Wireless Backhaul for Public Safety Networks
Built Mission Critical

Introduction

Today, public safety communication networks are challenged to expand their scope of functionality beyond what designers initially intended. With new and dynamic information flows driving the transformation of these networks, the impact on public safety communications infrastructure is clear and present. Next-generation mobile technology holds great promise for meeting the new requirements. This paper discusses the challenges of implementing efficient microwave backhaul systems in public safety networks and describes how Ceragon’s specially designated product portfolio can help public safety agencies meet these challenges.

Public Safety Networks

Professional Mobile Radio (PMR) public safety networks (TETRA is a commonly employed PMR specification) are in the process of evolving from application-specific networks into converged, multi-application and multi-agency wide-area networks, scalable to support any volume of activity from day-to-day operations through planned major public occasions like sports events and political conventions. Collaboration among cooperating agencies is critical when faced with inter-agency communication challenges, requirements for operational flexibility, and pressure to reduce and share costs.

The advent of next-generation wireless protocols will dramatically transform mission-critical public safety communications. 4G/LTE is poised to be the harbinger of change and is expected to enable public safety agencies to supplement critical voice and data services with enhanced multimedia applications as they promote interaction between narrowband public safety applications and 4G broadband networks. The US Congress recently passed a law allocating frequencies solely for the use of public safety LTE initiating a project to build out a nation-wide network. The European Union and other governmental organizations have their own similar initiatives.

Employing a technology architecture developed specifically for mobile broadband services, next-generation communication networks will allow public safety network planners to provide a collaborative infrastructure that augments existing narrowband networks. Public safety organizations will be able to support bandwidth-intense, rich-media applications while providing
unprecedented speed and guaranteed capacity with low latency to first responders and law enforcement personnel.

Integrated communication services that span wireless and fixed voice, video and data services will allow police, EMS, fire departments, municipal and welfare services to communicate in emergency situations over a unified infrastructure using disparate virtual networks. The 4G/LTE network infrastructure will blur jurisdictional boundaries and provide cross-jurisdictional interoperability resulting in streamlined and efficient responses to emergency situations.

Typical public safety backhaul network scenario

Public Safety Backhaul Network Challenges and Requirements

*High availability, reliability and resiliency:* Public safety networks are inherently mission-critical as would be expected when dealing with human lives. Therefore, backhaul systems transmitting critical information from the field need to be always-on, resilient and reliable. This translates into technical requirements such as high system gain (signal strength), high MTBF, equipment redundancy, and resilient network topologies (e.g., rings). High system gain also allows for longer links or, alternatively, for smaller antennas to be deployed to reduce tower load and leasing expenses.
**Differentiated services:** The use of a common infrastructure for different agencies requires a method of control over quality of service (QoS) and dynamic provisioning of services according to different scenarios. Separation is also required between an agency’s operational network—PMR, situational awareness, forensic data access—and its administrative network—e-mails, internet access, data backup. The QoS engine should be tightly integrated with the microwave equipment in order to cope with changing link conditions that affect link capacity and prioritization of traffic.

**Ultra-low latency:** Mission-critical information, especially in emergency situations, must be delivered in real-time. Therefore, low latency is needed from all network equipment and particularly the transport network.

**Future-ready while supporting legacy:** During the long migration phase to LTE networks, PMR and LTE services will co-exist in base stations. Therefore, backhaul networks need to be flexible in the sense that they will be able to support both native TDM and native Ethernet services in the migration phase with the ability to smoothly migrate to all-Ethernet networks in the future with continued support for leftover TDM services.

**Ceragon’s Public Safety Backhaul Solutions**

Ceragon designed its portfolio of wireless backhaul products to address the requirements of forward-thinking public safety organizations. Ceragon’s product line provides microwave backhaul solutions that can be deployed within converged multi-agency public safety networks. As a low-CapEx, quick-deployment alternative to fiber optics, Ceragon’s microwave platforms meet stringent latency and availability requirements while reducing operating costs.

