TDMA White Paper

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What is TDMA

Two-way radio has traditionally been a voice medium, and until recently the voice signal has been an analog transmission. The introduction of digital technology provides several advantages over the analog world. Digital technology provides better noise reduction and preserves voice quality over a greater range than analog. Users can hear what's being said much more clearly, increasing the radio's effective range while keeping public safety users responsive to changing situations in the field. Another advantage of digital technology is a greater use of the licensed radio frequency spectrum.

The frequency spectrum and the number of users it can support is a finite entity. Increasing demands for higher capacity, particularly in urban areas, is driving the need to change the way frequencies are used and to achieve greater spectrum efficiency for public safety.

The Project 25 Steering Committee studied the issue and made it a focus of Project 25 Phase II, which is the next phase in the standard for interoperability. Phase II implementation involves time division and frequency modulation schemes, with the goal of improving capacity in spectrally-constrained environments. The technology that P25 has defined in this next phase is time division multiple access (TDMA).TDMA is a technology that allows multiple conversations to share the same radio channel. TDMA divides each channel into two streams of time slots to enable twice the number of voice calls or data transmissions to share the same frequency channel without causing interference.

This is a significant enhancement to what is deployed in Project 25 Phase I today. P25 Phase I uses a 9.6 kb/s rate on the air interface, while Phase II TDMA uses a 12 kb/s rate. The increase in the bit rate is needed to accommodate the signaling and slot assignment required for two voice paths.

TDMA is a digital standard, meaning voice signals are encoded in bits. Although analog signals represent the actual duration of spoken words, digital signals can encode that duration in a way that enables significant compression while preserving voice quality. Note that the digital signal preserves voice quality while providing a shorter transmission time. Each TDMA time slot is approximately 30 milliseconds. The circuitry that translates voice into bits is able to pack 60 milliseconds worth of digitized speech into each 30 millisecond time slot. The receiving subscriber unit unpacks those bits into speech that has its full 60 millisecond time value. This is what enables two conversations to happen simultaneously and seamlessly via a single repeater. The alternation of time slots takes place in the technology only, and is transparent to the user. Figure 1 depicts the TDMA encoding scheme.

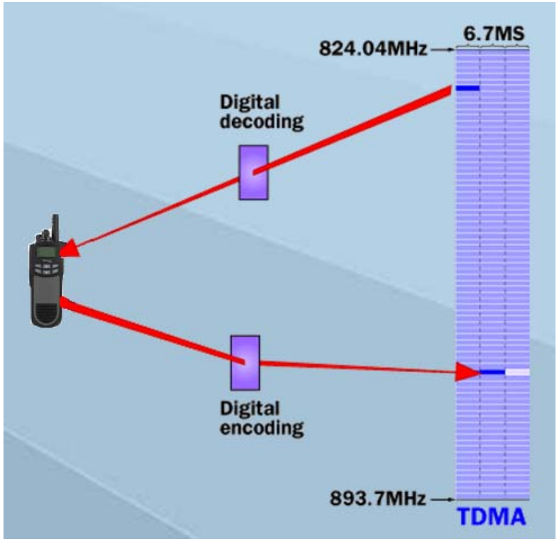

Figure 1
TDMA Encoding Scheme

Benefits of TDMA

TDMA provides numerous benefits for a public safety network, the most immediate of which is increased frequency capacity. Greater frequency capacity reduces the risks associated with frequency congestion such as dropped calls or channel interference. Increased frequency capacity will reduce administrative burdens. Agencies that are allocated these frequencies will not need to acquire additional spectrum to keep pace with increasing demands on their systems. This is increasingly important to growing communities and agencies that are increasing the size of their first responder forces.

TDMA also provides the user with extended battery life and talk time. According to the International Engineering Consortium, a subscriber radio on a TDMA network is only transmitting 1/3 to 1/10 of the time during conversations[1]. In addition, TDMA installations offer substantial savings in base-station equipment, physical space, and maintenance.

A new communications system has limited use if it is not backwards compatible with the legacy system. With this fact foremost in mind, the Project 25 Steering Committee paid significant attention to interoperability with legacy equipment. One of the critical P25 Phase II TDMA requirements is backward compatibility with P25 Phase I systems.

The developers of P25 Phase II include equipment manufacturers and first responder system officials from the federal, state, and local government ranks. Many states have acknowledged the benefits of TDMA and are now requiring an upgrade path to P25 Phase II in their system development plans.

EFJohnson and Project 25 Phase II TDMA

EFJohnson was one of the first companies to be fully compliant with Project 25, and as a participant and leader in the TIA Standards process remains committed to every phase of interoperability. EFJohnson radios have passed interoperability tests at government facilities, in independent test labs, and even in the labs of our competitors. The US Department of Homeland Security has formally recognized the company's engineering lab to test emergency responder radios for standards compliance. This recognition is part of the DHS' Project 25 Compliance

Assessment Program, which will provide more than 60,000 emergency response agencies nationwide with a consistent and traceable method to gather P25 compliance information on the products they buy.

Showing its support of P25 Phase II, EFJohnson Technologies announced a TDMA option for its award-winning ES Series of P25 compliant portable and mobile radios in August 2009. EFJohnson's implementation of Phase II TDMA is designed for optimal performance and radio capacity while maintaining full compatibility with existing networks. Backwards compatibility is of critical importance. Each communications network evolves at its own timetable, yet first responders need to communicate with nearby systems that may be at different stages of migration. Communications equipment is at its most effective when it is able to make the transition to the next phase while being compatible with past and present implementations. Choosing a radio with a TDMA option eases the transition to the next phase. First responders can upgrade to TDMA when their system can support it and their subscriber radios will be ready.

Purchasing a radio that can make the transition to P25 Phase II means choosing a future over obsolescence.

About the Author

John Oblak is the Vice President of Standards & Regulatory Affairs for EFJohnson Technologies. He has been active in the leadership of several industry standards committees. Mr. Oblak joined EFJohnson in 1984 and has held progressively responsible engineering and management positions in the company. He began his career in 1973 as a design engineer with RCA Radio Communications Systems Division, and held various responsibilities in the development of radio communications equipment. Mr. Oblak received a BS degree in Electrical Engineering in 1973, and a MS degree in Electrical Engineering in 1978, both from the University of Pittsburgh.

References

1. "Time Division Multiple Access" (TDMA) from the International Engineering Consortium website http://www.iec.org/online/tutorials/tdma/topic04.asp