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Vol. 15 No. 1 ©February 2015

Magic School Bus? No, MotoTRbo!

—Peter C. Abraham

Northshore School District Transportation Building

There is an American business proverb that says that one of the roots of the Chinese word for crisis can be interpreted as opportunity. In 2012, many communication agencies were beginning to deal with the crisis of meeting the 2013 FCC narrowbanding mandate. The Northshore School District took this crisis as an opportunity to upgrade and improve their transportation radio system from an aging simplex system to a three-site multi-cast digital MotoTRbo system.

The Northshore School District is located about 15 miles northeast of the Seattle, Washington, area and covers about 60 square miles of territory. The district is comprised of over 30 schools, which spans both King County and Snohomish County. The district serves close to 20,000 students, out of which approximately 16,000 need transportation services on a typical school day (that is about 80 percent of the student population). To meet the transportation need, there is an in-house transportation department with a fleet of approximately 150 vehicles.

Within the transportation department, there is a need for a radio system that covers the entire area of the school district. The radio system is needed for the normal daily communications as well as the rare but significant life safety issues. It was these two issues, coverage and life safety, that spurned Northshore to improve their transportation radio system beyond the narrowbanding mandate.

The original system was a wide-band VHF simplex system with some of the radios being over 20 years old. The age of these radios was one of the driving factors to upgrade their radio fleet. Some of the radios were not functional in that they were not transmitting full power or did not have sensitive receivers. Many of the radios were not narrowband capable. The initial phase of the project was to replace all of the radios within the fleet so that they would be narrowband capable, improve simplex communications, and be capable of the future radio system. After the radios were replaced, there was an improvement among some of the drivers, especially the ones with the faulty 20-year radios, but the need for school-district-wide coverage still needed to be addressed.

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The coverage requirement was not met because of the limitations of using simplex as the main mode of communications. Simplex is a direct mode of communications in which one end user radio connects directly to another end user radio, not through an intermediate repeater located in a geographic advantageous location. This direct mode is often limited by geographical terrain and distance. The dispatch center was able to communicate on simplex through a remote radio with an antenna on a tower. The tower was located in the southwestern section of the school district; this resulted in limited to no coverage into the northern and eastern sections of the school district. The limitation in coverage was the most frustrating issue to both dispatchers and bus drivers.

The second phase of the project was to implement a communications system that would provide radio coverage across the entire district; it also needed to be end user friendly and allow for future expansion. This is where some of the features of the MotoTRbo helped to reach these goals.

A multi-cast repeater system met the coverage requirement; MotoTRbo allowed for ease of implementation given the school district's existing IT infrastructure. A multi-cast repeated system is a mode of communications that links multiple repeaters together so that all of the transmissions are heard on all repeaters. These linked repeaters are located in different parts of the desired coverage area so that the combined coverage of all the repeaters gives school-district-wide coverage. An end user may only be able to communicate through one repeater, but since the repeaters are linked, the transmission is heard through all the repeaters.

One of the benefits of being a school district is that the linked repeaters could be installed at the schools. Therefore, there was no need to negotiate leases with outside entities. The two additional sites that were included in the multi-cast system were schools in the northwestern section and eastern-most section of the school district. Areas that previously had no coverage now had good coverage.

Implementing a multi-cast system required a link between each of the sites. This is where one of the features of the MotoTRbo system became an asset. Often times, to create a link between sites, some type of infrastructure needs to be implemented or leased; either of which requires additional finances, negotiations, coordination, and time. But in the case of Northshore, an intra-school-district IT network was already in place. MotoTRbo has a feature called IP Site Connect; IP Site Connect allows MotoTRbo repeaters to link together over an IP network (LAN or WAN). By using the MotoTRbo IP Site Connect feature, Northshore was able to link their repeaters for the multi-cast system with their existing IT network. The wide coverage requirement could now be met.

One of the aspects of a multi-cast system is that each repeater location uses a different channel pair. This can be confusing to the end user as they travel throughout the coverage area to figure out which repeater to switch to. Again, another one of the features of the MotoTRbo system became an asset in meeting the end user friendly requirement. MotoTRbo has a roaming feature in which the radio will automatically select a repeater. The selection occurs from a list based on several parameters. These parameters were optimized by driving testing the system and observing the roaming behavior of the

Dispatch Center - Back Room Console Equipment

Norway Hill Repeater and Triplexer

end user radio—a process that is similar to optimizing a cellular network. After optimizing the roaming parameters, the end user friendly requirement was met.

