

Prepared for

**The West Virginia Department of Health and Human Resources /
State Trauma and Emergency Care System**

Supported by

NORTHROP GRUMMAN

1.0 - EXECUTIVE SUMMARY

Introduction

Northrop Grumman Information Technology (NGIT) is pleased to offer the West Virginia Department of Health and Human Resources / State Trauma and Emergency Care System (STECS) this informational proposal related to providing professional engineering services for the continued design and build-out of the State Medical Command Microwave System. NGIT has included information regarding our ability to engineer a robust, microwave system backed by the extensive resources, experience, and commitment of Northrop Grumman Corporation.

NGIT is the nation's leading provider of integrated communications systems for state and local governments and public safety. As a provider of advanced information technology solutions nationwide, NGIT has a demonstrated and highly visible experience with wired and wireless networks. We are practiced at delivering fully integrated systems on time and within the contracted budget. NGIT is a single point of accountability and a proven leader in providing complex systems with minimal technical, schedule, and cost risk.

NGIT is prepared to discuss our informational proposal in more detail and on-site at any time. In addition, we have read the terms and conditions and are prepared to negotiate those if we are fortunate enough to receive the contract award. We believe our team offers the resources, skills, and experience that the State of West Virginia is seeking, and that the solution we provide will be the most reliable, robust, and secure.

Our Team

Our proposal offers a superb team of wireless industry experts including RF and network engineers, site design experts, and systems integration and test professionals. The Northrop Grumman team brings years of experience in telecommunications, utilities, transportation, public safety, IP networking, and systems engineering. Northrop Grumman Information Technology has the resources, technical depth and breadth, and consensus building approach that will be essential to the overall success of this project. Northrop Grumman provides a single point of accountability for all aspects of the end to end solution.

Northrop Grumman has also identified Goodman Networks as a key partner for this informational proposal. Goodman has provided wireless services for over 15,000 wireless sites in the United States. They were also recently awarded a turf trial for AT&T mobility's entire North Texas network, which is approximately 2,000 linear miles. We have provided more information on Goodman later in this document.

Our Experience

Northrop's relevant experience for this project is broad, including Systems Engineering and Integration projects for public safety communications, municipal wireless networks, Intelligent Transportation Systems, video surveillance and monitoring systems, and networking projects for Federal, State, and Local clients nationwide.

In addition, a major US City has contracted with NGIT for a city-wide broadband wireless network. This includes the design, build, and test of one of the largest and most complex private wireless networks in the world.

These projects, and others, have enabled NGIT to build a catalog of proven wireless applications. Northrop's wireless applications experience will enable STECS to get the most potential benefit from the system with the least development expense.

Northrop Grumman IT is a premier provider of IT solutions to government and commercial markets. We emphasize a proven systems engineering and integration process and programmatic excellence.

Summary of Features and Benefits

In summary, our proposal offers the following features and benefits:

- Highly robust, reliable design capabilities
 - Our team has supported over 60,000 route miles for Microwave, Point-to-Point, VHF and UHF LMR systems.
- Resources and experience of Northrop Grumman and Cisco
 - Experience from other wireless projects
 - State-of-the-art equipment with excellent support and growth path
- Programmatic and risk management excellence
 - Single point of accountability with depth and breadth
 - Backed by \$30 Billion Northrop Grumman Corporation

Northrop Grumman IT looks forward to the opportunity to work with the State of West Virginia and to building a world class microwave network.

Primary Contact:

Howard W. Robertson
Business Development Lead
Northrop Grumman Corp.
15010 Conference Center Drive
Chantilly, VA 20151
(571) 313-2627

Howard.robertson@ngc.com

a) Microwave backbone system design and build including

- **Tower site selection and path analysis design**
- **Overall system design plan**

Our team will work with the existing customer network engineers to determine where a site would be needed to best fit a network; from there we conduct search rings with local real estate agents to determine if an option is available. Once the overall network is conceptualized, we then have the ability to put together a path design and review it with the customer. Our past performance information will cover current projects with related experience.

