinks.

Measured 5 Percent Throughput Switch Power Consumption (no PoE loads)

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar and relative humidity from 30 to 75 percent. The numbers below indicate a 5 percent traffic load on the switch and its uplinks

100 Percent Throughput Switch Power Consumption (with maximum PoE loads)

The numbers indicate the power consumed by a typical system (the switch and the corresponding PoE loads) under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar and relative humidity from 30 to 75 percent. Typically this power draw is realized when a switch is running 100 percent traffic load of 64 byte sized packets on all its ports and uplinks and also drawing 100 percent PoE load .

5 Percent Throughput Switch Power Consumption (with 50 percent PoE loads).

The numbers indicate the power consumed by a typical system (the switch and the corresponding PoE loads) under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar and relative humidity from 30 to 75 percent. The numbers below indicate a 5 percent traffic load and 50 percent PoE load on the switch and its uplinks.

Table 4. Management and Standards Support for Cisco Catalyst 3560 Series Switch

Description	Specification	
Management	• BRIDGE-MIB • CISCO-CDP-MIB • CISCO-CLUSTER-MIB • CISCO-CONFIG-MAN-MIB • CISCO-ENTITY-FRU-CONTROL-MIB • CISCO-ENVMON-MIB • CISCO-FLASH-MIB • CISCO-FTP-CLIENT-MIB • CISCO-HSRP-MIB • CISCO-HSRP-EXT-MIB • CISCO-IGMP-FILTER-MIB • CISCO-IMAGE-MIB • CISCO-IP-STAT-MIB • CISCO-L2L3-INTERFACE-CONFIG-MIB • CISCO-MAC-NOTIFICATION-MIB • CISCO-MEMORY-POOL-MIB • CISCO-PAGP-MIB • CISCO-PING-MIB • CISCO-PROCESS-MIB • CISCO-RTTMON-MIB • CISCO-STP-EXTENSIONS-MIB • CISCO-SYSLOG-MIB • CISCO-TCP-MIB • CISCO-VLAN-IFTABLE-RELATIONSHIP-MIB • CISCO-VLAN-MEMBERSHIP-MIB	• CISCO-VTP-MIB • ENTITY-MIB • ETHERLIKE-MIB • IF-MIB • IGMP-MIB • IPMROUTE-MIB • OLD-CISCO-CHASSIS-MIB • OLD-CISCO-FLASH-MIB • OLD-CISCO-INTERFACES-MIB • OLD-CISCO-IP-MIB • OLD-CISCO-SYS-MIB • OLD-CISCO-TCP-MIB • OLD-CISCO-TS-MIB • OSPF-MIB (RFC 1253) • PIM-MIB • RFC1213-MIB • RFC1253-MIB • RMON-MIB • RMON2-MIB • SNMP-FRAMEWORK-MIB • SNMP-MPD-MIB • SNMP-NOTIFICATION-MIB • SNMP-TARGET-MIB • SNMPv2-MIB • TCP-MIB • UDP-MIB
Standards	• IEEE 802.1s • IEEE 802.1w • IEEE 802.1x • IEEE 802.3ad • IEEE 802.3af • IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports • IEEE 802.1D Spanning Tree Protocol • IEEE 802.1p CoS Prioritization • IEEE 802.1Q VLAN • IEEE 802.3 10BASE-T specification • IEEE 802.3u 100BASE-TX specification • IEEE 802.3ab 1000BASE-T specification • IEEE 802.3z 1000BASE-X specification	• 1000BASE-X (SFP) • 1000BASE-SX • 1000BASE-LX/LH • 1000BASE-ZX • 1000BASE-CWDM SFP 1470 nm • 1000BASE-CWDM SFP 1490 nm • 1000BASE-CWDM SFP 1510 nm • 1000BASE-CWDM SFP 1530 nm • 1000BASE-CWDM SFP 1550 nm • 1000BASE-CWDM SFP 1570 nm • 1000BASE-CWDM SFP 1590 nm • 1000BASE-CWDM SFP 1610 nm • RMON I and II standards • SNMPv1, SNMPv2c, and SNMPv3

