PAPER

AVIAT NETWORKS

FOUR RECOMMENDATIONS FOR FIRSTNET BACKHAUL

Opt-in or opt-out to the FirstNet plan is the most momentous decision the states will make about public safety in the coming years. They're charged with making a well-informed decision, based on a clear understanding of the pros and cons of both FirstNet and alternative proposals. While the financial model is obviously critical, operators must also give technical design serious consideration, since only a sound architecture can ensure that the network operates as needed to deliver mission critical communications to first responders.

In the context of this process, it's clear that the cost and reliability advantages of microwave will play a huge part in the FirstNet network. To that end, states will do well to follow the four recommendations in this paper to ensure their investment in network architecture and solutions best fits the needs of their first responders.

1. MICROWAVE COMPLIMENTS FIBER FOR MISSION CRITICAL, LTE-PROVEN TRANSPORT

Only microwave and fiber can meet the capacity needs of public safety LTE. Use the following parameters to make the best selection.

Capacity. Scaling to 2 Gbps or more, microwave meets the capacity needs of LTE. That's why mobile operators use it. They've deployed microwave LTE networks on rings and aggregation nodes, supporting well over ten three-sector base stations on a single microwave link.

Cost. Microwave has always been the most proven choice for public safety mission-critical networks. It's more cost effective, more reliable, and deploys easier and faster than fiber. A ten-year total cost of ownership (TCO) analysis shows that compared to leasing existing fiber or building new fiber, microwave offers at least a 50 percent savings.

Reliability/Survivability. Recent storms in the U.S. have shown the reliability of microwave. More than 25 percent of mobile sites failed during Hurricane Sandy, and while backhaul was not the only reason for site failure, it was a significant contributor and there were no microwave-related outages reported in this storm.

Note: The first thing mobile operators do when their fiber fails is to install microwave radios. This restores cell site backhaul immediately. Current public safety network operators use almost all microwave and suffered no outages during Hurricane Sandy.

Speed to Market. Microwave enables rapid deployment of wireless networks. New fiber builds can be very time consuming and historically prone to schedule delays—especially problematic in rural areas.

2. INVEST IN THE RIGHT MICROWAVE RADIOS UPFRONT

One of the most limiting FirstNet challenges is CAPEX spend. However, reliability demands that the backhaul network be protected, diverse, and impervious to drastic weather conditions. OPEX spend is also an issue. The configuration you choose needs to balance cost and reliability.

THERE ARE THREE OPTIONS FOR MICROWAVE CONFIGURATIONS:

- All indoor. Electronics mounted indoor and waveguide up to the antenna on the tower.
- Split mount. RF-electronics-only on the top of the tower, IF/baseband electronics mounted indoor, and shielded cable running down the tower.
- All outdoor. Electronics mounted at the top of the tower and Cat 5 cable or fiber running down the tower.

GENERAL GUIDES FOR CHOOSING

In a nutshell: All indoor has the highest performance, reliability, and cost. All outdoor has the lowest performance, reliability, and cost. Split mount typically offers a middle choice in all categories.

Reliability vs. cost. In some cases, network reliability is clearly more crucial. Examples include rural or inaccessible locations, aggregation sites, high-density-response sites, and towers that can't be climbed during long winter periods. In these cases, a higher investment in reliability makes sense. In other cases, CAPEX savings makes more sense. Two common examples are single-site connections and easily accessible roof-top locations.

Tower considerations. For overloaded towers, adding larger antennas may not be an option. All-indoor radios offer the ability to deliver high power levels (up to +39dbm), enabling use of much smaller antennas, or even Class B antennas, with greater savings yet. This choice can eliminate the need for tower modifications or new towers.

Frequency coordination. All-indoor radios with antenna coupling units (ACUs) and high-precision filters enable frequency coordination in congested bands, such as 6 GHz and 11 GHz, in some locations. This would not be possible with diplexer-based split-mount or all-outdoor radios.

THE ARGUMENT FOR ALL INDOOR

Future proofing the backhaul network should be a top priority in any decision process. Services make up a large part of the operating expense of microwave. Tower climbs and antenna installation and alignment are the largest pieces of that. If they can be eliminated or minimized, operating costs go way down.

While all-indoor radios cost more, they're cheaper to expand and more easily serviced, for several reasons:

- For all indoor, there's only a waveguide and an antenna up on the tower. To add channels, service personnel simply go into the cabinet and add an RF unit. With an outdoor radio, the operator has to pay for a tower climb, which can cost as much as $10,000.
- For all outdoor, when a new outdoor RF unit is added, the antenna may have to be swapped out for a larger one, due to new signal loss from combined radio channels on the tower.
- In addition, mission-critical indoor radios can include low-loss expansion ports to allow easy addition of extra radios. Consider paying more upfront with all-indoor radio. As capacity grows, you save more and more money.
- For split-mount radios, an effective configuration is to install a dual polarization antenna, but use only one polarization at startup. This allows for the addition of another radio without upsizing or adding a second antenna. A tower climb is required, but the even higher cost of upgrading the antenna is prevented.
- For all-outdoor radios, use a radio that can carry two channels, with link aggregation. The second channel can be enabled in software and thus will not typically require a tower climb. This is a very cost-effective means of capacity growth.