- **Project Management support**

If we are awarded the project and have negotiated a successful contract, our Project Management Team's (PMT) activities could include but not be limited to the following:

- Develop a mutually agreed structure for cost and schedule data, which will be reported at the market and regional levels.
- Develop mutually agreed project plans and timelines to monitor and track project schedule objectives. The plan can take into account the impact of activities on existing customers that are being served via the microwave sites under construction. The plan can also show long lead times (ie leasing, zoning, permitting, etc...starting early enough to allow other parallel tasks with shorter duration to ensure they meet at a single point in sequence.)
- Implement and maintain the project tools required to manage and track project progress.
- Provide Red/Yellow/Green status reporting (Stoplight Report)
- Develop an escalation path for resolution of all issues related to the project.
- Provide a process flow diagram for the work allotted showing durations, & Pre-requisites of paths with earliest start dates and latest finish dates clearly defined. (Gantt Chart)
- Revision Control initiated at project kick-off.
- Regulatory Requirements will be taken into account in the project plan.
- Access to site must be accounted for in the Project plans – keys, landlords, Security, Gov't facilities, etc...
- Develop a quality feedback/tracking structure for Drive test and Quality audits
- Monitor the schedule including activity descriptions, inter-dependencies, and delivery dates consistent with the project execution plan.
- Develop the project organization structure and resource plan. This includes identification of all resource requirements, workload and work capacity analysis, and job profiling.
- Identifying the project schedule risks and make risk mitigation recommendations.
- Establish the necessary access to the location for material staging and personnel access by working with the customer and other stakeholders

- **Path studies and engineering documentation to determine system requirements**

Our team has provided path study and preliminary engineering documentation for more than 60,000 route miles, for Microwave, Point-to-Point (PtP), VHF and UHF LMR systems, for clients such as BNSF railroad, GE Factory LMR, Cingular/AT&T Mobility, City of Austin, TX and T-Mobile, as well as multiple independent telecommunication firms. We have installed a PtP microwave network in one of the largest metropolitan areas in the nation.

- **Antenna system design with documentation and data sheets**

We routinely perform this type of work for clients such as T Mobile, Alcatel-Lucent, T Mobile, Cingular, Verizon, BNSF RR, City Of Austin, TX, LCRA and Guadalupe and private system clients. Our review of the antenna sizing, power handling, transmission feed system, and tower implementation ensures the highest quality deployment

- **Builds of materials specifications and lists**

Our engineering team can create a multi level bill of materials (BOM's) and then provide that list to our logistics team for procurement. Our logistics team can then procure warehouse and transport material for a full and complete delivery to each project site within the State of West Virginia. We have the ability to be contracted to maintain current, complete and accurate records of the type, quantity, disposition, and location of all equipment and materials in all stages of procurement and delivery. These records can be maintained and updated on a continuous basis and reported data on the disposition of the equipment and materials can be made available to the STECS.

We have the ability to supply the following materials (makes and models to be approved by customer). However, we understand that the STECS may also wish to consider providing the material as well:

- RF lines (coax and jumpers) and associated connectors, loads, and hangers, DC Stops
- Conduit and connectors and for power and Telco upgrades
- Grounding materials, including buss bars as required.
- Telco wiring extensions required
- Electrical materials (breakers and wiring)
- H-frames, to support site upgrades and expansions. Ground scopes which include H-frames also include multi-tenant H-frames if current full, including conduit run from H-frame to building and conduit run from H-frame to telephone pole or Telco box. NEMA enclosure boxes are included. Conduit run from H-frame to building includes material and installation of DC power cable.
- Antenna mounting pipes as required, including hardware.
- 50 ohm terminations as required
- Surge arrestors
- Materials related to Civils construction i.e. concrete, rebar, wire mesh etc
- Antennas and associated RET equipment including cabling as required
- Monopole Platforms (Conventional Pipe Mounts are In Scope)
- TMAs
- TMA Power Distribution Units
- Bias Ts,
- Diplexers,
- Duplexers
- Narrow Band Low Loss Combiner
- Auxiliary service cabinets
- External outdoor enclosures

- Rack Frames
- Automatic Transfer Switches (Intersect or equivalent)
- Waveguide boots
- DC/DC power converters
- AC/DC Power Rectifiers
- DC/AC Power inverters
- A/C MTS or Automatic Transfer Switches
- Outdoor NEMA 3 rated AC distribution panel with adequate breakers
- Antenna Mounting Platforms
- All Pipe to pipe adaptors and associated hardware
- DC Power Plants (if C option is selected.)
- DC breakers and/or DC distribution panels
- RET PDU units and, 3/8" hardline and daisy chain cable
- Jumpers, including all associated materials including, but not limited to, weatherproofing, connectors, and grounding.
- Shelters
- Batteries
- HVAC modifications
- GSM / UMTS Cabinetry

• **Developments of T1 plans and DAC applications**

We have the ability to regularly perform T1 Testing that spans end to end thru the DSX. We can coordinate the activity schedules with LE Carrier, CO and the Cell Site Engineers for the T1 testing. We can also provision the required T1 test equipment, provision and install the hard loop and confirm connectivity to the other end of transmission link.