Table 5. Safety and Compliance

Description	Specification
Safety Certifications	• UL 60950-1, First Edition • CUL to CAN/CSA 22.2 No. 60950-1, First Edition • TUV/GS to EN 60950-1, First Edition • CB to IEC 60950-1 with all country deviations • AS/NZS 60950-1, First Edition • NOM (through partners and distributors) • CE Marking
Electromagnetic Emissions Certifications	• FCC Part 15 Class A • EN 55022 Class A (CISPR22) • EN 55024 (CISPR24) • AS/NZS CISPR22 Class A • CE • CNS 13438 Class A

	• MIC • GOST • China EMC Certifications
Telco	Common Language Equipment Identifier (CLEI) code
Warranty	Limited lifetime warranty

Cisco Services for Access Switching

Cisco and our partners can help you create a robust, dependable Cisco Access Switching solution. The Cisco lifecycle approach to services defines the requisite activities at each phase of the solution lifecycle. Assessments help align your solution to business goals and gauge readiness to support new technology. Effective planning and design expedite solution adoption. Award-winning technical support increases operational efficiency, and optimization improves performance, resiliency, stability, and predictability and prepares your network and teams for change. For more information, visit http://www.cisco.com/go/services.

Table 6. Cisco Services and Support Programs

Service and Support	Features	Benefits
Advanced Services		
• Cisco Total Implementation Solutions (TIS), available direct from Cisco • Cisco Packaged TIS, available through resellers • Cisco SMARTnet® and SMARTnet Onsite support, available direct from Cisco • Cisco Packaged SMARTnet support program, available through resellers	• Project management • Site survey, configuration, and deployment • Installation, text, and cutover • Training • Major moves, adds, and changes • Design review and product staging • Access to software updates 24 hours • Web access to technical repositories • Telephone support through the Cisco Technical Assistance Center (TAC) • Advance Replacement of hardware parts	• Supplements existing staff • Helps ensure that functions meet needs • Mitigates risk • Helps enable proactive or expedited issue resolution • Lowers TCO by taking advantage of Cisco expertise and knowledge • Minimizes network downtime

Ordering Information

Table 7 gives ordering information for the Cisco Catalyst 3560 Series switches.

Table 7. Ordering Information for Cisco Catalyst 3560 Series Switches

Part Numbers	Description
WS-C3560-8PC-S	• 8 Ethernet 10/100 ports and 1 dual-purpose 10/100/1000 and SFP port • Compact form-factor with no fan • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560-12PC-S	• 12 Ethernet 10/100 ports and 1 dual-purpose 10/100/1000 and SFP port • Compact form-factor with no fan • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560-24TS-S	• 24 Ethernet 10/100 ports and 2 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Base software feature set (IPB)
WS-C3560-24TS-E	• 24 Ethernet 10/100 ports and 2 SFP-based Gigabit Ethernet ports • RU fixed-configuration, multilayer switch

	• Enterprise-class intelligent services delivered to the network edge • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560-48TS-S	• 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Base software feature set (IPB)
WS-C3560-48TS-E	• 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560-24PS-S	• 24 Ethernet 10/100 ports and 2 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560-24PS-E	• 24 Ethernet 10/100 ports and 2 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560-48PS-S	• 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560-48PS-E	• 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560G-24TS-S	• 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Base software feature set (IPB)
WS-C3560G-24TS-E	• 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560G-48TS-S	• 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Base software feature set (IPB)
WS-C3560G-48TS-E	• 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560G-24PS-S	• 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard • IP Base software feature set (IPB)

