Cambium Networks™

CAMBIUM PTP 650 SERIES

UNRIVALED CONNECTIVITY AND BACKHAUL FROM THE INDUSTRY LEADER IN RELIABILITY AND PERFORMANCE

UP TO 450 MBPS WITH SUB-6 GHZ, HIGH-CAPACITY, NON-LINE-OF-SIGHT POINT-TO-POINT BACKHAUL SOLUTIONS

COMMUNICATE WITH **MORE SPEED, RELIABILITY, VERSATILITY,** AND **SECURITY**

The last decade has seen massive growth in converged data, voice and video traffic globally. This growth has been, and continues to be, driven by escalating demands for video content, smart-device adoption and usage, advanced Long Term Evolution (LTE), and small-cell technologies.

Tomorrow promises to bring an explosion of enterprise applications for smart phones and tablets. Designed to boost employee productivity and increase customer acceptance, these mission-critical applications will require high bandwidth, throughput, and security to efficiently support vital infrastructure. All signs indicate that data, voice, and video traffic will continue to grow exponentially as more and more devices share applications and information.

The available spectrum is becoming scarce, and network operators are looking to sub-6 GHz solutions to fill the void. When deploying a sub-6 GHz solution for mission-critical applications, it is essential that the system be able to overcome a wide array of environmental challenges such as obstructions, interference, over-water fading, and severe weather conditions.

At Cambium Networks, we are focused on supplying ultra-reliable solutions that accommodate ever-escalating requirements for reliability, speed, versatility, and security. Our Dynamic Spectrum Optimization, narrow channel operations, and high spectral efficiency make our Cambium PTP 650 Series wireless Ethernet bridges the lowest-risk approach to sub-6 GHz deployment. We have engineered PTP 650 systems to deliver industry-leading, rapid-deployment and future-proof connectivity and backhaul for high-performance networks. As a result, you can communicate virtually anywhere and scale to meet future requirements.

GET THE BEST FROM YOUR PTP BACKHAUL SOLUTION

OPTIMAL PERFORMANCE

As you evaluate wireless options for your requirements, you want the best the industry has to offer at the best possible price. True value encompasses the relationship between the manpower and money you invest and the speed, reliability, versatility, security, and support you receive. In each of these categories, our PTP 650 solution gets the highest rating.

PTP 650 systems are designed and engineered with the same industry-vetted, field-proven Cambium technology that made our PTP 600 solution the best in its class. In the PTP 650, we elevated that technology to present our latest best-in-class solution. The result is that the PTP 650 delivers unsurpassed performance in its category.

PERFORMANCE DIFFERENTIATORS
Highest throughput
Highest spectral efficiency
Most reliable NLOS performance
Greatest range
Most powerful interference mitigation
Best channel optimization
Most flexible input-output options
Industry-leading link planning tool

Our global sales and support teams provide unmatched assistance throughout the sales process, system design and deployment, operations, and management. Because we focus on wireless broadband exclusively, we have the experience and expertise to help you optimize your network infrastructure and achieve your communication goals.

With our top performance, best-in-class support, and competitive price point, you can rely on the Cambium PTP 650 to offer the highest performance and value in point-to-point wireless connectivity.

ENGINEERED FOR BEST RESULTS

The PTP 650 represents the culmination of deployment experiences and customer feedback from more than 75,000 point-to-point links deployed worldwide over the past eight years. The solutions are engineered with advanced technology that delivers a wide range of connectivity and backhaul functions, supports diverse and evolving network requirements, and empowers your customers and users through innovation.

With wireless communications, there are many environments that pose serious performance and reliability challenges such as obstructions, weather, water, distance, and interference. In these situations, a solution's technology is rigorously tested, and many comparable systems drop packets or cannot even make a connection. PTP 650 radios are engineered to handle these challenges and supply carrier-grade reliability and high-performance connectivity in the most challenging environments. As a result, you can depend on your PTP 650 system to out-perform comparable systems and operate flawlessly.

