Kansas City Southern Railway

FRA Grant Methodology, Activities and Lessons Learned
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Methodology

At The Kansas City Southern Railway ("KCSR") we endeavored to modernize our outdated legacy microwave system in preparation for our Positive Train Control ("PTC") deployment. Our goal was to upgrade our microwave network preserving the function of our existing communications system, while migrating to a more robust IP network based communications system. Disaster recovery and PTC interconnection were our primary considerations. These are the methods and activities that we followed to accomplish the successful implementation of the technology. Due to the number of locations needing the upgrade we broke the effort into more than one phase.

Phase I Activities

Microwave Radios

We researched microwave radio manufacturers looking at different interface options for equipment they manufactured.

Technical Considerations:

- Path reliability projections
- Bandwidth limitations
- Frequency limitations
- Ethernet capable
- Failover capabilities

Using each possible combination of microwave radio and interface option, we analyzed the solutions, considering our list of existing circuits/endpoint devices. We explored the interfaces necessary for each legacy device, under each considered option. We also had to consider if legacy endpoint equipment might need to be replaced.

We solicited bids from manufactures whose radios we believed would work in our environment and matched our requirements. Vendors that received solicitations were Ceragon, Harris and Alcatel.

We selected Ceragon IP-10 radios because their equipment offered features that met our requirements and it was the lower cost solution.

Network Routers

We were using General DataComm ("GDC") multi-plex units for re-routing and T1 interfaces on the legacy microwave system. We were very happy with the performance of the equipment and the support we had been receiving from GDC so we engaged them for assistance on a routing solution.

We chose Huawei AR 4549 routers that were recommended from GDC recommended to accomplish the IP routing.

Generators

One of the key objectives of the modernization project was to have a highly available communications system. In order to meet that objective we needed to replace our aged back up power systems.

We identified locations that were in need of replacement.

Generators needed to be compatible with some existing modern transfer switches already in service.

Generators needed to provide adequate power for existing load, exceeding it by at least 25% for future requirements.

Generators needed a minimum of three alarm contacts to monitor generator run, generator over crank (failed to start), and AC power fail. Most models providing these alarm contacts were the industrial versions.

We migrated to an outdoor model generator due to issues of in-building models overheating or starving for oxygen if building ventilation failed, and issues with fuel leaks into enclosed building possibly.

We solicited bids from vendors for systems that would meet our needs and we chose the Generac QT025A 25kW.

Installation steps:

- Surveyed each site to determine optimal placement of system.
- Completed layout for generator foundation and measured for conduit locations
- Dug conduit trenches from new generator location to existing building for power input to transfer switch, alarm cable and gas line to gas regulator
- Installed conduit and gas line

- Build form for generator foundation
- Pour concrete and finish surface
- Install and anchor generator to foundation
- Install ground rod and ground generator
- Complete wiring of transfer switch and alarms
- Install generator battery
- Connect gas line
- Test generator by disconnecting commercial power

Approach

Before moving forward with the purchases of the Ceragon radios and the Huawei routers we asked both vendors to provide us with sets of test equipment so that we could gain a better understanding of how the equipment operated in a lab environment.

After getting comfortable in the lab we expanded the model, and started looking at the impact of implementation across the entire network.

A one for one comparison, existing endpoint/channel interface to IP interface, was performed on the entire network.

Each site had to be surveyed to understand the connectivity requirements for other equipment at the site. We wanted to make sure that interface requirements were determined for equipment that could not communicate over IP such as distributed power repeaters and wind speed indicators.

We also had to take into consideration future equipment that could be installed (PTC needs, additional dispatch radios, additional CTC base radios, etc.).

We had to install GDC SDT (Synchronous Data Transfer) modules to interface the serial port on our Safetran Packet Switches to the IP network in the back office and the serial port on the BCP to the IP network at the tower. This provided a way to use the IP network to transport Serial Synchronous 9600 baud data, allowing the existing packet switches and BCPs to be used after conversion to Ethernet.

We configured the Ceragon radios, Huawei routers, and endpoint interface devices in our Shreveport lab before and racked all equipment in racks before moving the racks to our tower locations. This

minimized the field installation time and ensured proper operation.

The racks containing the new equipment were staged at our tower locations next to the existing equipment racks to help minimize any outages during cutover.

A site package, containing all necessary equipment, hardware, and drawings was created and delivered to each location to assist technicians during the install and cutover.

All cabling, power connections, and grounding terminations were completed before equipment was put in service.

Installation considerations made use of the diversity antennas at each location. Having two sets of antennas between locations allowed for one set of antennas to support the legacy microwave radios and the second set to support the new microwave radios. This enabled us to have both the legacy network and the new network in service, allowing the cutover of each endpoint independently.

Operation of two systems in parallel required that the new coordinated frequencies be added to the existing microwave licenses. After the legacy equipment was removed, the microwave licenses were modified again, removing the legacy frequencies. This process was necessary to comply with FCC regulations during the transition.

After all endpoints were operating on the new microwave system exclusively, the old equipment was removed from locations and the diversity antennas were connected to the new equipment.

Phase II Activities

There were policies and procedures to follow for procurement in the second phase that were not placed upon us in previous phase.

Microwave Radios

We placed an ad in an industry magazine advertising that we were soliciting bids for a digital microwave solution. See ad below.

> The Kansas City Southern Railway Company (KCS) is undertaking a project to modernize our current analog microwave system between Kansas City, Missouri and Shreveport, Louisiana. As part of the project KCS will be replacing the current wireless backhaul infrastructure which will include an upgrade to digital Ethernet radios.

Radios required will need to be upper 6 Ghz and have the RF bandwith capability of 10 Mhz, 30 Mhz.

