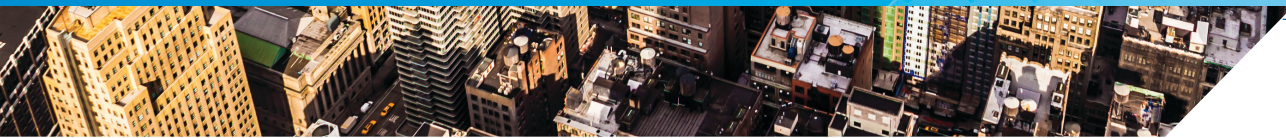




Small-Cell Backhaul: Fiber Can't be Everywhere, but Cambium Can

SUB-6GHZ SOLUTIONS FOR 3G/4G/WI-FI SMALL-CELL BACKHAUL



Mobile Broadband Market Requires Small Cell Backhaul

Data traffic is doubling in the mobile network every year and now Service Providers are approaching the capacity limits of the current network architectures. Outdoor Small Cell architectures allow additional capacity to be deployed where needed to ease congestion and expand coverage complementing existing 3G/4G networks.

Backhaul Deployment Challenges

Outdoor small cell environments present a variety of deployment challenges: scalable provisioning, municipal planning regulations, cyber-security protection, tough environments and dynamic street-level RF conditions.

Small cells need to be placed where the highest demand is occurring, frequently in areas lacking traditional backhaul options. Providing backhaul to these areas is one of the greatest challenges faced by network operators seeking to deploy small cells.