SUPERB VERSATILITY

No wireless solution is useful unless it easily and seamlessly integrates into your existing network infrastructure. Operating as layer 2 Ethernet bridges, our PTP 650 radios provide the versatility you need to configure and deploy a broadband solution that works with your existing network and network-management infrastructure while delivering the highest-level of reliability and efficiency.

CAMBIUM PTP 650 SERIES SOLUTIONS
PTP 650 (4.9 TO 6.05 GHz) Integrated
PTP 650 (4.9 TO 6.05 GHz) Connectorized

Available in Integrated and Connectorized versions, each PTP 650 radio supports multi-band functionality operating between 4.9 and 6.05 GHz radio frequencies, using channel bandwidths ranging from 5 MHz to 45 MHz (where local regulations allow). The Integrated models have a built-in, high-performance directional antenna. Connectorized models can be fitted with separately-purchased, external antennas, including up to 8-foot dishes and spatially diverse configurations. They deliver superior performance over long distances and in extremely adverse environments, including near- and non-line-of-sight scenarios.

Multiple input-output options add more flexibility to configure the best solution for your network requirements. With a wide range of configuration options and internal controls, you can customize PTP 650 links based on your particular network infrastructure, communication objectives, and environmental conditions. Input/output features include a fiber interface, out-of-band management, and an auxiliary 1000 BaseT 802.3at PoE output port. The 802.3at output option allows you to power another device such as a video camera or wireless access point at the top of the tower.

FUTURE-PROOF EXPANDABILITY

PTP 650 systems offer selectable channel sizes with varying data rates to configure bandwidth and throughput based on your requirements. As an example, you can begin with up to 125 Mbps capacity. At anytime, you can increase throughput in a single step or incremental steps up to 450 Mbps. Each increase is initiated via software-activated license keys and does not require hardware changes. You also have the ability to synchronize multiple PTP 650 links, allowing multiple radios to co-exist on a single tower and in a small geographic area while minimizing self-interference.

PTP 650 TIERED CAPACITY	
CAPACITY LEVEL	MAXIMUM THROUGHPUT
Lite Capacity	125 Mbps
Mid Capacity	250 Mbps
Full Capacity	450 Mbps

BETTER SPECTRUM UTILIZATION

PTP 650 radios provide as much as 60 percent higher spectral efficiency than comparable systems. This means you can deliver higher-throughput with minimal spectrum usage. For example, a PTP 650 system can deliver 200 Mbps in a 20 MHz channel versus the typical 100 Mbps offered by other technologies such as 802.11n. In addition, a PTP 650 monitors all available channels and dynamically selects the optimal channel to sustain the highest data rate with the greatest reliability. As a result, the PTP 650 link is always self-optimizing without intervention from an operator. There is also an option to manually lock the frequency (in either direction) and restrict each link to specified frequencies.

GREATER RANGE AND SPEED

PTP 650 solutions offer a high link budget and high power, enabling your network to get more capacity at all ranges up to 450 Mbps maximum. In typical applications, PTP 650 systems support a link budget that provides more than twice the range relative to comparable systems. The radios deliver up to 27 dBm transmit power to provide the greatest range. Equally important, the PTP 650 delivers 23dBm at 64QAM and 256QAM to push even the highest performing links to longer distances. Integrated models are configured with 23 dBi antennas, while Connectorized models can support up to 8-foot dishes. (Link budgets and antenna sizes are dependent on local regulatory rules, and the PTP LINKPlanner tool will precisely predict link performance and availability.)

CONNECT WITH CAMBIUM, THE INNOVATION LEADER IN WIRELESS BROADBAND

POWERFUL FEATURES

Cambium PTP 650 systems set the standard for sub-6 GHz performance with such important features as:

