Wireless Hauling Solutions for Internet and Business Service Providers

Introduction

Internet service providers are facing a disproportionate relation between demand for higher capacity, on one hand, and fierce competition driving down revenues, on the other. ISPs are forced to search for ways to lower their costs while delivering a consistent stream of advanced services. One of the first cost-lowering solutions they look for is an alternative to expensive leasing or ownership of optical fiber. Regardless of access technology, DSL, WiMax, WiFi, LTE or other, wireless backhaul continues to be the most cost-effective method for bringing the Internet from the point-of-presence (PoP) to customer access points.

Fiber deployment is especially challenging in rural environments where leasing or owning fiber, whose deployment cost is a function of distance, is very expensive, especially when there is no concentration of paying customers to justify the cost. As a result, rural communities tend to be under-served and are often subject to 1990s-like bit-rates and access technologies. Even in urban environments, fiber deployment can be challenging and expensive as trenching involves government bureaucracy and right-of-way obstacles. Fiber's long lead times and high expense can be overcome with quick and simple-to-deploy wireless solutions.

Wireless networking technology can also open up new opportunities for ISPs enabling business-continuity and disaster recovery solutions for enterprises. Deploying redundant paths (e.g., rings) with microwave is much simpler and less expensive than with fiber, increasing network availability and enabling the service provider to offer more attractive SLAs for enterprise customers. Short last-mile—or even last-few-hundred-yards—segments from the fiber path to customer premises can be connected almost instantly by deploying microwave solutions rather than waiting for fiber to become available.

ISP Backhaul Network Requirements

High Capacity: As demand for capacity continues to escalate, service providers have to be ready for the "bandwidth tsunami" by installing high-capacity backhaul with high spectral efficiency in order to keep frequency licensing expenses low while accommodating future upgrades and expansion. Enhanced capacity-boosting techniques must be implemented in order to better utilize scarce and costly spectrum. While few hundreds of Mbps may suffice for today's needs, the rapidly growing capacity requirements dictate rates in the range of 0.5-2 Gbps in order to assure long years of use.

Reach: Varying geographic conditions require a variety of wireless solutions that can operate cost-effectively in both urban and rural environments. To meet these challenges, ISPs need to opt for both line-of-sight (LoS) solutions for extended reach and traffic aggregation of multiple sites, as well as non-line-of-sight (NLoS) solutions - especially in high-density urban scenarios.

Simplicity and Flexibility: ISPs will often install equipment on end-user premises and lease tower space at aggregation points. Backhaul equipment must be compact both for fitting into indoor customer premises as well as for reducing costs associated with outdoor tower leasing. Changing configurations, paths or re-installing equipment in different locations must be quick and simple in order to adapt to evolving connectivity needs. Remote network management must be available for addition/elimination of customer locations and for remote configuration and fault-monitoring of equipment located on customer premises. A unified management solution for all types of equipment in the provider's network is imperative.

Differentiated Services: The backhaul network needs to recognize dynamically that not all types of information require the same priority. Domestic consumers might expect best-effort service while enterprise customers demand stringent SLAs and guaranteed bandwidth (and will pay a premium). The wireless backhaul network must employ a service differentiation mechanism to allow ISPs to offer diversified SLA packages and to sell more revenue-generating services with predictable and guaranteed service performance.

Reliability: ISPs looking to reduce on-site, maintenance-related expenses require a cost-effective transmission medium with high reliability. They need carrier-grade solutions with high MTBF, rather than settle for generic OEM radios—cheaper to procure, but burdensome to operational expenditure, repair times and customer satisfaction.