To participate in the bidding process for the Ethernet radios please contact Sheri Lesmeister-Brown at SLBrown@kcsouthern.com to request a copy of the RFP. Requests for the RFP must be made via email no later than the end of business on June 1, 2011.

We used the requirements that were used in the previous phase and put together and RFP that was sent to vendors.

We gave vendors the opportunity to ask questions get more clarification on the RFP. We sent responses to all questions we received to all vendors that intended to respond.

We received final responses from Ceragon, Electronic Technology, Inc. and Aviat Networks.

We chose Ceragon because their bid came in lower than the other providers and we had previously installed their solution at our other sites.

We followed the same configuration, testing and implementation steps that we used in the previous phase.

Network Routers

By the time we started this phase of the project we had migrated the majority of our data network equipment to Cisco. Even though consistency with technology is important at these sites we felt it was more important to use common routing equipment throughout our network where possible. Because of that we decided to use Cisco routers instead of the Huawei routers used on the previous phase.

We placed an ad in network industry magazine advertising that we were soliciting bids for a digital microwave solution. See ad below.

The Kansas City Southern Railway Company (KCS) is undertaking a project to modernize our current microwave system between Kansas City, Missouri and Shreveport, Louisiana. As part of the project KCS will be purchasing Cisco equipment to replace existing network equipment at microwave locations.

To participate in the bidding process for the Ethernet radios please contact Sheri Lesmeister-Brown at SLBrown@kcsouthern.com to request a copy of the RFP. Requests for the RFP must be made via email no later than the end of business on June 20, 2011.

This material is based on work supported by the Federal Railroad Administration under a grant/cooperative agreement dated 1/31/2011. Agreement number FR-TEC-0008-11-01-00.

We created an RFP using specification and a bill of materials that was created by our network engineering team.

We received final responses from Alexander Open Systems, CDW, DPSciences, Electronic Technology, Inc., ISG Technology, Sirius, Technology Group Solutions and World Wide Technology, Inc.

We chose Sirius as the provider because they offered the lowest cost solution.

After receiving the equipment our network engineering team configured the routers in Kansas City and shipped the devices to Shreveport, LA for testing with the Ceragon radios.

Generators

We identified sites in this territory that needed upgraded generators.

We followed the same processes and procedures for site preparation and installation as we did in the previous phased.

We placed an ad in an industry magazine advertising that we were soliciting bids for a digital microwave solution. See ad below.

> The Kansas City Southern Railway Company (KCS) is undertaking a project to modernize our current microwave system between Kansas City, Missouri and Shreveport, Louisiana. As part of the project KCS will be procuring eighteen Generac back up power systems to install at microwave locations.
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> To participate in the bidding process for the Generac systems please contact Sheri Lesmeister-Brown at SLBrown@kcsouthern.com to request a copy of the RFP. Requests for the RFP must be made via email no later than the end of business on June 27, 2011.
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> This material is based on work supported by the Federal Railroad Administration under a grant/cooperative agreement dated 1/31/2011. Agreement number FR-TEC-0008-11-01-00.

We created an RFP using the same specifications for the Generac generators that were installed in the previous phase.

We only received a response from one vendor, Comet Industries, so we reached out to other vendors that sold Generac generators, Generators of Houston and USP&E but we received no responses.

We purchased the generators from Comet Industries.

We followed the same processes and procedures for site preparation and installation as we did in the previous phase.

Components

At this point in the project we had not received any competitive bids from MBE's. We still had a number of small components that we packaged together in an attempt to allow MBE's the opportunity to participate in the project.

We sent the component list to a number of MBE's we believed could fill the order that we had, they were: Mervwill, Rand, Pstrada and National Material Supply.

We received bids back from each of the vendors above and chose Pstrada because they offered the lower pricing for the entire package.

Approach

Because this is phase II the diligence and research required to understand the solution to deploy has already been done. We had already completed the survey of sites in this corridor during Phase I so we knew what equipment both current and future that would be affected by the conversion to IP.

One significant that event that occurred before this second phase began was an initiative to replace our current Safetran Packet Switch infrastructure with their OCG Server product. This upgrade provided us added redundancy in our core system and also meant we could communicate over IP from the dispatch consoles to the tower locations. Because of the OCG installation we did not need the GDC SDT (Synchronous Data Transfer) modules in this phase.

We configured the microwave radios and endpoint interface devices in our Shreveport lab and racked all equipment in racks including the Cisco routers that were configured in advance in Kansa City before moving the racks to the field locations.

We staged the racks at the locations like we did in Phase I to help minimize any outages during cutover.

All remaining installation and cutover procedures were done the same as they were in Phase I.

Lessons Learned

During the process of researching the Ethernet microwave radios we realized there were many advantages that we hadn't known before. We assumed we would get better probably more efficient re-routing but also learned about other advantages:

- Reduced latency
- Better bandwidth utilization
- Scalable

We came to the realization that the data network used exclusively for handling data traffic for applications had to be prepared and ready to handle "communications" traffic coming from the new IP radios.

We had to become more familiar with dynamic routing (OSPF). Before this project started we were only using static routing on our network.

We realized the importance of having the data network involved in the design of the microwave system. We didn't have their involvement on the first phase and struggled more than we should have trying to learn the new routing protocol.

We realized we had legacy equipment that was not IP capable and that some vendors didn't offer and IP solution.

We learned that there was more work than we had originally planned or understood in the design of interfaces that was needed to communicate with the legacy equipment not capable of IP.

We had to learn new diagnostic and trouble-shooting techniques.

One thing that came to light is the realization that the Data Network and Communications teams have to work more closely together. Not only during the installation phases but also support and trouble shooting of network/communication issues going forward.

We have to become more security aware now with the microwave system. These new radios are now networked IP devices.