- Up to 450 Mbps Aggregate Throughput
- Low Latency – 1 to 3 Milliseconds Typical One-Way
- Multi-Band Functionality with 4.9 to 6.05 GHz in a Single Radio
- Best Non-Line-of-Sight (NLOS) Performance
- Five-9's Reliability Even in Challenging Conditions
- High Spectral Efficiency – 10 bps/Hz Maximum
- Up to 124 Miles (200 Kilometers) Reach
- Multi-Bandwidth Flexibility – 5, 10, 15, 20, 30, 40, 45 MHz
- Always-On, In-Band, Online Spectrum Analyzer
- Symmetrical, Asymmetrical, and Adaptive TDD Ratios
- Dynamic Spectrum Optimization (DSO) for Interference Avoidance
- IPv4/IPv6 Dual-Stack Management
- Secure Management Interfaces (SNMPv3, HTTPS/TLS)
- Secure Over-the-Air Communications (128/256-bit AES Encryption)
- 802.3at PoE Output Port
- Fiber and Copper, GigE SFP Port Options
- In-Band and Out-of-Band Management (OOBM)
- 8-Port T1/E1 TDM Module (Rack-Mountable Indoor Unit)
- Extreme Durability with 40 Years Mean Time Between Failures (MTBF)
- Future-Proof, Software-Configurable Radios
- Capacity Upgrade Licenses

MULTI-LEVEL SECURITY

- 128/256-Bit AES Encryption
- HTTPS/TLS and SNMPv3
- Identity-Based User Accounts
- Configurable Password Rules
- User Authentication and RADIUS Support
- Event Logging and Management
- Syslog Support
- Vulnerability Management

TECHNOLOGICAL ADVANTAGES

The PTP 650 platform is built on the Cambium Networks point-to-point technologies that you have come to know and respect. We have sharpened existing technologies and added new technologies to further increase performance, reliability, and versatility.

FAST, PREEMPTIVE ADAPTIVE MODULATION

PTP 650 systems adapt rapidly to changing field conditions with fast Adaptive Modulation (AMOD). Each radio has error-coding functionality and 13 modulation combinations that are automatically selected for each individual frame based on analysis of the previous incoming frame. These rapid adjustments greatly increase link reliability and efficiency.

DYNAMIC SPECTRUM OPTIMIZATION (DSO)

Our unique DSO capability automatically optimizes each link for maximum reliability and performance. With DSO, PTP 650 links use the in-band, online spectrum analyzer to continually scan the entire operational band, seeking channels that may deliver higher performance and reliability without impacting the operational link. You can configure DSO to automatically jump to the optimal channel with no operator intervention. Additionally, PTP 650 systems support split-frequency operation, allowing each direction of a link to operate on a different channel. This feature mitigates the negative impact of situations where the interference environment is different at each end of the link. The time-stamped database tracks events, alerts an operator of any interference that triggers channel changes, and provides statistics that help to pinpoint the channels with the clearest data paths. With DSO, you can be confident that your PTP 650 links are self-optimizing to operate on the best available channel.

NON-LINE-OF-SIGHT OPERATIONS

The PTP 650 delivers proven near-line-of-sight and non-line-of-sight performance through a combination of features including a unique adaptive frame structure, fast adaptive modulation, 1024-subcarriers, split-frequency operation, and spatial diversity.

TIME DIVISION DUPLEX (TDD) SYNCHRONIZATION

TDD capability synchronizes transmit and receive signals and enables efficient frequency re-use. Of great importance to service providers, this capability allows the deployment of multiple radios on a rooftop or tower with greatly reduced self-interference. Our Cambium TDD-SYNC synchronization module provides the links with an accurate timing reference for installations where multiple radios will be deployed on a single tower or within range of each other.

SYNCHRONOUS ETHERNET (SyncE) AND 1588v2 PRECISION TIMING

As service providers migrate to 4G next-generation networks such as LTE, sub-6 GHz backhaul is highly recommended. Precise timing and frequency references are critical in these networks to support interoperability, frequency re-use, and scalability. The PTP 650 supports both 1588v2 (timing) and Synchronous Ethernet (frequency) delivery over the wireless backhaul link.

IPv6/IPv4 DUAL-STACK MANAGEMENT SUPPORT

IPv6 support is becoming more important as the global supply of IPv4 addresses becomes fully allocated. PTP 650 systems support a dual-stack, IPv4/IPv6 networking stack, allowing you to deploy and manage PTP 650 systems in an IPv6 or IPv4 network. If the initial deployment of the PTP 650 was in an IPv4 network, the system is IPv6-ready for future migration.