PTP 650S Front



PTP 650S Mounted



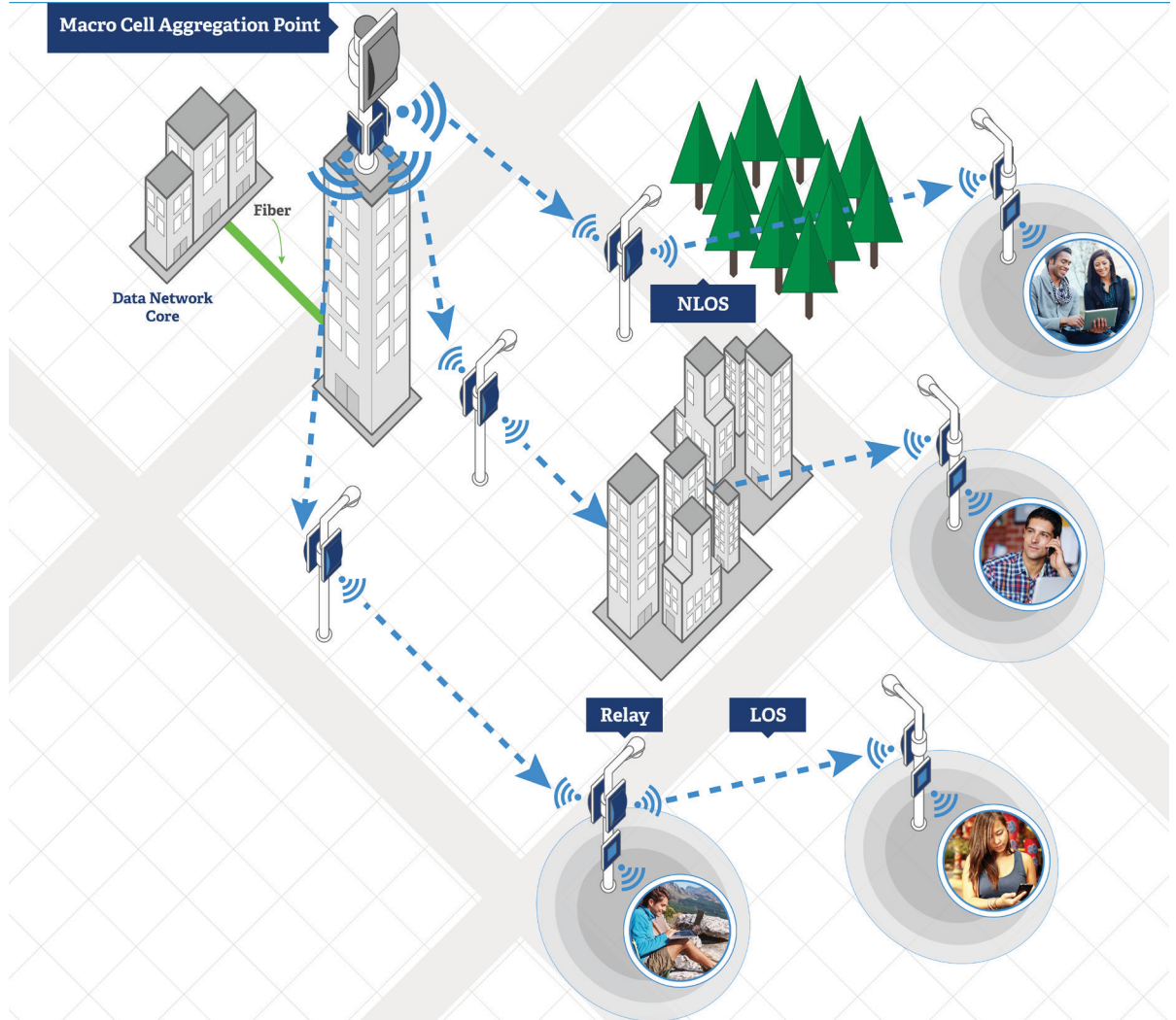
PTP 650S Back

Teaming up Small Cells with Cambium Backhaul

In many cases wireless backhaul is the answer. Cambium Network's Point-to-Point (PTP) wireless backhaul solutions are specifically engineered to overcome the most severe connectivity challenges.



Small Cell Backhaul
Deployment Cases



Small Cell Focus

✓ **NON-LINE OF SIGHT (NLOS) PERFORMANCE**

- Up to 450 Mbps
- Dynamic Spectrum Optimization
- Fast Adaptive Modulation
- High Spectral Efficiency

✓ **TIMING & FREQUENCY**

- IEEE 1588v2
- Synchronous Ethernet

✓ **RAPID DEPLOYMENT**

- Comprehensive Network Management Tool
- Small Form Factor
- Low Power Consumption

✓ **SECURITY**

- Secure Management
- Centralized Access Control
- Data Encryption



Feature Rich Small Cell Backhaul Technology

SUPPORT NEAR LINE OF SIGHT (nLOS) AND NON-LINE OF SIGHT (nLOS)

Small cell deployments deliver extra capacity to high density areas (hot spots) and limited coverage areas (not spots). Access to mounting points and macro cell aggregation points is constrained by street furniture, building facades, terrain and foliage. The backhaul technology solution has to be resilient in these difficult line of sight environments. The PTP 650S has a comprehensive feature set that delivers best-in-class nLOS and NLOS capabilities including 2x2 MIMO OFDM technology, Fast Adaptive Modulation (AMOD), Dynamic Spectrum Optimization (DSO) and high spectral efficiency.

CONTROL NETWORK TIMING AND FREQUENCY

Traditional 2G/3G networks use timing based on TDM circuits to ensure reliable call-handling, transport of real-time information and high channel reuse. Modern 4G/LTE architectures are using Synchronous Ethernet as a precise frequency reference and IEEE 1588v2 for synchronous timing. The PTP 650S supports both of these technologies. For Synchronous Ethernet, the PTP 650 passes a frequency standard from the original Ethernet port to the remote end of the link with high accuracy +/- 16 ppb (parts per billion) required for 3GPP2 base stations. For IEEE 1588v2, the PTP 650S acts as a transparent clock correcting for the residence time of packets on the wireless link. The resulting backhaul operates with precise timing and frequency references.

ENSURE SECURITY

The security of the network encompasses management access, data encryption and physical security. The PTP 650S has a feature-rich set of capabilities in all areas of information assurance. Physical security is ensured by a tamper-evident seal with all software images encrypted and signed. Management interfaces are secured with HTTPS and SNMPv3 for remote access. User access is controlled through centralized RADIUS authentication and multiple user role-based access. Access to the security features can be monitored and audited using syslog. Finally, over-the-air data can be encrypted with 128 or 256-bit AES encryption.



Feature Rich Small Cell Backhaul Technology Continued

SIMPLIFY DEPLOYMENTS

The ability to rapidly and easily deploy small cell backhaul is a key factor in the speed and flexibility of operations. The PTP 650S meets this challenge with multiple features, including highly agile mounting options, a small form factor and low power consumption to simplify installation on all kinds of street furniture and building facades. Audible and GUI-based alignment indicators allow for fast and easy placement of end points to ensure maximum throughput even in NLOS environments. Once installed, our comprehensive Wireless Manager allows service providers to intuitively configure and monitor the system.

MAXIMIZE THROUGHPUT

In the varying RF conditions typically found in street level deployments, it is critical to rapidly and accurately adapt the modulation and maximize the throughput while avoiding packet loss. The PTP 650S achieves this with with Fast Adaptive Modulation (AMOD) by analyzing the channel frame-by-frame. PTP 650S has error-coding functionality and thirteen 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. As a result, optimum capacity with the highest modulation (64/256-QAM) can be achieved at all times even in challenging NLOS and nLOS conditions.

ENHANCE RELIABILITY

Spectrum congestion is unavoidable as the density of wireless deployments increases. Noise from a variety of sources can change over time and affect an existing communication channel, while a neighboring channel may offer significantly better performance. The PTP 650S' Dynamic Spectrum Optimization (DSO) capability takes care of this by continuously scanning the spectrum and measuring channel quality during normal operation. Once configurable thresholds are met, the backhaul link will seamlessly change to a better performing channel without interruption of service. This self-optimizing network (SON) functionality enables automatic network optimization and provides a comprehensive history for the analysis of noise sources if needed.

