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LOGIC TRUNKED SYSTEMS

This month we continue our tour of different trunked radio systems with a look at Logic Trunked Radio (LTR). This protocol was developed in 1978 by the E.F. Johnson company and is still in use, primarily by private companies such as taxicabs, utilities, delivery trucks, and repair services. It is not very popular with public safety agencies, who typically operate either Motorola or EDACS trunked radio systems.

LTR operates differently than Motorola and EDACS in several ways.

Decentralized operation

All mobile radios in a centralized trunking system must request service through a single control channel. Access requests are usually handled in sequential order, and this bottleneck may delay messages during periods of heavy use. More importantly, a dedicated control channel also removes one radio frequency from use as a voice channel. A five-channel Motorola system, for instance, would have one control channel and four voice channels.

LTR systems use a distributed method of access where service may be requested on any channel, and every channel may be used for voice communications. In a five-channel LTR system, all five channels can be used for voice traffic, making more efficient use of the assigned radio frequencies. Also, since each repeater operates more or less independently, if equipment associated with one repeater fails, all the others continue to operate normally.

LTR systems can have up 20 repeaters, one repeater per channel, all of which must be located at a single site. The repeaters are physically interconnected by a data bus and share status information with each other. Each repeater can then transmit information about which channels are idle and which are busy, and which talkgroup is active on which channel.

LTR uses digital control signaling combined with analog voice transmissions. Each repeater continuously transmits information in a sub-audible data stream that rides below the voice information. A 150 Hz tone transfers data at 300 bits per second, but is not usually heard since most scanners only pass audio signals between 300 Hz and 3000 Hz.

Because LTR mobile radios always know which channels are busy, they only transmit a request for service when a channel is idle. Other trunking systems allow their mobiles to attempt access even when every channel is full, further congesting the control channel.

LTR repeaters usually operate in transmission trunking mode, where the channel is used only for the duration of the transmission. When the user who is talking lets up on the push-to-talk switch, the repeater releases the channel and makes it available for other users. As the conversation progresses each transmission may appear on a different radio frequency, giving the impression that the conversation "hops" from one channel to another.

Under some circumstances a repeater may switch to message trunking and hold a channel open for the duration of a conversation. This is often done for telephone calls or other interconnected operations.

Even when in transmission trunking mode, some other trunking systems do not immediately

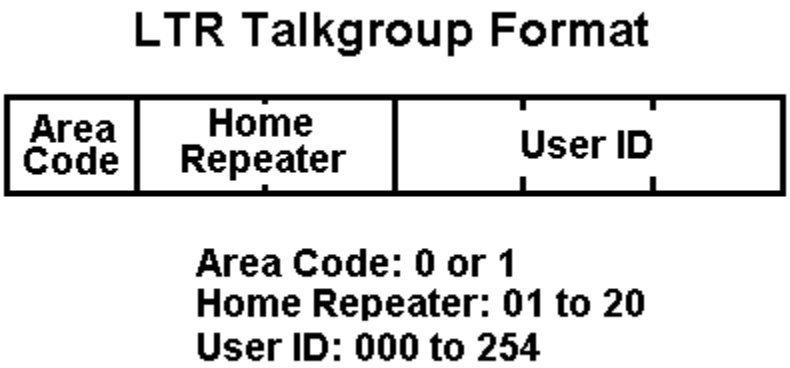
release the channel after the user stops talking. The repeater is configured to hold the channel open for a second or two, giving the other members of the talkgroup an opportunity to respond. If the system is very busy and the channel is released right away, a second conversation may take the channel and a person trying to respond in the first conversation will not be able to answer, since all the channels would be in use. This "hang time" is rarely needed, but it increases the waiting time for other mobile radios to access the system. It also means scanner listeners may hear a moment of dead air or system noise after the conversation ends but before the repeater turns off, which usually prevents the receiver from resuming scanning.

Mobile Identification

Each LTR mobile radio is assigned to one of the repeaters. Whenever a mobile radio is not involved in a call it is listening to its "home" repeater to keep track of idle channels and to know if anyone is calling it. Even though LTR mobile radios have the ability to make a call on any channel, they usually try their home repeater first.

Each repeater can be assigned as many as 250 identification codes. The combination of home repeater number and identification code is the "address" of a mobile radio. A typical five-repeater system could have as many as 1,250 separate addresses and the largest twenty-repeater system may have up to 5,000 addresses. An address may be assigned to an individual mobile radio and used as a unique identifier, or it may be used as a group identifier by assigning it to more than one mobile radio.

Each LTR system also has an "area code" which is usually included in the address. This value can be either 0 or 1, and is usually 0. If two LTR systems are operating close enough to interfere with each other, one system will be assigned area code 0 and the other will be assigned area code 1. Repeaters in area code 0 will ignore transmissions with an area code of 1, and vice versa. Mobile radios will also listen only to their assigned area code.



Enhancements

LTR-Net is a follow-on protocol to the original LTR, providing users with additional features and functionality. The LTR-Net protocol allows multiple sites to interconnect, giving users the ability to dispatch and communicate across a much wider area. It also supports direct radio-to-radio communication, direct dialed telephone calls, and over-the-air radio reprogramming.

The LTR-Net protocol is compatible with the older LTR equipment. LTR radios can operate on an LTR-Net system, and LTR-Net radios can operate on LTR systems. A user with an LTR-Net radio can even be in the same talkgroup as an LTR radio user, and operate on the same channel.