WS-C3560G-24PS-E	• 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560G-48PS-S	• 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560G-48PS-E	• 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
CD-3560G-EMI=	• IP Services License (formerly EMI) upgrade kit for IP Base versions of the Cisco Catalyst 3560G-24TS, Catalyst 3560G-24PS, Catalyst 3560G-48TS and Catalyst 3560G-48PS • Advanced IPv6 routing
CD-3560-EMI=	• IP Services License (formerly EMI) upgrade kit for IP Base versions of the Cisco Catalyst 3560-24PS, Catalyst 3560-48PS, Catalyst 3560-24TS, Catalyst 3560-48TS, and Catalyst 3560-8PC • Advanced IPv6 routing
PWR-RPS2300	Cisco RPS 2300 with one connector cable
RCKMNT-1RU=	Spare rack-mount kit for the Cisco Catalyst 3560
RCKMNT-REC-1RU=	1RU recessed rack-mount kit for the Cisco Catalyst 3560
RCKMNT-19-CMPCT=	Rack-mount kit for the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
CBLGRD-C3560-8PC=	Cable guard for the Cisco Catalyst 3560-8PC compact switch
CBLGRD-C3560-12PC=	Cable guard for the Cisco Catalyst 3560-12PC compact switch
GLC-LH-SM=	1000BASE-LX/LH SFP transceiver module for MMF and SMF, 1300-nm wavelength
GLC-SX-MM=	1000BASE-SX SFP transceiver module for MMF, 850-nm wavelength
GLC-ZX-SM=	1000BASE-ZX SFP transceiver module for SMF, 1550-nm wavelength
GLC-T=	1000BASE-T SFP transceiver module for Category 5 copper wire Not supported on the Cisco Catalyst 3560-8PC compact switch
GLC-BX-D=	1000BASE-BX10 SFP transceiver module for single strand SMF, 1490-nm TX / 1310-nm RX wavelength
GLC-BX-U=	1000BASE-BX10 SFP transceiver module for single strand SMF, 1310-nm TX / 1490-nm RX wavelength
GLC-GE-100FX=	• 100BASE-FX SFP transceiver module for Gigabit Ethernet ports, 1310 nm wavelength, 2 km over MMF • Not supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
GLC-FE-100FX=	• 100BASE-FX SFP transceiver module for 100-Mb ports, 1310 nm wavelength, 2 km over MMF • Only supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
GLC-FE-100LX=	• 100BASE-FX SFP transceiver module for 100-Mb ports, 1310 nm wavelength, 10 km over SMF • Only supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
GLC-FE-100BX-D=	• 100BASE-BX10-D SFP transceiver module for 100-Mb ports, 1550 nm TX /1310 nm RX wavelength, 10 km over single-strand SMF • Only supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches

GLC-FE-100BX-U=	• 100BASE-BX10-U SFP transceiver module for 100-Mb ports, 1310 nm TX/1550 nm RX wavelength, 10 km over single-strand SMF • Only supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
CWDM-SFP-1470=	Cisco CWDM SFP 1470 nm; Gigabit Ethernet and 1G/2G FC (gray)
CWDM-SFP-1490=	Cisco CWDM SFP, 1490 nm; Gigabit Ethernet and 1G/2G FC (violet)
CWDM-SFP-1510=	Cisco CWDM SFP, 1510 nm; Gigabit Ethernet and 1G/2G FC (blue)
CWDM-SFP-1530=	Cisco CWDM SFP, 1530 nm; Gigabit Ethernet and 1G/2G FC (green)
CWDM-SFP-1550=	Cisco CWDM SFP, 1550 nm; Gigabit Ethernet and 1G/2G FC (yellow)
CWDM-SFP-1570=	Cisco CWDM SFP, 1570 nm; Gigabit Ethernet and 1G/2G FC (orange)
CWDM-SFP-1590=	Cisco CWDM SFP, 1590 nm; Gigabit Ethernet and 1G/2G FC (red)
DWDM-SFP-3033=	DWDM SFP 1530.33 nm SFP (100 GHz ITU grid)
DWDM-SFP-3112=	DWDM SFP 1531.12 nm SFP (100 GHz ITU grid)
DWDM-SFP-3190=	DWDM SFP 1531.90 nm SFP (100 GHz ITU grid)
DWDM-SFP-3268=	DWDM SFP 1532.68 nm SFP (100 GHz ITU grid)
DWDM-SFP-3425=	DWDM SFP 1534.25 nm SFP (100 GHz ITU grid)
DWDM-SFP-3504=	DWDM SFP 1535.04 nm SFP (100 GHz ITU grid)
DWDM-SFP-3582=	DWDM SFP 1535.82 nm SFP (100 GHz ITU grid)
DWDM-SFP-3661=	DWDM SFP 1536.61 nm SFP (100 GHz ITU grid)
DWDM-SFP-3819=	DWDM SFP 1538.19 nm SFP (100 GHz ITU grid)
DWDM-SFP-3898=	DWDM SFP 1538.98 nm SFP (100 GHz ITU grid)
DWDM-SFP-3977=	DWDM SFP 1539.77 nm SFP (100 GHz ITU grid)
DWDM-SFP-4056=	DWDM SFP 1540.56 nm SFP (100 GHz ITU grid)
DWDM-SFP-4214=	DWDM SFP 1542.14 nm SFP (100 GHz ITU grid)
DWDM-SFP-4294=	DWDM SFP 1542.94 nm SFP (100 GHz ITU grid)
DWDM-SFP-4373=	DWDM SFP 1543.73 nm SFP (100 GHz ITU grid)
DWDM-SFP-4453=	DWDM SFP 1544.53 nm SFP (100 GHz ITU grid)
CWDM-SFP-1610=	Cisco CWDM SFP, 1610 nm; Gigabit Ethernet and 1G/2G FC (brown)
CAB-SFP-50CM=	Cisco Catalyst 3560 SFP Interconnect Cable (50 dcm)
CAB-SM-LCSC-1M	1m-fiber single-mode LC-to-SC connectors
CAB-SM-LCSC-5M	5m-fiber single-mode LC-to-SC connectors