• **Network management systems and alarms**

Our team is familiar with the configuration and implementation and operation of the Harris Farscan NMS, the original ALU TMS NMS, and industry standard SNMP systems. We recognize that the alarm configurations for all systems are configured unique to customer specifications. We have experience with Manager of Managers such as HPOpenview that can be implemented to control any and all of these local NMS platforms.

• **Network Synchronization plan**

Network Sync plan- is normally accomplished using GPS receivers and a rubidium source at all sites. We can be contracted to determine the best plan necessary, dependant upon the size of the coverage area. Our team has implemented these systems for Cingular, Verizon, and AT&T Mobility as well as several Federal, Commercial, State and Local customers

• **Prior coordination notices (PCN) documentation**

Our engineering staff can be contracted to routinely create the documentation necessary for submission of frequency coordination requests, which causes the generation of the PCN. Our staff has submitted

thousands of documents. Clients such as T-Mobile BNSF RR, county, city and state governments have been served.

- **Specifications of all equipment and antennas systems**
- **Detailed equipment list and specifications**

Our team has the full breadth of staff to support the STECS microwave system. We regularly write detail specifications on multiple pieces of OEM (original equipment manufacturers) equipment. Our staff has written thousands of specifications that include all levels of a project details: Items would include (but not limited to): site address, site contacts, delivery information, equipment information, front equipment drawings, floor drawings, power assignments, circuit assignments, grounding, equipment and rack placements, overhead racking, part numbers for all materials, fiber optic assignments, DSX assignments and placement, main distribution frame placement, battery placement, antennas placement with calculations, etc.... We can also be contracted to provide full AutoCAD drawings capabilities and submit final "as built" drawings as well.

- **Frequency selection and coordination with Comsearch**

RF Engineering has initiated countless requests for frequency coordination and selection for such clients as T-Mobile, BNSF RR, Cities of Austin, Dallas, San Francisco, LCRA, GVUC, ENMR Telephone, OSRHE and many others.

- **License filing and coordination**

Typically we submit licensing information to Comsearch. They return the application to us for verification by our engineering staff before filing.

- **Integration of equipment and system with existing equipment and hardware**

Our field staff have installed and integrated countless microwave systems throughout the United States. This includes the cutover of live traffic onto new equipment for such customers as T-Mobile, Verizon Wireless, and Harris-Stratex and many others.

- **2.4 GHz MW path relocation support as needed and required by FCC**

We have performed hundreds of radio relocations for T-Mobile, BNSF, Cellular One, City of Austin, PrimeCo, Airpath, etc.

- **Design of "overbuild" networks for cut-over of existing paths to new digital system with minimal outage time**

Our engineering staff has completed multiple network overbuilds for national carriers over the past 10 years. We currently are doing this type of work for our customers and can provide detailed examples upon request.

- **Coordination with vendor and DHHR for IP addressing within the network management system**

We are familiar what is necessary to perform this but have not been required by any of our clients to perform this function.

- **Written documentation of “as built” system including equipment rack drawings and overall system wide channel plan**

We have the ability to complete and submit “as built” drawings back to the STECS after project completion. A typical project would involve NGIT doing a site survey in which we capture the current conditions of the STECS site and of the network. During the implementation phase we track any and all changes that occur (if any) and upon project completion all drawings (floor plans, grounding, antennas, radios, rack drawings, tower, T1 assignments, etc.) and systems information would be updated and marked “as built” and turned over to the customer for their records.

- **Evaluation of PCN requests for interference from Comsearch**

Our engineering staff routinely creates the documentation necessary for submission of frequency coordination requests, which causes the generation of the PCN. Our staff has submitted thousands of documents for clients such as T-Mobile BNSF RR, and county, city and state governments.

Other PCN’s.

We currently assist Alcatel-Lucent with PCN’s of their equipment and provide software and hardware upgrades nationwide when required. Normally the Original Equipment Manufacturer (OEM) notifies the equipment owner of any changes to a system (hardware or software) and they make recommendations as to what actions need to take place. This is usually covered in a service level agreement when the OEM equipment is purchased. Normally the OEM will have automated PCN’s that are sent out via email for all customers that purchased their products and registered them.

