Wireless Backhaul for Evolving Public Safety Networks

Introduction

Public safety communication networks are challenged to expand their scope way beyond their original functions. With accelerating information flows and 24/7 availability driving the transformation of these networks, the impact on public safety communications infrastructure is enormous and immediate. Next-generation mobile technology is the key for meeting the new swell of requirements. This paper discusses the challenges of implementing efficient microwave backhaul systems using mobile standards for public safety networks and describes how Ceragon's designated solutions portfolio can help public safety agencies meet their challenges.

Background

Public safety agencies increasingly rely on mobile computing and network applications to improve the efficiency of public safety personnel and first responders. Today's public safety personnel are equipped with tablets, handheld computers, and mobile video cameras to improve their efficiency and to allow them to collaborate instantaneously with central command and coworkers. Unattended sensors and video surveillance cameras extend the eyes and ears of public safety agencies.

The need to access and share this vital new flow of communications is driving the deployment of metropolitan and regional networks that can maintain contact with highly mobile first responders. These high-reliability networks must deliver large volumes of information cost-effectively as they transmit real-time video, voice and data.

Emergency services and other agencies involved in public safety, require highly secure and reliable communications networks. In emergency situations, low-latency capability is crucial to overcome any delays in information delivery. Frontline communications are usually wireless, while radio access points demand high-capacity backhaul across secure links for effective operation in emergencies.

Today's 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. These networks need to be highly scalable to support any volume of activity - from day-to-day operations, to planned major events like sports and political conventions. Collaboration among

agencies is critical when faced with inter-agency communication challenges, requirements for operational flexibility and pressure to reduce and share costs.

Next-generation wireless standards can dramatically transform mission-critical public safety communications. Long Term Evolution (LTE), the emerging international 4G mobile standard, holds the key for public safety agencies to supplement critical voice and data services with enhanced data-rich applications. LTE facilitates cost-effective interaction between today's narrowband public safety applications and mobile broadband network. Employing a network architecture developed for mobile broadband services allows public safety planners to provide a collaborative infrastructure that augments their current narrowband networks.

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, 4G/LTE network infrastructure will provide cross-jurisdictional interoperability, resulting in a streamlined and efficient response to emergency situations.

In order to aid this transition, the U.S. Congress has recently passed a law allocating the D-block of the 700MHz frequency band solely for public safety LTE deployments. Further legislation has created the "First Responder Network Authority" ("FirstNet"), to provide emergency responders with a high-speed, nationwide network dedicated to public safety (the "Public Safety Broadband Network" or "PSBN"), and backed by $7 billion of federal funding.
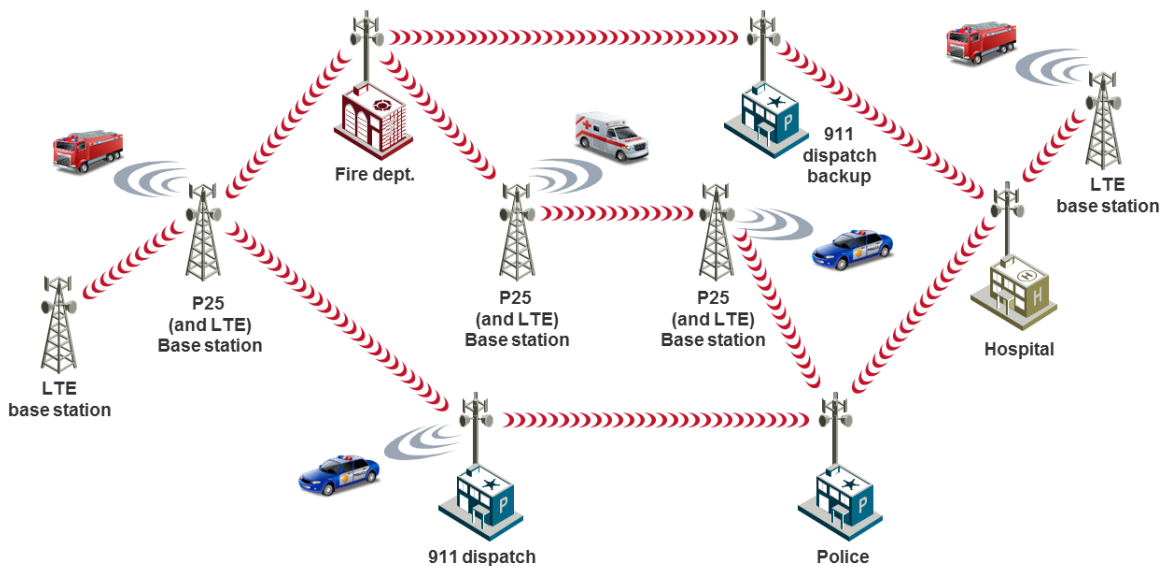
Public safety backhaul network scenario