For more information about Cisco products, contact:

- United States and Canada: (toll free) 800 553-NETS (6387)
- Europe: 32 2 778 4242
- Australia: 612 9935 4107
- Other: 408 526-7209

World Wide Web URL: http://www.cisco.com

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LINKSYS

AC1900

LINKSYS AC1900 DUAL-BAND **SMART** Wi-Fi ROUTER
EA6900

SMART Wi-Fi

Access Your Home Network.
Anywhere. Anytime.

Linksys AC1900 Smart Wi-Fi Router features high-speed Wireless-AC technology and Smart Wi-Fi software to bring the next generation in home network performance

Meeting the demand of today's connected homes, the flagship Linksys AC1900 Smart Wi-Fi Router offers best-in-class Wireless-AC technology for a faster, stronger connection that is perfect for high-definition media streaming, online gaming, and Internet access. Outfitted with an upgraded central processing unit (CPU) and offering dual-band speeds up to N600 + AC1300 Mbps*, the AC1900 is designed to deliver the most superior performance in a consumer router. The AC1900 is the first in the Linksys Smart Wi-Fi router line to feature customizable and removable external antennas. The antenna trio works to deliver ultimate wireless signal and range to manage the influx of multiple users and devices operating at the same time.

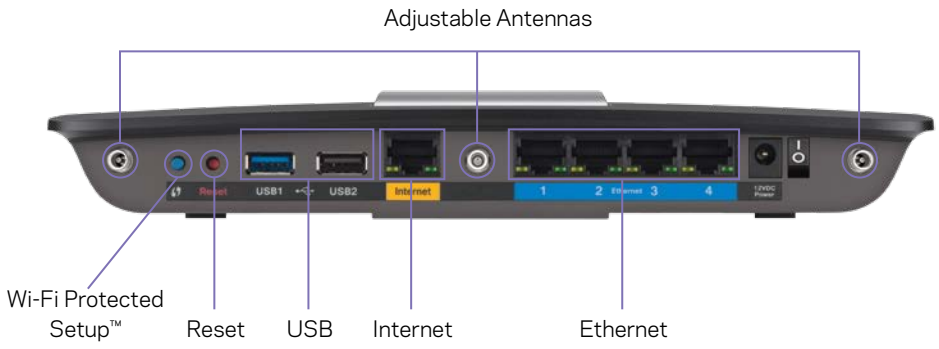
The AC1900 router exclusively offers Linksys Smart Wi-Fi software, allowing users to monitor and control their home network any time, from virtually any location. A growing selection of apps provides additional customization possibilities, taking home networks to the next level.

