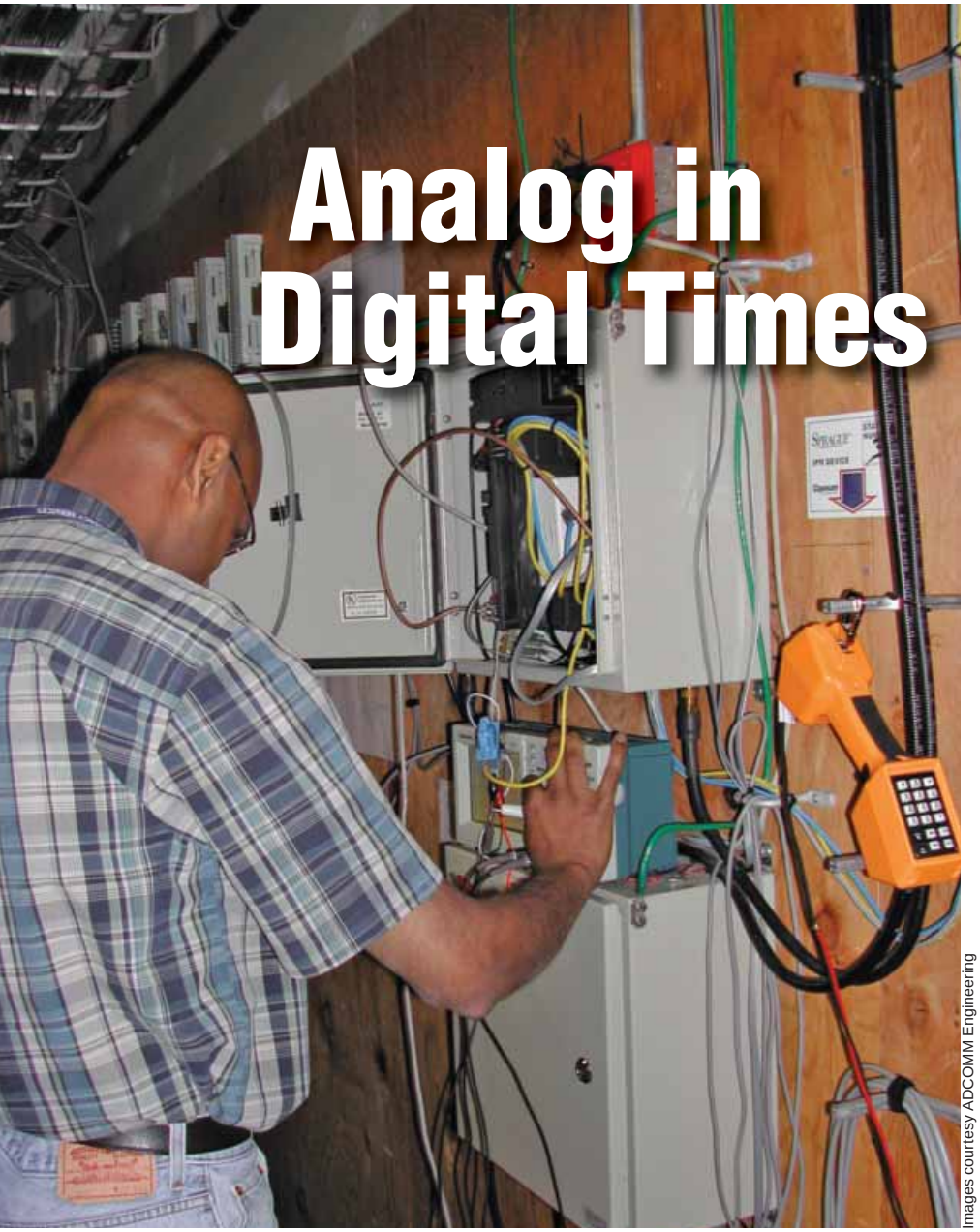
RadioResource
MissionCritical™
COMMUNICATIONS



Analog in Digital Times

Images courtesy ADCOMM Engineering

Although a digital migration is underway, analog technology still has a foothold and can integrate with IP networks.