Public Safety Backhaul Network Challenges and Requirements

High capacity: While LMR networks needed to support only narrowband voice communications, the shift to LTE and the need for support of bandwidth-hungry data applications necessitates high capacity communications, from hundreds of Mbps at the network edge, and up to Gigabit capacities at aggregation sites.

High availability, reliability and resiliency: Public safety networks are inherently mission-critical as would be expected when dealing with human lives, property and emergency situations. Therefore, backhaul systems transmitting critical information from the field need to be resilient and reliable. This translates into technical requirements such as extraordinarily high MTBF with equipment redundancy and resilient network topologies. High system gain allows for longer links to be deployed or alternatively for smaller antennas to be used (reducing tower load and leasing expenses).

Powerful signal strength: High transmit power allows for deployment of longer links and the use of smaller antennas reducing capital expenditure, tower load, leasing expenses and maintenance costs.

Differentiated services: The use of a common infrastructure for collaborating agencies requires a regimen of effective control over the quality of service (QoS) and dynamic provisioning of services by scenario. 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 wireless backhaul equipment in order to cope with dynamic link conditions which affect capacity and prioritization of traffic.

Ultra-low latency: Mission-critical information flows, especially in emergency situations, must be transmitted in real time with no hesitation. Low latency is required from all network equipment and interacting with and all the way through the transport network.

Future-ready while supporting legacy: During the migration phase from today's networks to LTE, legacy LMR and new LTE services will co-exist in the base stations. Backhaul networks will need to be flexible to support simultaneously TDM and Ethernet in the migration phase. Over time, they will need to migrate smoothly to all-Ethernet with support for remaining TDM services.

Compactness: Since the wide variety of public safety agencies already host communication equipment of various purposes and generations, the physical footprint in their communication equipment shelters can already be substantial. The new communication equipment added to these systems as the networks are migrated forward must be compact taking up minimal rack space and requiring little power for operation.

Security: With the proliferation of cyber terrorism and crime, public safety networks are constantly in the sights of domestic and foreign adversaries, and sophisticated criminal elements. Networks must be secure at all levels, from protected management interfaces that block access from unauthorized users, to payload encryption that ensures that mission-critical data cannot be collected or altered by hostile forces.

Ceragon's Public Safety Backhaul Solutions

Ceragon designed its portfolio of wireless backhaul solutions to address the requirements of forward-thinking public safety organizations. Ceragon's products provide microwave backhaul solutions that can be deployed to support public safety operations as multi-agency public safety networks converge. 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 LTE base station backhaul

Ceragon's *FibeAir® IP-20A* can be used to deploy LTE backhaul networks that offer high capacity, low latency, and support for a hybrid architecture of packet and legacy TDM services as well as a smooth migration to all-packet architecture, in an all-indoor, compact solution.

- *Capacity:* Operating over licensed frequencies of 6, 7, 8 and 11 GHz, as well as in the 5.8GHz unlicensed frequency, FibeAir IP-20A supports an industry-leading 1Gbps of radio throughput per channel.

- *Availability:* Public safety networks require *always on* communications. FibeAir IP-20A's exceptionally high transmit power ensures a robust link that maintains high availability for longer link spans with smaller antennas. Its Adaptive Coding and Modulation mechanism makes sure that links maintain connection even under harsh weather conditions. With its multiple radios and extensive networking protection schemes, FibeAir IP-20A delivers an always-on radio link.

- *Reliability:* FibeAir IP-20A provides an unrivaled reliability benchmark with radio MTBF of over 100 years. Ceragon radios are designed in-house and employ cutting-edge technology with unmatched production yield. Public safety authorities enjoy reduced capital expenditures due to fewer spare parts required for roll-out and lower operating expenditures as the equipment requires infrequent maintenance.

