Module 4: Basics of Microwave Networks and NRIN
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Course Objectives

- Comprehend the basics of a Data Network
- Understand Microwave Radios as part of the Network
- Identify the Nebraska Regional Interoperability Network (NRIN)
- Analyze the specific benefits to a Local Jurisdiction’s participation in the NRIN System
- Understand the sustainability requirement of NRIN and begin to weigh the benefits of participation in the NRIN System
Radio Communications Essentials

- Basics of Networking
- Microwave Radio Network
- NRIN Project
- Sustainability
- Summary
- Questions
BASICS OF NETWORKING

• How Networks Operate
  • Network Protocols – Rules of the road
    • 1’s and 0’s in packets
    • 100’s of Megabytes per second
  • Hardware Devices – Determine the flow of Traffic
    • Transportation Medium
      • Copper, Fiber Optics, Microwave
    • Switches/Routers
    • Firewalls
      • Protect Nodes and Network
    • Nodes
      • End User
BASICS OF NETWORKING

- Internet/Network Protocols - Rules of the road
  - Multiprotocol label Switching (MPLS)
    - High speed and efficient
    - Direct traffic to nodes utilizing labels vs addresses
  - Internet Protocol (IP)
    - Used for Internal and External (Internet) Networks
  - Voice Over IP (VOIP)
    - Method of converting audio to a digital packet
  - Quality of Service (QOS)
    - Ensures the digital packets arrive in the right order
BASICS OF NETWORKING

- Switches/Routers – Traffic Control Devices
  - Create Paths on Data Network
    - Give priority to certain data packets
    - Regulate Bandwidth (transfer rate) on Network
  - Convert from one Medium to another
    - Interfaces connect to Fiber, Copper, Microwave
  - Convert from One Protocol to Another
    - Example: TCP/IP over Frame Relay
  - Provide a Level of Security
  - Can Reconfigure Network During a Failure
BASICS OF NETWORKING

- Security – Firewalls – Stop and One-Way Signs
  - Protect Nodes (end users) from unwanted data entering their network or going out on the network.
  - Hides Nodes from outside access
  - Can filter or monitor data
MICROWAVE RADIO NETWORK

- Overview of how Microwave Radio Works
  - Data is transferred digitally from one tower to another within line of sight
  - Antenna or Dish size can range in 18” all the way up to 6’
  - Frequency can be from 6 GHZ to 18 GHZ
  - Actual radio is located in building at the towers Base and only minimal electronics are on the microwave antenna
MICROWAVE RADIO NETWORK
MICROWAVE RADIO NETWORK

- Networking With Microwave
  - Provides digital medium to transport data
    - Multiprotocol Label Switching (MPLS) over Ethernet
    - Configured in Ring Topology to increase reliability
  - Cost Effective
    - Long distances

- Reliable
  - Carrier grade equipment
    - Same equipment telephone companies use
  - Can be engineered up to 99.999% (5-9's) reliability
    - Less then 5 minutes per year down time
MICROWAVE RADIO NETWORK

• Limitations
  • Line of sight
  • Environmental conditions can affect link connectivity
  • Requires relativity high locations on towers and other structures
MICROWAVE RADIO NETWORK

- Connectivity to a Network
  - Minimal electronics on antenna
  - Radio located in building or enclosure at tower base
  - Routers and switches co-located with radio
  - RJ-45 Jack (Telephone style Ethernet) or Fiber Optic connection available to PSAP on Router/Switch
  - Battery Backup
NRIN PROJECT

- The Nebraska Regional Interoperability Network is a network of microwave links and other communications mediums providing a 99.999% reliable 100Mbs MPLS over Ethernet network providing connectivity to the 78 Public Service Access Points (PSAP’s) in Nebraska.
- Within the scope of the project other uses include Paraclete, Radio base station interconnectivity, and others we will discuss.
NRIN PROJECT

• Pilot Region – Panhandle Region
  • Towers identified and analyzed for structural stability
  • Tower agreements obtained
    • 3 are in works
  • Equipment Installed in PSAP’s
  • Tower antenna installation in process
  • Acceptance testing will follow build out
NRIN PROJECT

