Wireless Backhaul for Public Safety Networks

Built Mission Critical

Introduction

Today, public safety communication networks are challenged to expand their existing 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.

Background

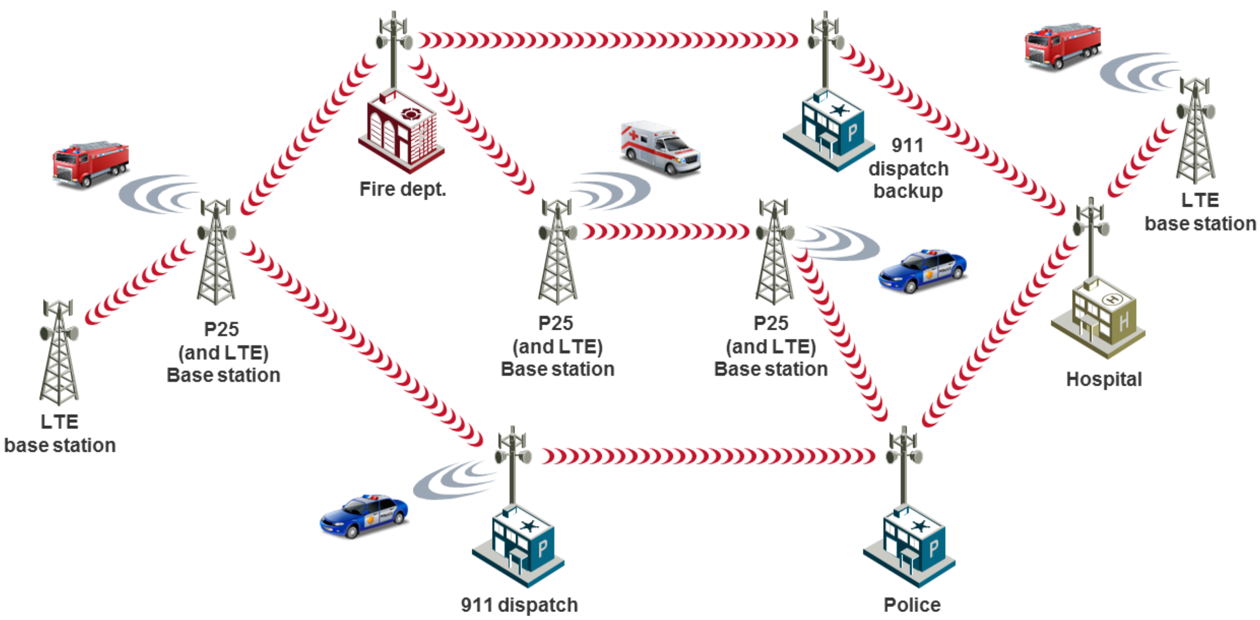
Land Mobile Radio (LMR) public safety networks are in the process of evolving from application-specific networks into converged, multi-application and multi-agency wide area networks, scalable to support any volume of activity from day-to-day operations through planned major events like sports, and political 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. 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 allow interaction between narrowband public safety applications and 4G broadband networks. The U.S. Congress has even recently passed a law allocating the D-block of the 700MHz frequency band solely for public safety LTE deployments.

Employing a technology architecture developed specifically for mobile broadband services, next-generation communication networks will allow public safety 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. Moreover, a 4G/LTE network infrastructure will blur jurisdictional boundaries and provide cross-jurisdictional interoperability resulting in a streamlined and efficient response 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 to be deployed or alternatively for smaller antennas to be used (reducing 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 (LMR, 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 which affect link capacity and prioritization of traffic.

Ultra-Low Latency: Mission-critical information, especially in emergency situations, must be delivered in real-time, and 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, LMR and LTE services will co-exist in the 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 support for leftover TDM services).

Compact Form-Factor: As public safety agencies need to host multiple communication systems of different purposes and generations, physical footprint in their communication equipment shelters is limited. Therefore, new communications equipment introduced to them should be of a compact form-factor, taking up minimal rack space.

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.

P25 and future LTE base-station backhaul

Ceragon's ***Evolution IP-10G Compact Long Haul*** (CLH) product 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 of 6, 7, 8 and 11 GHz as well as in the 5.8GHz unlicensed frequency, 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 CLH'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, Evolution IP-10G CLH delivers an always-on radio link.

- ***Reliability:*** Evolution IP-10G CLH 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. Important resulting advantages are reduction in capital expenditures due to fewer spare parts required for roll-out, and reduction in operating expenditures as maintenance and troubleshooting are infrequent.

- ***Resilience:*** Evolution IP-10G CLH'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 which slows it down. Moreover, Evolution IP-10G CLH boasts ultra-low latency features (compared to other microwave products) 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):*** Evolution IP-10G CLH 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.

- ***Flexibility:*** Nowadays, when TDM-based LMR traffic is still prevalent, Evolution IP-10G CLH supports native transmission of TDM traffic alongside Ethernet traffic for data applications. Using the same hardware (with minor software re-configuration which can be done 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.

- ***Compact all-indoor form factor:*** IP-10G CLH was designed with a small footprint and simple maintenance in mind. 1+0 links can be implemented in a 2RU (rack unit) form-factor including the baseband unit and the radio unit, while 1+1 links need only 3RU. This makes IP-10G CLH one of the most compact solutions in the microwave industry.

New LTE Deployments

Since LTE frequencies will be higher than most LMR frequencies, their area coverage is expected to be lower than that of LMR necessitating deployment of new base stations in order to cover the same area. For these new sites, where TDM support will not be needed, an even more compact solution is available. The ***Evolution IP-10Q CLH*** is an all-Ethernet solution supporting up to four carriers in a 1RU baseband unit. It features similar capabilities as the Evolution IP-10G CLH solution (availability, reliability, resilience, low latency, QoS) while being more compact, allowing a 1+1 configuration in only 2RU, and a 2+2 configuration in only 3RU for sites which aggregate numerous LTE base-stations and need to support very high capacity.

Backhaul Based on the 4.9 GHz Public Safety Band

In 2003, the FCC allocated a 50MHz bandwidth in the 4.9GHz spectrum band (4.940-4.990 GHz) for licensed deployment of public safety wireless communications networks. The physical qualities of this frequency band allow communications which do not require a line-of-sight between antennas. For this 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 the 4.9GHz public safety band and other 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 (6-11 GHz) is congested. FibeAir 2000 is managed under the same network management system (NMS) as the rest of Ceragon's microwave solutions.

About Ceragon

As the world's #1 wireless backhaul specialist, Ceragon Networks (NASDAQ: CRNT) ensures that mobile and fixed-line carriers as well as private network operators, have the transmission capacity to deliver the voice and premium data services that we all rely on. Ceragon's commitment to research and development allows us to develop generation after generation of innovative solutions for our customers. With unmatched technology that increases capacity while lowering cost, Ceragon's advanced microwave systems allow wireless service providers to evolve their networks effectively from circuit-switched and hybrid concepts to all-IP networks. Ceragon's solutions are designed to support all wireless access technologies, delivering more capacity over longer distances under any given deployment scenario. Ceragon's solutions are deployed by more than 430 wireless service providers of all sizes, and hundreds of private networks in more than 130 countries. Visit Ceragon at www.ceragon.com.