THIRD-GENERATION MECHANICAL PACKAGING

PTP 650 radios have protective aluminum enclosures that are Ingress Protection (IP66/67) rated against dust and water intrusion to withstand the rigors of outdoor use and temperatures from -40° to +140° F (-40° to +60° C). Utilizing third-generation mechanical design, the radios incorporate features to simplify installation and maximize reliability.

INFORMATION SECURITY IS NON-NEGOTIABLE

REASSURING, ROBUST SECURITY

In today's world, the security of any and all communications is a major concern. Whether you are a service provider, government agency, or business enterprise, the confidentiality of over-the-air transmissions and secure access to management interfaces needs to be ensured. At Cambium, we have deployed significant financial and manpower resources to provide you with the highest level of information security and protect your wireless communications from malicious attack.

ENCRYPTION

PTP 650 systems support FIPS-197 compliant 128-bit and 256-bit Advanced Encryption Standard (AES) encryption via an optional software license upgrade.

MANAGEMENT INTERFACE PROTECTION

HTTPS/TLS, the secure version of HTTP, has been implemented to protect the system's management interface. PTP 650 radios also support installation of user-provided X.509 digital certificates. Simple Network Management Protocol version 3 (SNMPv3) adds security to SNMP. In certain cases, a license key is required to implement these capabilities.

IDENTITY AND EVENT MANAGEMENT

You can enable identity-based user accounts with configurable password rules to control user access to the radios. Remote Authentication Dial In User Service (RADIUS) can be used to remotely authenticate your users and their levels of access based on network policies.

AUDITING AND EVENT MANAGEMENT

Security-related and other events are logged locally and can optionally be sent to a centralized logging server using syslog. Such messages include: successful and failed log-in events and changes to the security configuration.

DISASTER RECOVERY

Our "save and restore" feature lets you back up a radio's operating configuration file. The file can be restored quickly and easily if a unit must be reset or replaced.

VULNERABILITY MANAGEMENT

We regularly scan PTP 650 software using industry-standard tools to probe for vulnerabilities. Those that pose risk are resolved.

FIPS 140-2

FIPS 140-2 validation is in process. Since the PTP 650 is based on previously validated software in the PTP 600, many of the FIPS-required features are available now.

EASY, ACCURATE LINK PLANNING

Our easy-to-use Cambium PTP LINKPlanner tool lets you accurately predict performance characteristics and verify the success of your project prior to purchase based on your specific radio path conditions and tower locations. You can plan and optimize a single link or multiple links simultaneously, apply "what if" scenarios, see the effects of your changes immediately, generate a PTP 650 Bill of Materials (BOM), and obtain configuration details to speed deployment. LINKPlanner is available at no charge as a stand-alone tool and can be downloaded from our web site.

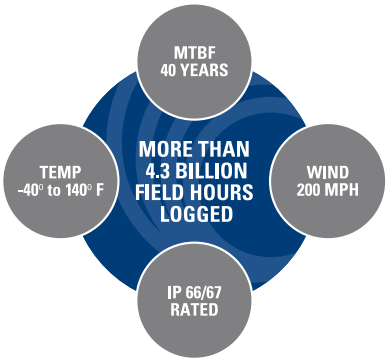
SYSTEM MANAGEMENT YOUR WAY

Easy to use and deploy, PTP 650 systems contain embedded web servers to manage a link either locally or remotely. The servers are designed to easily integrate with Web or SNMP-based management systems as well as our Wireless Manager software, version WM 4.0/SP4 or higher.

The systems support both in-band and out-of-band management. In-band management gives you the convenience to manage the far end of a link from the near end and imposes virtually no performance restrictions on your customer or user traffic. Out-of-band management (OOBM) lets you manage your radios over a separate local-area-network (LAN) connection from either end of the link. With this management method, you can separate the management traffic from your customer or user traffic. Both options are designed to help you quickly troubleshoot links and reduce the need to travel to individual radio sites.

PERFORMANCE BOOSTING TOOLS

PTP 650 systems include industry-leading metrics to help you attain the best possible performance from your wireless system. Those metrics include antenna alignment information, measurements of throughput, signal level, signal quality, and troubleshooting diagnostics.



