How to Avoid Radio Obsolescence

By FreeWave Technologies

Over the years, utilities have tried several different methods to monitor and control their electrical transmission and distribution systems. From the beginning days of autonomous territories to today's highly integrated world, one thing has remained constant – the need for information. Advances in research and development have brought utilities from using stand-alone remote devices running unmonitored, to a fully integrated system of power quality monitoring and distribution. There have been many different approaches to bringing information back to a central location or to a remote control point where it can be processed and decisions can be made. Homeland security issues are leading more companies to consider farming out their communication systems outside of the firewall. Many have, or are considering, implementing their own communication system in an effort to boost network protection of vital company assets. This allows utilities to maintain their own reliable communication system without having to depend on outside vendors and keep the information safe from outside threats. One of the major technologies employed to accomplish this has been radio communications technology. This article is going to cover the basic fundamentals required in designing a radio system that meets today's needs while allowing for future growth.

When a utility company sets out to design a radio system, it needs to understand its technical requirements and what future needs it might have. Does its current remote terminal units (RTU) and intelligent electronic devices (IED) talk serially? Will it be upgrading soon to Ethernet? Is there any way to get that 4-20mA analog input into its RTU two miles away? A common mistake utilities make is when they misuse or improperly design their system. For example, an Eastern U.S. utility had installed an Ethernet radio system and tried to bring video back from all of its substations. It soon found out that video requires huge amounts of bandwidth and it brought their system to a halt. So, it switched to a system that sent an alarm if there was motion detected and then it would look at the video at that one location, resulting in a much more effective use of its radio system and its available bandwidth.

In another example, a utility wanted to start upgrading its system to Ethernet, but didn't have the resources, or the desire, to replace all of its existing serial equipment. This was such a common issue that radio manufacturers came up with a great solution—they designed a radio that has both Ethernet and serial ports. This allowed the utility to add Ethernet devices to its network while still talking to its existing serial devices. This gave the utility a path for upgrading without having to replace everything at once.

Another thing manufacturers have done to help avoid obsolescence is to make the radios programmable. A radio can be configured as a master, a repeater, or a remote and they can be programmed for different frequencies. This allows them to serve as a spare for more than one system. The power and bandwidth even can be programmed to meet the FCC re-farming regulations. This feature allows a utility to use a radio for its 25kHz channel and, if it wants another channel, or if the FCC makes it go to a 12.5kHz channel, it can just reprogram the radio.

To design a quality radio system, it is important to perform path studies. This process will determine how radios will perform in a specific environment. Is the terrain fairly level? Are there a lot of trees or buildings? Manufacturers will specify how far their radios will propagate by ideal line-of-sight theoretical calculations, but after 20-25 miles of seemingly level terrain, even the curvature of the earth can begin to block the signal. Typically, the lower the frequency, the further the radio signal will propagate and penetrate obstructions. So, it is important to pick a radio system based on the terrain and bandwidth requirements. The FCC limits the amount of power and bandwidth a radio can produce at a specified frequency. Based on the aforementioned propagation study, a radio manufacturer can help determine which radio is best suited to a company's needs -- including whether or not repeaters are needed, how high the antennas need to be and what frequency should be used. It also is important to design what is known as a "fade margin," so that in the coming years, as vegetation grows or as buildings are erected, the radio system will still enable reliable communications. As an example, a rural cooperative was having trouble talking from a control house to a pole-top switch located only one mile away. After a little investigating, it was discovered that there was a heavy wooded area between the two sites and the control house was at the bottom of a quarry. So, even though the distance was very small, there was significant obstruction between the two points.

It also is important to consider the radio frequency (RF) environment surrounding a radio system. Typically, SCADA radio systems do not put out a lot of power. So, if a company has a master or repeater sight co-located with a paging or cellular system transmitting at very high power levels, there may be interference. A municipality in the South Central U.S. was having trouble getting its radio system up and running. It would communicate intermittently. As it turned out, it had installed the repeater antenna on top of a water tower, right in the middle of a cellular antenna system. It moved the antenna down to one of the legs of the tower, getting vertical separation of the antennas, and the radio system became fully functional.

Just as the solid state digital era is driving change and development in control and monitoring equipment, it also is allowing for advancement in the radio communications world and, while it has created new opportunities with its advancement of features, it also has created some hardship. When a manufacturer designs a new product, many of the chipsets that go into the design of that product become obsolete after just five years. This requires manufacturers to "reinvent" their existing products—the ones they have been selling for the last five years. A few years ago, a large utility in the Midwest was halfway through upgrading its analog system to digital, when it found out the manufacturer was coming out with a new digital radio that wouldn't communicate with the current digital radios it had just purchased. This is why it is important to choose a manufacturer that has shown long-term stability and commitment to its market. It should choose a radio manufacturer that develops new products with new features that still communicates with its existing products.

One of the unique things about having microprocessor-based radios is that a lot of engineering time and energy goes into firmware development. So, even though there seems to be fewer and fewer components in the radios, the design process has not diminished. The reason this is worth mentioning is that a lot of the design is in the software, so as the manufacturer continues to upgrade and add features, it can easily be downloaded into existing radios. This allows utilities to upgrade their radio systems to meet new protocol or security standards.

In conclusion, changing communication technologies and regulations have soured many utility companies from implementing widespread remote monitoring. Changes in FCC licensing and the re-farming of frequencies have been confusing. Advances in technology, from analog to digital, have left many legacy systems and products unsupported by their manufacturer. Utilities are looking for a long-term, flexible communication system that will support their existing equipment and allow for future growth. The key to staying ahead of the game is to understand the needs of the system, design a radio communication plan around that system and work with a quality manufacturer that will support all of its products. In today’s competitive world, every utility must effectively monitor and utilize all of their resources.