One of the side benefits of the repeated multi-cast system that was realized afterwards was that bus drivers were now able to communicate directly to each other at greater distances; the benefit was that it allowed for driver-to-driver coordination without having a dispatcher relay. In the original simplex system, drivers were only able to communicate with each other if they were in close proximity. On occasion, a driver would need to stop mid-route due to some unforeseen circumstance (engine trouble, unforeseen scheduling issue, etc.) and would notify dispatch. Dispatch would then do an all-call seeking another available bus. With the new system, a driver will still notify dispatch, but now other available drivers would begin to respond and dispatch would oversee the self-coordination. This type of traffic increased and was seen as a great benefit to the daily operation of the transportation department.

Another long-term benefit of MotoTRbo is that it allows for future expansion. The basic MotoTRbo system is a two voice path system in which Northshore is only using one. There has been some discussion of perhaps adding other departments or dedicating the second path for AVL (automatic vehicle locator) and other vehicle related telemetry. The unused second voice path allows for future expansion without being tied down to one expansion path or requiring additional investment into the communication system.

Outside of the multi-cast repeater system and end user radios, the dispatchers' consoles were upgraded as well. The original simplex system used single channel analog consoles that was shared among several dispatchers; this console was connected to a radio site that was located in the southwestern section of the school district. As a backup option, two mobile radios with roof-mounted antennas were also available (at times these radios would cause feedback during transmissions). The radio tower and the dispatch building are located about 5 miles apart and the two had both differing and overlapping coverage. In the fringe areas, what was heard on one was not heard on the other; this was confusing to both the dispatchers and end users. The new system uses the CTI TurboVui Solo package. Each dispatcher has a Windows-based computer with the CTI TurboVui Solo software client installed on it and goose-neck PTT microphone connected to a USB port. The software client then connects to an in-house control station (a fixed 2-way radio programmed to a repeater); it is through this control station that the dispatchers are able to talk through the new multi-cast repeater system. Through the use of this console system, each dispatcher has their own console connection with their own audio controls. Audio feedback is no longer an issue and radio users can be identified during transmissions (the Northshore vehicle ID is programmed as the radio ID). In the event that the computers fail, there is a control station in the dispatch room that can be used as a backup radio.

As with all projects, there were a few challenges that needed to be overcome. Northshore's location above the FCC's Line A required reiterative Canadian frequency coordination. Because this was a live life safety system, migration could only occur during scheduled extended out-of-service windows, specifically spring break and summer vacation. These challenges were more schedule effecting than system requirement and capability hindering.

The migration from the old system to the new system lead to several tangible improvements. The migration from wideband to narrowband made Northshore compliant for the 2013 FCC Mandate. The migration from simplex/talk-around system to a three site multi-cast repeater system provided radio coverage throughout the school district; the coverage improvement was the most celebrated improvement. And finally, the migration from analog to MotoTRbo digital allowed for digital features such as Radio-ID and emergency alert. In the end, the crisis of narrowbanding resulted in Northshore being very happy with their new system.

Goodbye, Dave

—Joe P. Blaschka, Jr., P.E.

This last December, we lost a friend, co-worker, advisor, and great person. Dave Magnenat, who worked for ADCOMM for a bit over 10 years and who I had known for probably 10 years before that when he was working for Kitsap County CENCOM, lost his valiant battle with leukemia in December of 2014. We had hope through most of Dave's fight that he would be victorious. When the cancer came back with a vengeance last fall, it became clear that Dave was going to be directing projects on the other side.

Dave was a great employee always jumping in to help when needed and volunteering to do things when he saw something that needed to be done. Most of all, I will miss his great smile and laugh. He leaves behind Mary Jane, his wife and soulmate, and two great daughters as well as other extended family and many friends. We all hope to see Dave as we all make the transition to the other life.

THE LAST BYTE

—Joe P. Blaschka, Jr., P.E.

2014 was a difficult year for ADCOMM as we struggled with Dave's sickness and the loss of a great friend and co-worker. In addition, I lost my sister to pancreatic cancer this last summer and spent time taking her to doctor visits and helping with her care where I could. As a result, our work schedules were significantly impacted. We are working through this now and hope to be caught up in the next couple of months. We are looking forward to a much brighter 2015. Thank you to all who have stuck with us and helped us out.

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