- **Specialized roof top design of antenna systems**

Our engineering staff has provided EF&I antenna design services on many building roof tops throughout the US. This includes microwave and other communications stations.

- **Assist in recommendation of alternative vendors for components and hardware**

Our staff has the expertise when working with multiple vendors to provide our customers with the best solution.

- **Engineering legal advise with FCC in key license documents**

We are not in a position to provide legal advice on FCC matters. However we can make recommendations.

- **Bandwidth usage analysis**

On one of our large metropolitan deployments we regularly monitor bandwidth usage and perform detailed analysis and reporting to our customer. We make recommendations for equipment upgrades as well as new equipment installation from these ongoing reports.

b) Tower Site Design and Civil Work

Our tower design services would normally look at the towers for specific information to determine next steps on the design:

- Tower Inventory - A tower inventory is the collection of data regarding all equipment mounted on a tower being considered for co-location. NGIT can work with the STECS to identify climbers to make tape drop measurements of equipment mounting heights, gather antenna type and azimuth data, gather microwave size and azimuth data, detail antenna mount types, and to determine the existing coaxial line layouts on a tower. Tower inventories are typically needed in cases where a structural analysis/assessment is to be performed and tower design information is known, but tower loading information is unknown.
- Tower Mapping - Tower mapping includes the equipment inventory services required for a tower inventory, but also includes gathering of specific tower member sizing data. NGIT can work with the STECS to measure and record the details of all tower structural elements and connections in addition to the tower inventory tasks. This would be required in cases where a structural analysis is to be performed, but no tower design information is available.

- **Analysis of location and terrain**

We normally look at this in two aspects.

1. Where the sites need to be placed (network engineering phase)
2. Search Ring would be conducted (work with local real estate agents to find a suitable site)

- **Survey, plot design, site elevations, and "as built" documentation including tower, buildings, utilities, and associated attachments**

See below, same applications would apply, as well as engineering support for any "as built."

- **Plot map of site**

Our team has the ability to provide for the following services to help with site location:

- Candidate Search (Preliminary Search Ring for new site builds)
- Lease Amendments (for Tower Companies or Landlords)
- Lease Executions (Negotiated on behalf of customer)
- Zoning (admin only, Planning & Zoning co-ord and approval)
- Zoning Hearing (Attend public meetings)
- Co-Location Application (Master License Agreement/Site License Acknowledgement, coordinate and track preparation through legal services, including filing all applications with the tower owners, etc.)
- File Review and Letter (as required)

- **Filing of appropriate regulatory applications and permits including appropriate due diligence to include required NEPA, SHPO, and other environmental and historic evaluations**

Our team has completed these filings or confirmed they have been completed for all of the UMTS (AT&T Mobility) and new site builds we have been involved with. We estimate this at over 650 sites in the last 3 years. These are required to assure that sites are not in culturally, environmentally, and historically sensitive areas. These services were performed on both existing sites and Greenfield sites where no towers previously existed. Filing details of these are below:

- NEPA Screening - Work includes the performance of NEPA threshold screening services as required by FCC regulation and the FCC Environmental Assessment Checklist
- NEPA Threshold Screening (incl. SHPO and THPO) Perform FCC required NEPA and related NHPA compliance due diligence according to the latest FCC regulations (Subpart I, Part 1 of the Commission's Rules, 47 C.F.R. §§ 1.1301 to 1.1319 and related amendments)
- Phase I ESA - Conduct an environmental assessment in accordance with the guidelines of ASTM E1527-00 Standard Practice for Environmental Site Assessment: Phase 1 Environmental Site Assessment Process and the related ASTM E1528-00 Standard Practice for Environmental Site Assessment
- Phase II ESA - If warranted, a PHASE II environmental assessment shall be completed in accordance with ASTM E1903-97 (2002) to determine what contaminations are on site, where they are located, the level of contamination, and what actions must be taken to un-contaminate the premises or reduce contamination to an acceptable level
- SHPO - Performing a National Historic Preservation Act Section 106 review to determine impact on any historical properties or properties for which Tribal or Native Hawaiian Organizations have interest.