Conclusion:
When you consider the above factors, all-indoor radios are often the best choice for mission-critical public safety networks and mobile LTE networks. But specific characteristics determine the optimal radio configuration at any one site.

3. ENABLE SECURITY ON YOUR MICROWAVE NETWORK

FirstNet places strict security requirements on network elements. Any radios deployed under this program must enable the following security capabilities.

SECURE MANAGEMENT

Management of the microwave platform should be secured and comply with FIPS 140-2 Level 2. Secure management solutions need to provide flexibility and the security needed for microwave transmission management. They also need to protect from unintentional misconfiguration of the radio network. With secure management, messages sent from the network operations center (NOC) to the radio are protected and not subject to compromise or spoofing by an unauthorized user to damage traffic.

PAYLOAD ENCRYPTION

Microwave radios should support encryption on both data and management payloads. Payload encryption protects wireless communications from eavesdroppers.

Eavesdropping equipment or sniffers between links or near the transmitter will only see garbled transmissions.

INTEGRATED RADIUS CAPABILITY

For an additional level of protection, the microwave platform needs to integrate RADIUS capability into existing IT infrastructure. Integrated RADIUS client capability and centralized AAA domain server capability are supported for remote authentication, authorization, and accounting, for an extra level of security for the network.

4. LOOK TO LOCAL, MADE IN USA EXPERTS

Designing an LTE backhaul network is always a challenge. CAPEX and OPEX limitations make the selection even more difficult. However, those challenges pale in comparison to the demands of designing and implementing a public-safety-grade network. When failure is not an option —when outages are measured not in revenues lost, but in lives lost—it's critical to select a microwave network provider with demonstrated excellence in these areas.

Look for providers that can deliver effective solutions in demanding conditions and whose networks have survived the test of time. Has the network provider's solutions stood strong under extreme conditions, such as hurricane rains and winds? Does the provider have a record of designing long-haul networks with attention to the unique environmental conditions of each link? A network provider that knows how to steel the network for these conditions means that your network will adapt to conditions and reliably deliver needed services and performance.

Site-specific variations offer unique challenges that can only be overcome by innovative thinking and product selection. Can we use Class B antennas to address tower-loading issues? Can we use unlicensed 5.8 GHz to provide frequency diversity solutions in spectrum congested environments? What tradeoffs are possible among high-power radios, spatial diversity, and a second antenna?

Aviat radios are designed, built, and supported within the USA. A long nationwide presence includes corporate headquarters, an R&D center, manufacturing, and full deployment services and after-sales support in all fifty states. With more than 70 years of USA-based expertise, you can be confident solutions will include an understanding of your unique requirements, superior products, and comprehensive support for all your mission-critical needs.

See our white paper, "SMALLER ANTENNAS WITH EHP," for a real life example of innovative thinking that led to cost-effective solutions.

EXAMPLES OF FIRSTNET-READY NETWORKS

Aviat Networks has been working with customers to ensure that the networks they install are built with the lowest cost upgrade path to support the capacity, reliability, and security demands of FirstNet.

The state of Colorado, Nevada, West Virginia, New Mexico, and Oregon have deployed leading-edge microwave designs, following the four recommendations in this paper. These networks include some or all the following attributes:

- Microwave is the majority transport technology
- Use of scalable all-indoor radios that allow for cost-effective future capacity expansion to support LTE
- Microwave capacity in excess of 380 Mbps per link today, with expansion capabilities
- Dual polarization on antennas and waveguides are deployed upfront, to ensure low-cost future capacity growth
- High-performance, filter-based, all-indoor radio designs and high-performance antennas are used to ensure easy clearance of new frequency channels in 6 GHz and 11 GHz bands, again, supporting capacity growth
- All radios are equipped with a strong security feature set, which is already enabled or easily enabled via a license key
- Towers and shelters have been upgraded where required and where possible, to support for new LTE equipment

HERE COMES FIRSTNET

Public network operators are about to make some big decisions and are looking for the best information, guidance, and service from network providers. The best way to build a cost-effective, FirstNet-capable network is to leverage existing assets, use skilled, creative network designers, and select the best equipment options. Microwave will play a large role in this process and in the nation's FirstNet network.

Aviat Networks research shows that public safety operators can save up to 80 percent off the cost of a new microwave network by reusing existing infrastructure. Cost-sensitive operators in every state will be looking to repurpose as many installed microwave assets as possible for the nationwide public safety network. And they'll be looking to make wise decisions that result in both cost-effective and high-performance mission-critical network.

To this end, look to experts who have addressed the challenges presented here many times over and have a strong track record of delivering on your critical objectives—on budget and on time.

For more information on how Aviat Networks can help with FirstNet backhaul planning, please contact marketing@aviatnet.com.

_wp_FirstNet_Ready_09Jun2017.docx