Key Features and Benefits

- **Up to 4.3x† faster than N technology:** Simultaneous dual-band speeds up to 600 Mbps (2.4 GHz) + 1300 Mbps (5 GHz)* for media-intensive applications
- **Improved signal reception:** Advanced Beamforming technology improves Wi-Fi reception by focusing the Wi-Fi signal to a select device within home environments that suffer from signal interference
- **Faster transfer rates:** USB 3.0‡ delivers 10x faster transfer rates than USB 2.0 for photos, video and data files
- **Faster speeds:** Three external, removable antennas provide additional Wi-Fi signal strength for maximum flexibility
- **Peace of mind:** With Linksys Smart Wi-Fi technology, users can prioritize devices or websites, gain parental control over content, monitor network activity, turn Wi-Fi access on or off, and create select password-protected guest networks
- **Smart Wi-Fi apps:** A growing suite of apps offers improved opportunities to control one's home network
- **Stress-free setup:** Android users can utilize the SimpleTap™ connectivity feature to set up a wireless network and connect Wi-Fi devices to it

AC1900

LINKSYS AC1900 DUAL-BAND **SMART** Wi-Fi ROUTER EA6900



Package Includes:
- Linksys Smart Wi-Fi Router AC1900, EA6900
- Quick Start Guide
- CD-ROM with Documentation
- Ethernet Cable
- Power Adapter
- SimpleTap Card

System Requirements:
For Router Setup and Linksys Smart Wi-Fi access:
Internet Explorer® 8, Safari® 5 (for Mac®), Firefox® 8 or Google Chrome™
For Printer Sharing and User Documentation:
PC: Wi-Fi enabled with CD or DVD drive, Windows® XP SP3, Windows Vista® SP1 or later, Windows 7, or Windows 8
Mac: Wi-Fi enabled with CD or DVD drive, Mac OS® X Leopard v10.5.8 or later, Snow Leopard v10.6.1 or later, Lion v10.7, or Mountain Lion v10.8

Specifications are subject to change without notice.

An active, customer-purchased Internet Service Provider broadband account is required for connection of this router and other connected computers and devices to the Internet.

Some devices may require additional wireless adapters or an Ethernet cable to connect to this router.

Specifications:
Wireless Standards with Link Rate
IEEE 802.11 a/b/g/n/ac

Wireless Operating Spectrum:
Simultaneous Dual-Band
2.4 GHz and 5 GHz
Next-Generation Wireless-AC Technology For Powerful Networking.

Wireless Security:
Wi-Fi Protected Setup™ button
WPA®/WPA2® encryption
SPI firewall
WEP encryption

VPN Support:
PPTP
IPSec pass-through

Media Specifications:
UPnP Server

Ports:
1x Internet
4x Gigabit Ethernet
1x USB 2.0
1x USB3.0
Power

Power Supply Specifications:
Input: 110-240V~ 50 Hz 1.5A
Output: 12V DC 3.5A

Radio Specifications:
Operating Frequencies:
2412 MHz - 2472 MHz &
5180 MHz - 5240 MHz

Output Power:
2.4 GHz: 19.40 dBm
5 GHz: 22.66 dBm

Antenna Type:
Di-Pole

Antenna Gain:
2.4 GHz 1.3 dBi
5 GHz: 0.87 dBi

*The standard transmission rates—600 Mbps or 1300 Mbps (for 5 GHz), 600 Mbps (for 2.4 GHz), 54 Mbps, and 11 Mbps—are the physical data rates. Actual data throughput will be lower and may depend on the mix of wireless products used and external factors.

†Up to 4.3x faster physical data rate when compared to 802.11n Wi-Fi routers using two antennas to transmit and receive data. Actual speeds will vary depending on a number of factors. In order to achieve the best performance, router must be used with a compatible AC1300 wireless device.

‡May require a software/firmware update available for download at linksys.com/support.

Part Number	Description	UPC / EAN	Warranty
EA6900-ME	AC1900 Dual-Band Smart Wi-Fi Router	745883598724 / 4260184663187	2-Year Limited

linksys.com

Linksys Pte. Ltd. c/o Belkin BV
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Made in China