**PMR and future LTE base-station backhaul**

Ceragon’s *FibeAir IP-10G* solution can be used to deploy LTE-ready networks that offer high capacity, low latency, and support for an all-packet architecture, as well as a hybrid architecture of packet-with-native-TDM services (or TDM over pseudowire), in an all-indoor compact solution. It operates at licensed frequencies from 6 to 42 GHz and supports capacities of up to 1Gbps per carrier. Let’s take a closer look at the solution:

- **Availability:** Public safety networks require *always on* communication. IP-10G’s exceptionally high system gain ensures a robust link that can maintain high availability for
longer link spans with smaller antennas. The Adaptive Coding and Modulation (ACM) mechanism makes sure that links stay up and running even under harsh weather conditions. Coupled with multiple radios and networking protection schemes, FibeAir IP-10G delivers an always-on radio link. Both standard and high-power radio units allow deployment in any geographical scenario, be it urban or rural.

- **Reliability:** FibeAir IP-10G provides an unrivaled reliability benchmark with radio MTBF of 110 years. Ceragon radios are designed in-house and employ cutting-edge technology with unmatched production yield. This results in minimized network downtime (as required from mission critical networks), as well as reduction in expenditure due to fewer spare parts and infrequent maintenance and troubleshooting.

- **Resilience:** FibeAir IP-10G’s 1+1 protection configuration has the highest level of redundancy with its no-single-point-of-failure design, starting from a redundant power feed all the way through redundant interface ports, management modules, Ethernet switches, TDM cross-connects and radio units, up to Ethernet and TDM line protection and various radio diversity schemes.

- **Low latency:** Microwave technology inherently presents lower propagation delay than fiber since the signal travels through the air and not through optical fiber that slows it down. Moreover, compared to other microwave products, FibeAir IP-10G boasts ultra-low latency features that are essential for next-generation public safety network deployments, assuring real-time communications for mission critical applications. Ultra-low latency also translates into longer radio chains, broader radio rings and shorter recovery times.

- **Quality of service (QoS):** FibeAir IP-10G uses a latency-optimized radio design employing sophisticated QoS capabilities. It offers prioritized traffic handling that encourages differentiation of services and guarantees bandwidth and latency for mission-critical services. Critical services can be prioritized over less critical services.

- **Flexibility:** While TDM-based PMR traffic is still prevalent, FibeAir IP-10G supports native transmission of TDM traffic alongside advanced Ethernet traffic for data applications. Using the same hardware (with minor software re-configuration which can be performed remotely), the radio can be configured to transmit all-Ethernet traffic for future LTE deployments. At the end of the migration phase, where individual cases will still demand support of legacy TDM services, these will be transmitted over Ethernet using Ceragon’s unique **Smart TDM Pseudowire** while maintaining the same physical TDM interface, thus retaining TDM service continuity. This kind of flexibility gives the customer hassle-free migration through all migration phases while avoiding up-front investment in future needs.
**Backhaul based on sub-6 GHz frequencies**

The physical qualities of frequencies below 6 GHz allow communications which do not require a line-of-sight between antennas. For the kind of deployment in which an antenna line-of-sight is not a viable option, Ceragon offers the **FibeAir 2000**, a point-to-point microwave backhaul solution which operates in sub-6 GHz licensed and unlicensed bands. Supporting aggregated capacities of up to 200Mbps, hybrid TDM and packet, as well as all-packet setups, QoS, and 1+1 protected configurations, FibeAir 2000 is the optimal solution for non-line-of-sight public safety backhaul scenarios or areas where commercial microwave spectrum (6-42GHz) is congested. FibeAir 2000 is managed under the same comprehensive network management system (NMS) as the rest of Ceragon’s microwave solutions.

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**About Ceragon**

Ceragon Networks Ltd. (CRNT) is the #1 wireless backhaul specialist. We provide innovative, flexible and cost-effective wireless backhaul 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, Ceragon delivers 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 serve 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.