Towers UNITE Networks

Sharing infrastructure with utilities and other mission-critical network owners is a good idea for a host of reasons.

By Klaus Bender

A government-building penthouse is used for land-mobile and cellular antennas.

Most of us understand the concept of radio coverage. Whether we remember adjusting the position of our first AM radio to catch the scratchy broadcast of a baseball game as a child or cursing the reception of our satellite dish as an adult, we know good coverage means getting a strong radio signal.

The question most system planners and designers seek to answer is, "How do we increase coverage?" Without understanding the technical factors that drive the coverage of a radio system, making informed decisions on system designs to improve radio system reliability of coverage is impossible. Once basic concepts are set as a backbone, using resources available in a community can help make the most of investments in private radio systems.

The basic principles of how radio propagation works aren't difficult to grasp with the right coaching; knowledge of these concepts can go a long way when making important design decisions. Radio signals travel at the speed of light between multiple locations. They can be blocked by trees or buildings and often bounce from one surface to another. Adequate radio coverage means delivering a radio signal to a receiver that is strong enough for the signal to be interpreted or decoded. The signal can be an AM radio broadcast, home satellite TV programming, or dispatch information for a police or

fire emergency call. The fundamental building blocks of radio-system coverage for all these examples are frequency, number of base stations or transmitters, and power.

Frequency. The lower the frequency, the farther a signal can travel. If two systems have the exact same antenna height, surrounding terrain, and power emanating from antennas, the lower frequency system communicates farther than its higher frequency counterpart. Lower frequencies propagate farther. There are a number of factors that cause this effect, but the premise is simple. Lower frequencies propagate around or through objects that block higher frequency signals. This is a major reason a large number of public-safety systems remain in the VHF band at approximately 150 – 220 MHz.

Number of Stations. The frequency characteristics of radio transmission drive the number of base-station locations needed for coverage of large areas. The higher the frequency, the more base stations are required for a given level of service — assuming antenna heights are equal. If one base station is adequate in VHF low band (30 – 60 MHz), two may be required at high-band VHF (150 – 180 MHz). The progression continues from the UHF band transmitter (450 – 512 MHz) to 800 MHz trunked systems. More base stations are required to achieve the same level of radio coverage as frequency increases.

To be fair, raising the height of either the transmitting or receiving antenna can compensate for the shortcomings of higher frequency signals. However, constructing taller antenna structures isn't always an option.

Power. For a given frequency, another way to increase radio coverage is to increase power. One thing recent disasters have shown is that radio coverage inside a building requires more signal than handheld coverage on the street. This idea has its limits depending on frequency. A microwave antenna system with a building blocking one end is unlikely to achieve good coverage, regardless of the power of the transmitters.

Within limits, a deficiency in one of the drivers of coverage can be compensated by increasing the other two. A common remedy for a base-station site with poor coverage is to raise the antenna or increase the power. An agency may select a lower frequency communications system because fewer base stations are needed, reducing the costs. But companies and government agencies often don't have the luxury of using frequencies with optimum propagation characteristics. Regulations and safety concerns will often limit the power available for base and mobile stations. It becomes clear that having the best place to put base-station antennas is critical to system design and improving coverage. There is only so much power land mobile systems have at their disposal, and once that level is reached, the only way to increase coverage is to add more sites. Reducing the number of stations to reduce costs can have significant consequences.

6 Steps to Successfully Share Sites

1 Appoint a responsible organization or individual

2 Inventory available space

3 Build with wireless in mind

4 Simplify agreements

5 Respect safety concerns

6 Keep up to date

Including local utilities in infrastructure discussions is taking hold after natural disasters have shown that communications between utilities and other first responders is critical.

The Value of Shared Sites

There is a high value of infrastructure — the place to mount the communications system antennas — that makes coverage possible. In any given area, there are numerous important agencies vying for resources. Police, fire, local government, ambulance services, and electric, gas, and water utilities all have buildings, towers, and poles that can be used for antenna space. While sharing resources within municipal governments is becoming more common, approaching local utilities and including them in infrastructure discussions is also taking hold, after natural disasters have shown that communications between utilities and other first responders is critical.

Making the decision to investigate an agency's ability to share its own infrastructure with other agencies is the first step in the process. Additional steps include:

■ Appoint a responsible organization or individual. When possible, a single point of contact for antenna space on government buildings is a good idea. A person or agency responsible for building use in a jurisdiction is an excellent choice for managing potential antenna space for multiple groups. Properly allocating these resources relieves the communications officers from each group from making decisions as to the use of buildings for antenna space.

■ Inventory available space. Inventory government buildings that currently support wireless antenna sites. Make a list of all antenna systems on the building and include as much information as possible about each system, including frequency, antenna type and location, power, and FCC information. This will aid in the determination of compatibility among multiple systems on the antenna site. Use building drawings if available. From this information, create a database of buildings available for use.

■ Build with wireless in mind. New government construction projects should be designed to intelligently and safely support wireless antennas. Buildings that make space available for radio equipment and antennas will support an organization's needs, as well as offer revenue opportunity with commercial providers.

■ Simplify agreements. Contract and lease negotiations are often the most difficult part of putting antennas at a new antenna site. A common, simple, but thorough lease agreement that can be used among government departments, as well as third parties like commercial carriers, streamlines the request-and-review process.

■ Safety first. Utility infrastructure, including transmission towers, substation property, and utility poles, offers excellent places to mount low- to medium-height antenna systems. Always respect the safety concerns of the system operator when considering the use of these resources.

■ Keep up to date. Trade associations and industry groups can be an excellent source of information regarding infrastructure sharing. APCO International aids public-safety entities with all aspects of telecommunications; talk to APCO about how infrastructure may benefit other first responders. The Utilities Telecom Council (UTC) specializes in utility and critical infrastructure communications policy and regulation. UTC members offer a variety of potential antenna sites. Contact the association for more information.

When police, fire, and other users of radio spectrum openly discuss communications system designs, common aspects of operations are revealed. This discussion can lead to a higher level of infrastructure sharing, where multiple entities participate in the design and deployment of common systems for fire, police, and other emergency services. A well-managed joint agency system offers many benefits. Procurement is simplified when there is no longer a requirement to support multiple radio systems. Incident response can also benefit from a common communications platform with common terminology.

The number of sites will be the crucial deciding factor in system coverage, and therefore, the cost of the system. Choice of frequency band plays a part in the number of sites. The VHF band is popular because it propagates better than UHF, but the VHF band has been around longer and is far more congested. Congestion means fewer frequencies are available or the possibility of interference increases. Interference at the wrong time can have disastrous consequences. The amount of signal level needed for reliable communications varies with the environment; terrain and foliage make a difference in radio propagation. In-building communications require more signal level on the outside of a building or repeaters inside a building. Reducing or eliminating in-building requirements could greatly reduce the cost of a proposed system in terms of dollars.

A local water tank doubles as an antenna site for several networks.

Knowledge is the most important tool in communications system design. If coverage requirements of each system are known, methods can be evaluated to achieve predetermined goals. Documenting the infrastructure available allows for more informed decisions on system operation and design. Pooling the resources of multiple organizations benefits all players in the form of additional real estate available for future communications needs. An intelligent policy on the use of government infrastructure can also create revenue opportunities in the booming commercial communications industry. ■

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