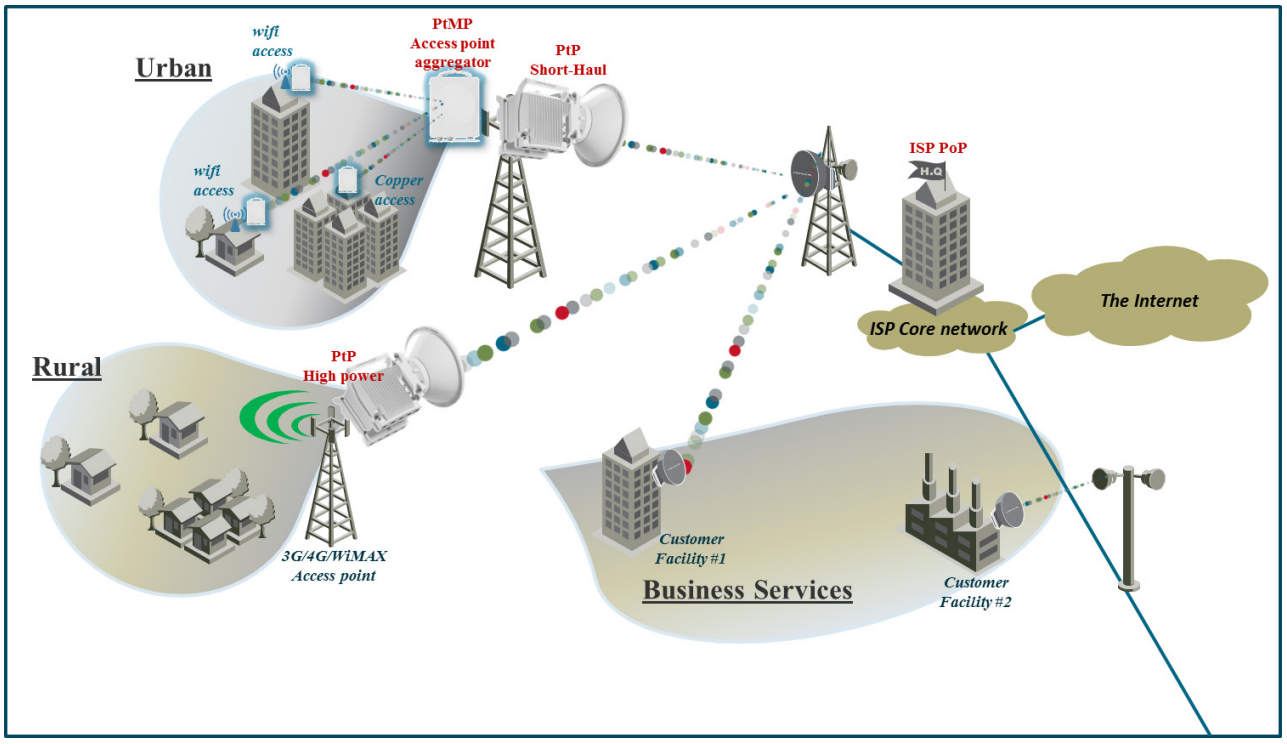
Future-proofing: The flexibility of some of the latest technological advancements endows wireless solutions with the ability to adjust to changing network conditions. Before the advent of such solutions, the then-current level of technological and operational flexibility was able to extend

usability horizons to a certain degree before equipment had to be retired to give way to lower-cost, higher-value substitutes. Today, the situation is quite different. The hardware and software flexibility of wireless hauling solutions enables them to maintain their cost-effective operation over time even while network requirements are changing.

FibeAir IP-20C can be remotely upgraded from 1+0 to 2+0, doubling capacity without site visits

Ceragon's ISP Hauling Solutions

Ceragon's innovative IP-20 Platform is designed to address all the hauling requirements of forward-thinking Internet and business service providers. Ceragon is the #1 wireless hauling specialist. We develop and integrate high-quality, carrier-grade products in-house to boost capacity and efficiency while lowering long-term operating costs. With solutions deployed in more than 130 countries, Ceragon offers world-class experience and expertise to ISPs. The comprehensive FibeAir product portfolio provides cost-effective wireless ISP hauling solutions from the access portion of the network all the way to the ISP's PoP, all managed under a single network management system . As a low-TCO, high-MTBF, quick-deployment alternative to fiber, Ceragon's wireless platform meets stringent latency and availability requirements while reducing operating costs and expediting the operator's return on investment.



Typical ISP backhaul scenario: point-to-multipoint connectivity (PtMP) for access point aggregation, point-to-point connectivity (PtP) for backhaul to the PoP and enterprise connectivity, and high-power PtP connectivity for rural backhaul

Ceragon's Wireless Solutions

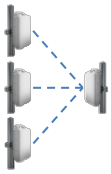
Ceragon boasts the industry's widest range of products that deliver innovative, market-leading wireless backhaul solutions. The solutions support any radio transmission technology, any network topology and any deployment configuration. ISPs can deploy outdoor, indoor and split-mount configurations to suit any scenario, whether long or short distance, or any topology such as chain, ring or mesh. Ceragon's solutions can be remotely provisioned and configured remotely via Ceragon's comprehensive Network Management System.

With high powered radios, the industry's most efficient use of spectrum, stingy power consumption and very high reliability, Ceragon's solutions deliver the highest wireless capacity at the lowest cost of ownership.

