A Comparison of Private and Shared-Public Radio Networks in Electric Utility System Distribution Automation Applications

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The Trend from Private to Shared-Public Networks

Electric utilities in the United States have historically relied on private radio networks utilizing Multiple Address System (MAS) radios for distribution automation applications. These radios operate on licensed frequency pairs, typically on VHF and UHF frequencies.

In the 1990s, many electric utilities began to migrate to private radio networks utilizing unlicensed, spread-spectrum radios. These radios operate in the ISM (Industrial, Scientific, and Medical) band that utilizes frequencies in the 902 MHz to 928 MHz range.

Spread-spectrum radio, originally developed by the United States military, allows multiple users to simultaneously share a radio band. Some spread-spectrum radios communicate on a peer-to-peer basis. Others provide a point-to-point link between field devices or point-to-multipoint from a master station to the field devices.

But some utilities—concerned about the cost of operating and maintaining private radio systems—migrated instead to shared-public cellular telephony or cellular digital packet data (CDPD) for control and SCADA applications. Cellular modems in large quantity are much less costly than most radios (typically half the cost of a spread-spectrum radio). And enterprise-level service rates can be very low. Cellular service, further, promised an inexpensive way to provide coverage in rural areas.

Cellular service has, however, demonstrated some significant shortcomings, including coverage, availability, and reliability issues. Cellular systems can (and have) collapsed due to heavy call volume during emergencies (most notably the attacks of September 11, 2001). And cell towers often lack adequate backup power during outages, leading to dropped calls. Cellular providers, furthermore, have abandoned CDPD or are in the process of upgrading to 3G technology (true digital voice and data) . . . forcing customers to purchase costly hardware upgrades.

Automation Projects and the Smart Grid Have Changed the Direction . . . Back to Private Networks

Distribution automation and the Smart Grid have created an increased demand for bandwidth, speed, and security in utility radio networks. These applications can involve hundreds or thousands of devices.

Smart Grid applications such as an IntelliTEAM II® Automatic Restoration System or a Distribution VAR Management System significantly increase data traffic requirements, as devices are constantly communicating with each other regarding status, analog information, load information, etc.

In an IntelliTEAM II System, for example, each team member is updated two or three times a minute. Cellular systems are not suitable for such high-traffic, real-time-based applications since service rates for unlimited data traffic are prohibitively expensive.

Cellular systems, furthermore, are not self-healing—a major goal of the Smart Grid. Each cell tower represents a single point of failure. Upon loss of a cell tower, it's unlikely that a modem will be able to establish connection to an alternate tower; cellular systems are not designed to provide such redundancy. And the aforementioned lack of adequate backup power for many cell towers compromises the availability of cellular systems for mission-critical applications.

Cellular providers are predominantly focused on the consumer market, which generates the majority of their revenue, rather than relatively low-revenue-producing industrial applications like distribution automation.

As a point of information, S&C evaluated cellular systems for use in IntelliTEAM II applications. Although IntelliTEAM II can operate on such networks, the results were not favorable. The long message latencies (500 to 1500 milliseconds) and frequent dropped connections significantly affected restoration times. Such long latencies cannot be readily remedied since there's no possibility of adding repeaters.

For these reasons, some regulatory bodies have now mandated that utilities employ private radio systems for these applications, just like emergency services.

SpeedNet Radio Is Ideally Suited for the Smart Grid

S&C recognized that the Smart Grid would bring even greater demand for bandwidth, speed, and security and, in response, recently introduced the S&C SpeedNet™ Radio. SpeedNet Radio operates in the unlicensed 902- to 928-MHz range. It vastly improves the performance of private radio systems by combining extremely long-range communication, high-volume data transmission, and flexible mesh networking.

S&C SpeedNet Radio.

SpeedNet Radio offers the high bandwidth (650 kbps) and low latency (5 ms per hop) essential for distribution automation and feeder protection applications. SpeedNet Radio permits even faster restoration times . . . as low as seconds. Such low restoration times will likely be mandated in the future by regulatory bodies.

SpeedNet Radio provides the self-healing performance essential to the Smart Grid. It automatically builds a routing table that defines message paths. If a node is lost, a new path is quickly established, ensuring reliable transmission.

SpeedNet Radio provides better asset utilization too. It offers assignable message priority, making it suitable for backhaul applications in an Advanced Metering Infrastructure.

SpeedNet Radio additionally offers multi-level security. Its frequency-hopping spread-spectrum transmissions are inherently difficult to intercept and jam. Its 10-millisecond dwell time on a frequency is 60 times shorter than other systems, making each transmission less susceptible to interference. MAC address filtering denies network access to unauthorized radios, and AES 128-bit encryption protects mission-critical data.

IP-based addressing and an Ethernet interface make it easy to integrate SpeedNet Radio in a LAN or WAN.

Other SpeedNet Radio features include over-the-air configuration and software updates, battery back-up, and multi-level administrative passwords.

No one knows what the Smart Grid will require three, five, or ten years from now. But SpeedNet Radio will be able to handle the challenge, whatever it may be.