By Joe Blaschka Jr.

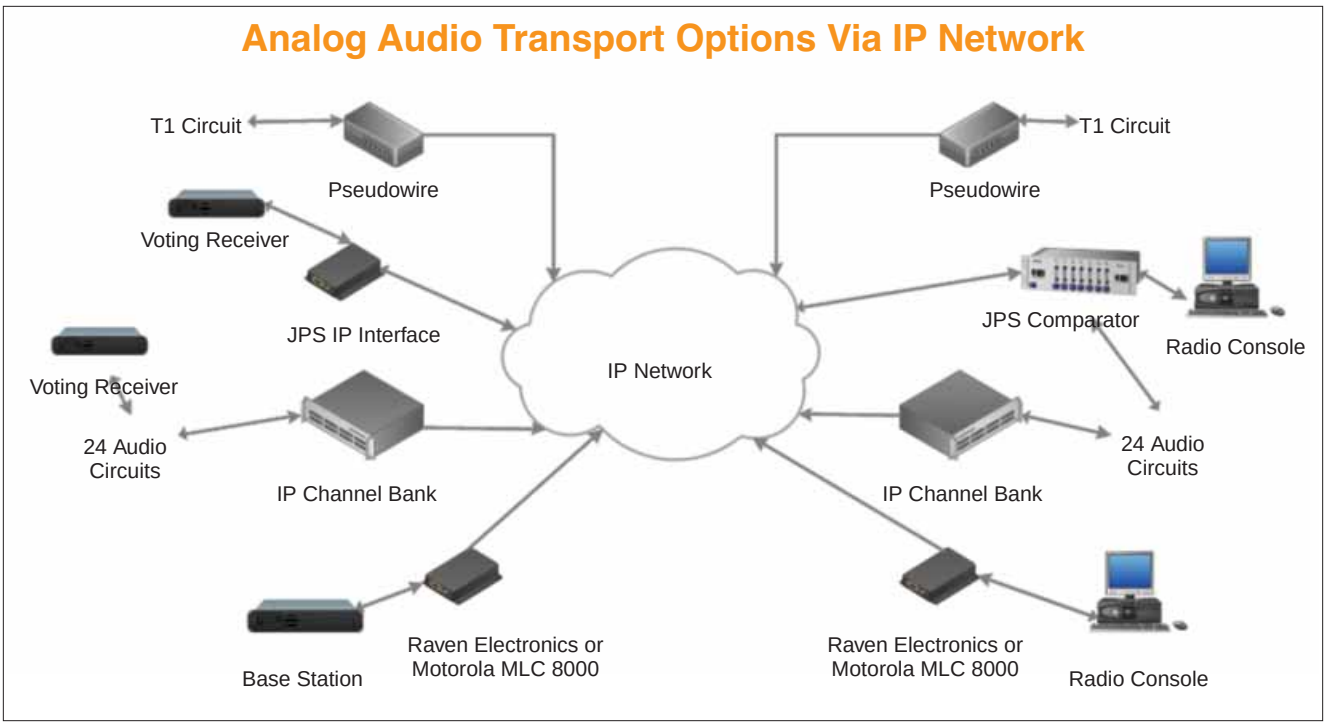
"Living analog in a digital world" sounds like the title of a country song about radio technicians trying to implement radio systems these days. To paraphrase a Mark Twain quote, "The rumors of analog's death have been greatly exaggerated." All around us, we see signs of digital systems being implemented, but analog still lives and continues to provide cost-effective service for many radio applications.

In this article, certain standards and brands of equipment are referenced as examples and are not specific endorsements of any particular product or brand. Each application is unique, and while many products have similar characteristics and specifications, they are generally not interchangeable. Organizations should do their own evaluation of equipment and brands.