- *Resilience:* FibeAir IP-20A's protection configuration has the highest level of redundancy. Its no-single-point-of-failure design—starting from a redundant power feed, through redundant

interface ports, management modules, Ethernet switches, and radio units, and up to Ethernet and TDM line protection with various radio diversity schemes—delivers a network that can cope well with environmental challenges.

- *Ultra-low latency:* Microwave technology inherently presents lower propagation delay than fiber. Compared to other microwave products, FibeAir IP-20A 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:* FibeAir IP-20A uses a latency-optimized radio design employing sophisticated Hierarchical QoS (H-QoS) capabilities. It offers prioritized traffic handling with higher granularity than that of standard QoS, providing a fine differentiation of services between agencies and applications and guaranteeing bandwidth and latency for mission-critical services.

- *Flexibility:* While TDM-based LMR traffic is still prevalent, FibeAir IP-20A supports transmission of TDM traffic alongside Ethernet traffic. Using a single hardware design, the radio can be remotely configured to transmit all-Ethernet traffic for future LTE deployments. This kind of flexibility gives the customer hassle-free migration through all phases, while avoiding up-front investment in future needs.

- *Compact all-indoor form factor:* FibeAir IP-20A was designed with a small footprint and simple maintenance in mind. 1+0 and 1+1/2+0 links can be implemented in 2RU (rack units) including the baseband unit and the radio unit, while 2x(1+1/2+0) links require only 3RU. This makes FibeAir IP-20A the most compact high-power solution in the microwave industry.

- *Security:* FibeAir IP-20A is endowed with multiple layers of protection. With intercept-resistant, narrow-beam microwave communications, secure authentication and management, and unbreakable AES-256 payload encryption, FibeAir IP-20A delivers highly secure, dependable, eavesdrop-free communications.

New LTE Deployments

Since LTE radio frequencies will be higher than most LMR frequencies, their area of coverage will be lower than that of LMR, necessitating deployment of new base stations to cover the same area. For these new base station sites, where all-outdoor installation is feasible, **FibeAir IP-20C HP** is the optimal, low-cost solution for efficient, reliable and secure LTE backhaul. It features similar capabilities as the IP-20A variant (capacity, availability, reliability, resilience, low latency, Hierarchical QoS, flexibility, security) while breaking records for compactness. Its unique MultiCore architecture enables transmission of up to 1Gbps radio throughput over a single channel in a single all-outdoor box with extremely low power consumption.

Backhaul based on the 4.9 GHz public safety band

In 2003, the FCC allocated 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 band allow communications which do not require a clear line-of-sight between antennas. Ceragon provides advanced solutions especially for such situations. For deployments where line-of-sight is not viable, Ceragon offers **FibeAir 2000**, a leading point-to-point microwave backhaul solution which operates effectively in the 4.9GHz public safety and other sub-6 GHz licensed and unlicensed bands. It supports aggregated capacities of up to 200Mbps for TDM, hybrid TDM and all-packet transport, and supports QoS and 1+1 protected configurations. Its non-line-of-sight capabilities provide a perfect solution where commercial microwave spectrum (6-11 GHz) is too congested or not available. FibeAir 2000 is managed under the same network management system as the rest of Ceragon's microwave solutions providing easy operation and maintenance.

Point-to-multipoint communications in the 4.9 GHz band, for applications like "safe city", border patrol and video surveillance are also possible using **FibeAir 2500**, Ceragon's PtMP, hub-and-spoke radio, offering up to 50Mbps throughput per subscriber unit and 250Mbps throughput per base-station unit. It can also be used in mobile scenarios, where a subscriber unit is located on a vehicle and communication is handed over automatically between base-station units.

Summary

Public safety communication networks are expanding rapidly. Taking advantage of next-generation LTE mobile network standards while supporting current operations, Ceragon's FibeAir IP-20A, FibeAir IP-20C HP and FibeAir 2000/2500 provide the cost-effective solution to integrated and responsive public safety operations.

About Ceragon

Ceragon Networks Ltd. (NASDAQ: CRNT) is the #1 wireless backhaul 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, 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 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.