In 1998 the first LTR-Net began operation in Des Moines, Iowa and Omaha, Nebraska to serve customers in the construction and service industries. There is also an LTR-Net system operating in 800 MHz and 900 MHz on the Caribbean island of Puerto Rico, providing voice, data, credit card verification and even GPS position reporting to commercial customers.

E. F. Johnson also sells a different trunking system called Multi-Net, which is not compatible with LTR and is not readily decoded by scanner listeners.

LTR decoding equipment

LTR has not been a priority for the TrunkTracking scanners made by Uniden, probably due to the lack of public safety organizations using this protocol. For the hobbyist there are a few other options.

Radio Shack has been selling the PRO-92 scanner since November of 1999. This 500-channel scanner, built by GRE in Japan, has built-in support for LTR systems as well as Motorola and EDACS. There have been a number of complaints about possible firmware bugs in this receiver, some of which are related to LTR. Many unhappy users have returned their radios to Radio Shack for a refund, although many happy users continue to report good results. It appears to depend largely on geographic location and the particular signal characteristics of the systems being monitored. It’s rumored that GRE is working on some fixes for the reported problems, and a new version of firmware is in the works.

To check the firmware version of a PRO-92, press the "3" key while the scanner is powering up and showing "Welcome to Multi-System Trunking." My scanner reports "Version 1.00," so I'm sure I've got all of the reported bugs.

Optoelectronics, based in Ft. Lauderdale, Florida, offers two different products capable of handling LTR.

The OptoCom is a computer-controlled receiver that uses a personal computer to decode and follow LTR trunking signals. The software was written specifically for the OptoCom and is included with the receiver. It provides full trunk following for LTR and Motorola systems, as well as the ability to receive non-trunked radio signals.

The OptoTrakker is an add-on box that connects to a user-supplied communications receiver and is capable of decoding LTR as well as several types of tone-controlled squelch used in non-trunked systems. It also comes with personal computer software that provides complete trunk following for LTR and Motorola systems when used with a particular Icom or AOR receiver.

I'd be interested in hearing from readers who are using the OptoCom or OptoTrakker for LTR decoding, or who have other setups for listening to LTR transmissions.

Finding LTR systems

LTR operations can be found in the 800 MHz and 900 MHz frequency bands, as well as some relatively new systems in UHF. Remember that 800 MHz trunking repeaters will transmit between 851 MHz and 869 MHz, so concentrate your efforts there.

LTR systems are not nearly as popular with scanner listeners as Motorola or even EDACS, and it is often very difficult to determine exactly who is using the system. Many LTR systems are owned and licensed to a private service provider. The provider, in turn, sells radios and airtime to many customers, each of whom usually has one or two talkgroups. For example, on a simple five-repeater system there may be private ambulance companies, taxicab operators, cable television repairmen, building inspectors, and local delivery trucks.

Chicago, Illinois

Midway Airport (MDW), while still perpetually under construction, is reported to have an LTR system running on the following frequencies: 476.3125, 476.5625, 476.7875, 477.4125, 477.6375, and 477.0875 MHz. Any reports from Chicagoland listeners would be welcome, especially to confirm whether the Chicago Police Department's Airport Law Enforcement Unit is using this system.

Bloomington, Indiana

Indiana University uses 854.7625, 855.0625, 856.8875, 857.8875, 858.8875, 859.8875, and 860.8875 MHz for their LTR system. Building maintenance and custodial services appear to be the heaviest users. So for all of you students exploring the steam tunnels, check these frequencies first!

Evansville, Indiana

At least one ambulance service is using this private system licensed to Mobiletel. Frequencies: 856.0625, 856.1875, 857.0625, 857.1875, 858.0625, 858.1875, 859.0625, 859.1875, 860.0625, and 860.1875 MHz.

Marshfield, Massachusetts

This seaside town south of Boston uses five frequencies: 453.4375, 453.5625, 453.5875, 453.6625, and 453.7625 MHz. Talkgroup 005000 is the Marshfield Harbormaster and the Fire Department uses 001010. Talkgroup 005020 is town-wide, used for simultaneously reaching the police department, fire department, and the harbormaster.

Rochester, New York

Genesee Business Radio Systems operates what amounts to two LTR systems. The systems overlap enough to require the use of the area code digit to separate them. Time Warner, the local cable television provider, has been heard using talkgroups 002151, 002152, 003151, and 003152. Rochester Cab uses 019120 and 019100. Note that there may be more frequencies in use than what is listed here.

Area Code 0: 851.3375, 851.7375, 852.2375, 852.2875, 852.6875, 853.1375, 863.8875, 865.6875, 864.3375, 864.7875, 852.7125, 865.1875, and 865.6375 MHz.

Area Code 1: 865.9875, 865.9625, 865.7875, 864.1625, 865.0625, 865.3375, 864.8875, 864.6375, 864.6125, 864.4375, 864.1875, and 863.9875 MHz.

Milwaukee, Wisconsin

At least two private LTR systems operate in and around Milwaukee, each with a private ambulance company as a customer. One uses the frequencies 861.2875, 862.2875, 863.2875, 864.2875, and 865.2875 MHz. The other operates on 855.5875, 856.7875, 857.7875, 858.7875, 859.7875, and 860.7875 MHz.

That's all for this month. Keep those e-mails coming to dan@decodesystems.com, and check my website at www.decodesystems.com for more radio-related information. Perhaps I'll even see you at the Dayton HamVention! Until next month, happy monitoring!

Comments to Dan Veeneman

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