Certainly, many public-safety systems have migrated to Project 25 (P25). Public service and commercial systems have moved to Digital Mobile Radio (DMR), NXDN and other digital technologies. This trend will continue. Plus, if the FCC requires 6.25-kilohertz technology as the next narrowbanding step, the move would need to occur during a 10-year-plus planning cycle.

However, for the foreseeable future, analog radio systems will remain in service. For many agencies, a wholesale move to a digital system is too expensive. For others, terrain obstacles and other system design limitations, such as the need for very low-power equipment for solar sites, are impediments to deploying digital radio technology.

The complication with remaining analog is that the transport circuits



This figure shows some of the possible analog interfaces to an IP network backbone.

and technologies to interconnect radio systems are moving to data network technologies. Digital interconnection methods such as T1s have been used for a long time. However, even T1s are being replaced with data network technologies based on the transmission control protocol (TCP) and user datagram protocol (UDP). Another related technology is multiprotocol label switching (MPLS), which is lumped into the IP bucket. Analog radio system owners and technical personnel must migrate from analog transport methods to data-network-based transport.

Current Situation

Many different technologies allow agencies to cost effectively interconnect analog radio infrastructure with data network technology. While this is good news, it requires radio technicians familiar with data networking. It also requires IT managers and technicians to accept the radio network infrastructure requirements. Sometimes, these two items become the biggest impediment to moving to an IP backbone. For example, many federal agencies outsource their IT support and network, creating a difficult situation for nonstandard applications. There is often little opportunity for a radio technician in a remote area, say a national park, to effectively communicate to the right people to interconnect analog radio digital interfaces to the outsourced network.

Once interface issues are resolved, a variety of technologies are available to mix and match analog and digital backbone infrastructure.

In some cases, it may be necessary to build a "shadow" digital backbone to support the radio network; however, this process requires radio personnel proficient in data networking. Once interface issues are resolved, a variety of technologies are available to mix and match analog and digital backbone infrastructure. The people interface can be one of the biggest hurdles to overcome when trying to work with your organization's IT department or when implementing your own network.

Equipment Options

There is a wide range of equipment available for new system implementation, retrofits and mixed systems. The different brands of equipment and approaches offer subtle differences. Study the options carefully and ask the manufacturer questions. One major difference with most IP equipment is that there are fewer blinky lights that tell you the status of what is going on. Many old analog products gave a clear indication of push to talk (PTT) or provided a carrier operated relay (COR) indication. Much of the new IP-based equipment is similar to data equipment when looking at the blinking lights on a switch or router. Sometimes, it only means the lights are on, but nobody is home.

Analog Circuit Replacements. Replacing existing analog circuits or adding new analog circuits using an IP backbone can be done using pseudowire technology. Pseudowire can support analog voice lines, T1 or E1 circuits, and other wireline-type technologies. There are many different approaches to pseudowire. Cisco cards can be plugged into Cisco routers supporting audio circuits. Companies such as TC Communications, RAD Data Communications and Engage Communication supply a

The complication with remaining analog is that the transport circuits and technologies to interconnect radio systems are moving to data network technologies.

variety of equipment that supports analog circuits. As with any analog-to-digital conversion process, voice quality is directly related to bandwidth. Sometimes there is pressure to lower the bit rate into the network so the voice sampling rate is lowered. This may work in some cases but will cause problems if a user is sending voting status tone, doing voice quality or signal-to-noise ratio voting, or using tone remote control. The best approach is to leave the voice sampling rate at 64 kilobits per second (kbps). Rates lower than 32 kbps can create problems for radio systems.