Among the range of Ceragon's wireless solutions, several provide a perfect blend of features and capabilities for ISPs.

Access-Point Backhaul and Aggregation

When access technology is short-range, like WiFi, a large number of hot spots need to be spread out among the locations where customers will be using them. The abundance of these access points necessitates an efficient and cost-efficient method of backhauling and aggregating them.



Ceragon offers ***FibeAir 2500***, the point-to-multipoint microwave backhaul solution capable of connecting numerous end-points to a single aggregation point. FibeAir 2500 can operate in licensed or unlicensed frequencies. It can operate at sub-6 GHz frequencies where line of sight is not mandatory making it suitable for street-level installation.

FibeAir 2500 is a small form-factor solution with integrated antennas capable of reaching distances as far as 20 km (13 miles). Each base unit has a total aggregated capacity of up to 250Mbps with up to 100Mbps per subscriber unit. Since the radio operates with TDD technology, the ratio of uplink/downlink capacity is easily configurable enabling efficient backhaul of inherently asymmetrical Internet services. FibeAir 2500 also supports QoS requirements with prioritization by subscriber unit and/or VLAN to ensure committed bandwidth for enterprise customers. FibeAir 2500 is managed under the same NMS as the rest of Ceragon's wireless solutions.

Urban/Suburban Backhaul

For backhaul over short or medium distances, Ceragon offers a range of effective FibeAir IP-20 solutions that boost capacity while lowering the cost per transmitted bit.

In congested urban environments, ISPs can take advantage of light-licensed E-band that offers ultra-high capacity over short distances (~3km/~2mi). Ceragon's ***FibeAir IP-20E*** delivers future-proof, high-capacity connectivity scalable to 1Gbps. Able to work in tandem with the FibeAir IP-20N multi-technology, aggregation node, FibeAir IP-20E can be deployed in comprehensive backhaul and aggregation-point settings offering a cost-effective solution with fast and efficient installation and long-term, reliable operation.

In licensed bands, ISPs can take advantage of the innovative ***FibeAir IP-20C*** high-capacity backhaul solution. Its unique multi-core radio architecture is based on an advanced parallel radio processing engine built around Ceragon's in-house baseband modem and RFIC chipsets. The result is superior radio performance with reduced power consumption and form-factor. IP-20C's second radio can be provisioned to double capacity, double link distance, or employ an east/west configuration using a single box. Its superior system gain can be leveraged to reduce antenna size, lowering installation and leasing costs significantly. FibeAir IP-20C provides up to 1Gbps of pure radio throughput in a single box.

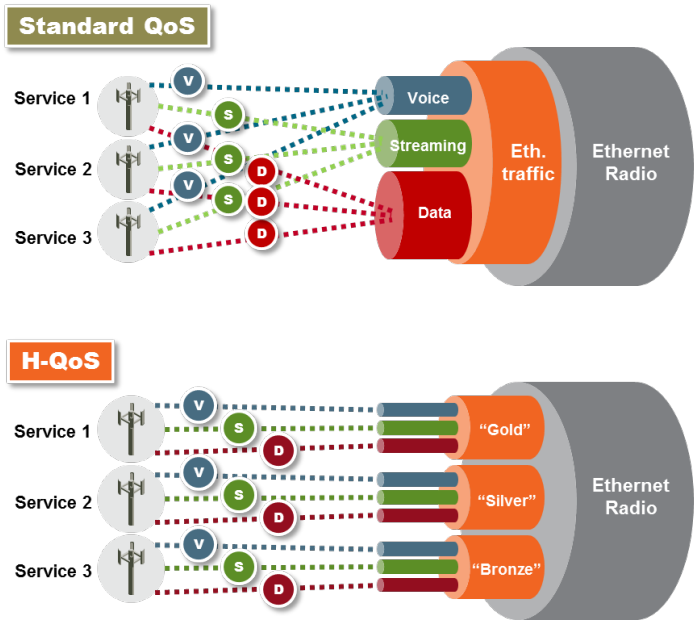
IP-20C's smaller, single-core sibling, the ***FibeAir IP-20S***, is a high-capacity, compact and low-power consuming solution for efficient and cost-effective, all-outdoor backhaul operation. Simple to install and maintain, it is the cost-effective, reliable solution for the hauling of outdoor edge nodes, providing up to 500Mbps of radio throughput in a single box.

