

Radio Communications Essentials

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
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Radio Communications Essentials

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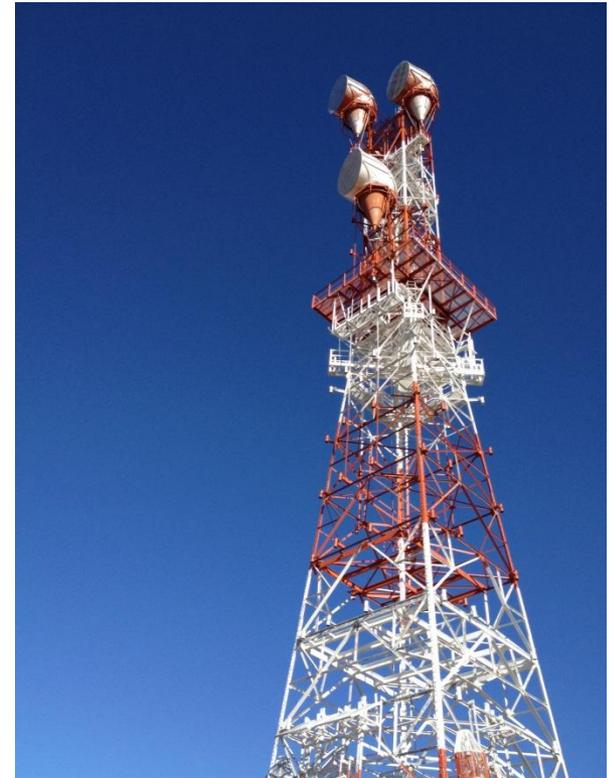
BASICS OF NETWORKING

- 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
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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
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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 than 5 minutes per year down time
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MICROWAVE RADIO NETWORK

- Limitations
 - Line of sight
 - Environmental conditions can affect link connectivity
 - Requires relatively high locations on towers and other structures
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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
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NRIN PROJECT

- The Nebraska Regional Interoperability Network is a network of microwave links and other communications mediums providing a 99.999% reliable 100Mbps 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
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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
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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
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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
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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.
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NRIN PROJECT

- 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
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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
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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
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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
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NRIN PROJECT

- 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
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NRIN PROJECT

- 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
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SUSTAINABILITY

- 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
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SUSTAINABILITY

- 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
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SUMMARY

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

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