Voting Systems. There are a number of options for updating a voting system to an IP-based backbone. You can use the pseudowire concept; however, a number of products are available for voting-receive-audio transport and voting using IP links. Most of these devices also transport transmit audio back using the same IP link. The Raven Electronics M4x and Motorola Solutions MLC 8000 are two examples of units where two-way audio transport, as well as the voting function, is provided. If you are using the JPS Interoperability Solutions SNV-12 voting system, the company has an IP backhaul voting module to make it easier to add voting receivers to locations where it is easy to get IP connectivity. With this approach, you can keep existing analog voting links and add IP-connected receivers for a mix-and-match approach.

Channel Banks. Often there is a need for a large number of voice and possibly even serial data circuits to a single location. T1 channel banks have been the mainstay for this application. The T1s are often from a microwave network, possibly telephone company T1s or a mix. There are IP network channel banks that are essentially the same as a T1 channel bank, except for the IP network interface. If you are using a more modern channel bank such as a GatesAir, TC Communications or RAD, you can simply upgrade the channel bank from the current T1 interface to an IP connection by changing the interface cards. If you are still using an old telco systems channel bank, it is time to upgrade. The channel bank approach works well because most of the back-end analog interfaces stay the same. The levels are still set using the same methods as before.

New Systems. Several new radio system vendors such as RF Technology and Tait Communications/Harris have integrated the transmitter control and voting into their analog products, greatly reducing the equipment count but not necessarily the cost. For example, the new Tait system, even in the analog mode, can use an IP backbone, and the receiver voting takes place inside a base station. There is not a separate voter unit to do the comparing. Unfortunately, this requires a complete change-out of the equipment on the same channel, and any future voting receivers must have the same digital interface. However, it simplifies the interconnections and level setting. Over time, as new products are developed, this approach will likely continue. For good or bad, it tends to require that system expansions use the same brand and model equipment. It is not like the old days when one could have a GE comparator and Motorola, GE and RCA receivers all connected together.

In any new system implementation, careful consideration should be given to how system expansions are handled. It would be nice to install a system once and never have to add to it or change its configuration. Unfortunately, that is not the real world. Many new system approaches tend to lock the system owner into that vendor for the foreseeable future. That is both good and bad. Give this aspect careful thought, so you are aware of the ramifications in the future.

Non-LMR Equipment. Many of the names used in this article as reference products are familiar to those in the LMR business. We tend to forget the broadcast industry has also been moving to IP transport and audio routing as well. There are a number of voice and analog products in that realm to consider as well. Some of those manufacturers include Barix, Comrex, Deva Broadcast and Mayah Communications. When considering these options, investigate the analog interfaces, as broadcasters often use different impedance values and audio levels.

The future is now. New systems, both analog and digital, are being implemented using IP technology. There are a variety of vendors and approaches to remaining analog in a digital world. Going forward, the blend of analog and digital will continue. Should the FCC require another round of narrowbanding, requiring the radio signals to be digital, a backbone network will already be digital. Regardless of the approach used, getting smarter in network technology and IP networks is a must for any radio technician these days. ■

Joe Blaschka Jr. is principal of ADCOMM Engineering and a registered professional engineer (PE) in eight states. He has been working in the communications field for almost 40 years. Email feedback to Blaschka at j.blaschka@adcomm911.com.

RadioResource *MissionCritical Communications* delivers wireless voice and data solutions for mobile and remote mission-critical operations. Editorial content targets organizations in the United States and Canada with mobile and remote communications needs, including public safety, government, transportation, manufacturing, utility/energy, business, and industrial entities. The magazine covers industry news; case studies; innovative applications; product information; emerging technologies; industry reports and trends; and technical tips. RadioResource *MissionCritical Communications* is published by RadioResource Media Group. Pandata Corp., 7108 S. Alton Way, Building H, Centennial, CO 80112, Tel: 303-792-2390, Fax: 303-792-2391, www.RRMediaGroup.com. Copyright 2018 Pandata Corp. All rights reserved. Reprinted from the March 2018 issue of RadioResource *MissionCritical Communications*. For subscription or advertising information please call 303-792-2390 or visit www.RRMediaGroup.com.