Rural Backhaul

For long-distance rural backhaul links, Ceragon extends the reach of its FibeAir IP-20C with its high power version, ***FibeAir IP-20C HP***. Deployable as an all-outdoor trunk or in a split-mount configuration with other IP-20 indoor nodes, IP-20C HP answers the cost challenges of rural environments by extending reach at very low deployment and operation cost. Using innovative mediation devices (which can also be used with IP-20C standard power radios), two IP-20C HP units can be directly mounted to an antenna, giving configurations of up to 4+0 or 2+2 (hardware protection) for up to 2Gbps of radio throughput. As with all FibeAir IP-20s, including those previously mentioned, this solution features intelligent, service-centric management, providing high service granularity and advanced OAM capabilities.

High Service Granularity

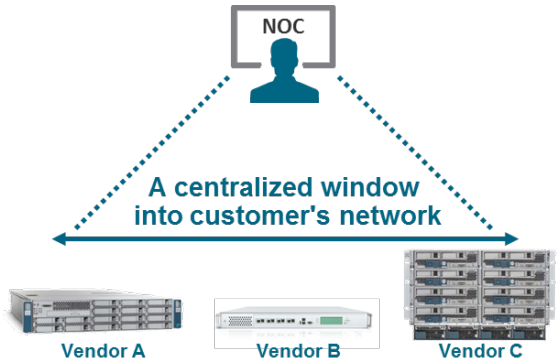
Unique in the microwave market and integrated in IP-20 solutions is the next generation of service-differentiation engines – Hierarchical QoS (H-QoS). It allows the service provider to create a structured quality-of-service architecture in which each service receives TDM-like treatment. For example, the service provider could differentiate between types of users (e.g., best-effort, bronze, sliver and gold SLAs) while assigning a priority to each service within these users (e.g., VoIP, real-time video and data) – thus *hierarchical*. This allows the service provider to assign highly granular prioritization of services while enforcing SLAs and selling premium services. While standard QoS only has 8 priority queues, Ceragon's H-QoS can accommodate thousands.



Hierarchical QoS (H-QoS) extends prioritization of services and SLA assurance

Effective Network Management

NetMaster is Ceragon's comprehensive Network Management System (NMS) designed for managing large and small wireless networks. With NetMaster, ISPs obtain a unified, real-time view of the network to provide continuity of service and achieve uninterrupted flows of traffic and revenue. NetMaster is a single point-of-entry for managing all radios as well as 3rd party network elements such as power supplies, switches, multiplexers and routers using the SNMP protocol. Netmaster provides end-to-end provisioning and management capabilities for fast network build-out and efficient management.



Open SNMP integrated in Ceragon's NMS enables discovery and management of SNMP-based equipment from other vendors

Professional Services

As the #1 wireless hauling specialist, Ceragon not only offers innovative equipment, but also a wide variety of professional services. From network and radio planning, through installation and commissioning, training and maintenance and support services, including execution of complete turn-key projects, Ceragon's vast experience and global presence can expedite network deployment and time-to-revenue while maintaining the network in compliance with SLAs.

Summary

Internet and business service providers are facing significant challenges. Demand for capacity is increasing dramatically while competition and other factors are eating into revenue streams. Innovative wireless networking solutions boost capacity while lowering costs over fiber deployment and leasing alternatives. Ceragon's advanced wireless solutions portfolio addresses capacity challenges while lowering the cost per transmitted bit. They extend reach while improving network flexibility and reliability. Providing a new level of hierarchical quality of service, Ceragon's solutions enable ISPs to create new revenue streams and service level agreements with the ability to differentiate between services and customers.

About Ceragon

Ceragon Networks Ltd. (NASDAQ: CRNT) is the #1 wireless hauling specialist. We provide innovative, flexible and cost-effective wireless backhaul and fronthaul solutions that enable mobile operators and other wired/wireless service providers to deliver 2G/3G, 4G/LTE and other broadband services to their subscribers. Ceragon's high-capacity, solutions use microwave technology to transfer voice and data traffic while maximizing bandwidth efficiency, to deliver more capacity over longer distances under any deployment scenario. Based on our extensive global experience, we deliver turnkey solutions that support service provider profitability at every stage of the network lifecycle, enabling faster time to revenue, cost-effective operation and simple migration to all-IP networks. As the demand for data pushes the need for ever-increasing capacity, Ceragon is committed to serving the market with unmatched technology and innovation, ensuring effective solutions for the evolving needs of the marketplace. Our solutions are deployed by more than 430 service providers in over 130 countries.