SUPERB DEPENDABILITY

With more than 4.3 billion field hours logged, our PTP radios are proven to withstand the rigors of outdoor use. Radios perform flawlessly in winds up to 200 mph (322 kph) and temperatures from -40° to 140° F (-40° to 60° C). Our PTP 650 systems average 40 years MTBF (Mean Time Between Failures) based on field component failure rates. IP 66/67 (Ingress Protection) rated protective aluminum enclosures protect the radios against dust and water intrusion.

LET OUR PTP 650 SOLUTION SERVE YOUR CONNECTIVITY NEEDS

PTP 650 USES AND APPLICATIONS

With more than 75,000 point-to-point systems deployed in more than 150 countries, you can be confident that we have a solution that will fit your application requirements.

- Leased-Line and Fiber Replacement
- Video Surveillance
- Network Redundancy
- Wire-Line and Wireless Network Extensions
- IP Network Migration
- High-Definition (HD) Video
- Video Conferencing
- Voice-over-Internet Protocol (VoIP)
- Disaster Recovery and Emergency Services
- Communications for Special Events
- Distance Learning
- Telemedicine
- Building-to-building and Campus Communications

Public Safety

- Real-time database access
- P25-compatible connectivity between base sites
- Last mile access
- Land-mobile radio (LMR) backhaul
- Secondary links
- On-scene monitoring
- Tactical deployment for first responders

Benefits:
Increased intra- and inter-agency collaboration, improved emergency response and situational awareness, better utilization of resources, and increased productivity

Oil and Gas

- Communications during turnarounds
- Process Control Systems (PCS) backhaul
- Offshore-to-onshore or offshore-to-offshore communications
- Backhaul over long distances and in extremely hostile environments

Benefits:
Increased productivity, continuous flow of information, quickly deployed communications, additional capacity, and uninterrupted critical operations

Government

- Border control
- Rapid deployment for emergencies and special events
- Emergency preparedness
- Disaster recovery
- Inter-agency and intra-agency communications
- Multiple radios on a tower or rooftop or in a dense network configuration

Benefits:
Increased inter- and intra-agency collaboration, anytime access to vital information, increased productivity, ongoing communications during emergencies and events

Service Providers

- 4G/LTE and macro-cell backhaul
- Small-cell backhaul
- Added capacity
- Service extensions
- Collocation of radios on a tower or rooftop or in a dense-network configuration
- HD video
- Last-mile access
- Wi-Fi offloading

Benefits:
Timely responses to market changes, ability to cost-effectively capitalize on new opportunities, more profitable service offerings, service to underserved and remote customers, and cost-effective infrastructure improvements

Utilities

- Remote monitoring
- AMI connectivity backbone
- Links to remote, rural facilities
- In-field reporting and collaboration
- Analog-to-digital migration
- Increased backbone capacity
- Last-mile fiber extensions

Benefits:
Improved energy efficiency, better insight into power usage, improved access to transmission, distribution and consumption data, increased productivity, reduced leased-line and fiber fees, smoother transition to a digital infrastructure

Business Enterprises

- Real-time data access
- Communications from a headquarters location to remote facilities
- On-demand video
- Online training
- Video conferencing
- Disaster planning and recovery
- Video surveillance and security

Benefits:
Improved business continuity, reduced leased-line and fiber fees, increased productivity, better inter- and intra-department collaboration, and enhanced physical security

CAMBIUM 650 SERIES:
BEST PERFORMANCE AND VALUE IN BROADBAND

STAY CONNECTED WITH THE INDUSTRY'S BEST

With our high-speed, reliable, and secure PTP 650 connectivity and backhaul solutions, you can communicate regardless of path conditions, weather conditions, and distances. So, you can remain connected to the people, places and information you need to accomplish your communication objectives today and tomorrow. At the same time, our competitive price point enables you to achieve the highest return on your investment.

PTP 650 Connectorized

PTP 650 Integrated
Front & Back

For more information, visit cambiumnetworks.com.

Cambium Networks™

www.cambiumnetworks.com

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