• Continued build out
  • Work from West to East
    • South West Region
      • Identified towers
      • Completing structural analyses
      • Developing Memorandums of Understanding/tower agreements
    • South Central Region
      • Identified towers
      • Preliminary structural analysis
    • South East Region, East Central, North East, and Finish North Central Regions
      • Identified towers
      • Windshield tower analysis
NRIN PROJECT

• Partnership with Nebraska Public Power District
  • Benefits to NPPD
    • Provide a secure data transport medium to areas of the state that currently are lacking connectivity
    • System can be expanded to meet increasing demands
    • Provide backup routes to existing locations
    • Secure network
NRIN PROJECT

• Partnership with the Nebraska Office of Chief Information Officer

• Benefits to OCIO
  • Reliable cost effective connectivity to communications sites that are part of the State Radio System
  • Data links between State Patrol Dispatch Centers
  • Interoperability with Regional Paraclete System
  • Backup to existing communications links to Courthouses and State Facilities.
Partnership with NPPD and the OCIO Benefits to Counties and Local Government

- Discussions with NPPD to provide monitoring of the NRIN system
  - Currently have experienced staff and infrastructure to provide 24/7 fault monitoring of system
  - Have an existing partnership with OCIO for the State Radio System
  - Cost savings
    - Public entity versus for profit
    - Utilize existing NPPD Fiber Network
    - Relationship with other Public Power entities in the State
NRIN PROJECT

- Partnership with NPPD and the OCIO Benefits to Counties and Local Government
  - Discussion with OCIO to provide Management of the NRIN system
    - Currently have experienced staff managing State data communications infrastructure
      - Initial design of system
      - Create data paths or routes to end users
      - Reconfigure system as changes occur
      - Trouble shoot problems
    - OCIO currently has a relationship with NPPD for the SRS
NRIN PROJECT

- Benefits of NRIN to Local Government
  - Sharing radio systems/equipment
    - Paraclete
    - Interoperability Channels and Base Stations
  - Sharing 911 telephone switches
  - Data sharing
    - Backup communications between Courthouses and State
    - Backup County computer data for off-site backup
  - Controlling base stations and other radio equipment
    - Eliminate “Leased Telephone Line” costs
  - Video Arraignments
    - Save transportation costs and improve security
NRIN PROJECT

- Role of the Nebraska Council of Regions (NCOR) in the development of NRIN
  - NRIN cost approximately 12 Million Dollars
  - Funding utilizing 80% local share of Homeland Security Grants
  - Nebraska State Purchasing responsible for bid process
  - NCOR, OCIO, and NEMA involved in vendor selection
Role of the Nebraska Council of Regions (NCOR) in the development of NRIN (Cont.)

- NEMA responsible for Grant and Project Management
- NCOR involved in roll out and installation
  - Tower agreements
  - Coordination of tower access
  - Storage of materials
- NCOR involved in acceptance and testing
• Governance – In Draft Form
  • Proposed governance would provide Local and County representation on a Regional Board
  • Governance Board would consist of representation from each of the 8 regions and NPPD and OCIO
  • Governance Board would oversee operation of NRIN in coordination with NPPD and OCIO
NRIN Project
- Partnerships with NPPD and OCIO will help keep costs down
- Grant sources will continue to be used as they are available
- Various sharing models are being considered
  - Regional
  - Statewide
- Public Service Commission funds may be available, especially for those locations that share 911 Telephone Equipment
- Use Government owned towers and resources to keep lease cost minimal
- Leverage Homeland Security funds to provide upgrades, generators, or modifications to towers for reduced or free tower leases
NRIN Project – Costs to consider

- Microwave Radio Repair/Replacement
  - Spares
  - Advanced replacement
- Insurance
  - NIRMA
- Tower Leases
- Electrical Costs at Tower Sites
- Networking Equipment
- Network Monitoring and Management
  - NPPD & OCIO
SUMMARY

- Basics of Networking
- Microwave Operations
- NRIN Project
- Sustainability
Questions