- **Collections of information and filing of appropriate FAA and FCC documents**

We can confirm that the proper documents are on file with these government agencies. For new sites being built, these must be filed in advance to confirm they do not impact or interfere with existing flight patterns of airports/heliports. These documents are now able to be filed electronically. We have performed either the filing of new documentation or confirmed the presence of existing documentation on many sites. For sites owned by others, this is not a requirement. This is a requirement only for the owners of the structure. It is our estimate that we have done this for several hundred sites. As a part of our due diligence for the STECS, we can review the documentation provided by the tower owner as provided with the submission of an application.

- **Tower loading and structural analyses as required to meet appropriate loading and antenna requirements**

We can perform a structural analysis to maintain the structural integrity of the tower at every site. This analysis could be used to compare existing loadings on a tower to those considered in the tower design. It requires that the engineer have access to tower design drawings and a current tower inventory, this is a drawing that has the tower height and all attachments identified. This deliverable could be in the form of a signed and sealed letter which states that the proposed additional loading can or cannot be supported by the existing structure. This effort is done as an outsource service by a registered PE. Sites being built where none had previously existed do not require this in the design for the tower as the manufacturing process takes these loads into account during the design phase. Should any of the equipment that was used in the design criteria change, the analysis would be redone. Below are the types of assessments that are ordered:

- Structural Assessment - After contract signing, NGIT can work with STECS to have a structural assessment performed by a registered Structural Engineer. This analysis will be used to compare existing loadings on a tower to those considered in the tower design. To perform this work, the

Engineer will need access to tower design drawings and a current tower inventory. The deliverable can be in the form of a signed and sealed letter, which states that the proposed additional loading can or cannot be supported by the existing structure.

- **Structural Analysis** - This work can include a full structural analysis of the tower, considering the existing and proposed loadings, with the intent to determine if there would be any overstressed tower members. An analysis would typically be performed if there is no tower design information or if the tower is at or near its design loading. The analysis will make recommendations on tower upgrades if needed, but will not include the design of the reinforcing. We normally provide sealed engineering calculations in addition to an analysis summary detailing the results of the analysis.

- **AC/DC power systems design**

Our team has DC power engineers in house that can assist in this area. Engineering services could include the analysis of existing or proposed system (fully loaded) and design a DC power system that would provide battery back-up for the network normally up to 8 hrs. Actual AC requirements would follow depending on the DC power system chosen.

- **Communications building selection and design**

Our team can assist in this area as we have ordered many remote terminal (RT) type shelters for AT&T Mobility and have built out the interior for some of those shelters. Actual details of the site would be needed to determine size and type of shelter needed. Some of the factors would include: What equipment will be installed in the shelter, what type of power system will be needed, overhead superstructure, main distribution frame (MDF) 110 punch downs (alarms), cable access points, grounding ring, growth factors, etc....

c) Radio System Coordination

- **Frequency identification and coordination of appropriate RF frequencies at appropriate tower sites**

We have worked with Comsearch and a number of other frequency coordination entities.

- **Coordinate with APCO or other coordinating entities**

Our staff has coordinated with APCO, and any other local government coordinators, and national coordination committees during the preparation for any FCC licenses in the past.

- **Trunked radio system connectivity channel plans**

Our staff has the expertise to work with customers to set channel plans and can complete and submit them as required.

- **Detailed equipment and antenna list and specifications**

This will be accomplished through our engineering services as described earlier.

d) Equipment specifications and training requirements

- **Develop detailed list of required and recommend service and test equipment to maintain the system components**

Our team will collaborate with the STECS to collectively determine any test equipment needed for system maintenance. Below is some typical test equipment that would be recommended. However actual system would need to be identified for specific recommendations.

Tool	Description	Manufacturer	Model
Cable/Antenna Analyzer	Site Master	Anritsu	S251C
Test Sets	T-1 Test Set Quickbert	Fluke	635A
	TEST EQUIPMENT	Anritsu	S332D
	Wi-Fi receiver	Yellowjacket	
	WI-FI Unidapt Kit	RF Industries	RFA-4024
	DS1/DS0 Analyzer	Acterna	T Berd 310-1
RF Test Sets	100W Can Load	Telewave	TWL-100
	Bird 100W Load for 4410A	Bird Electronics	4410-16
	Bird 4410A Wattmeter	Bird Electronics	4410A
	Bird 50W Load Resistor	Bird Electronics	50-NT-MN
	Phase Stable Cable 1.5M	Silverline	SLA06-NM76M
Signal Generator	Signal Generator	A Systems Inc.	PSG-27
Fusion Splicer	40 S Fusion splicer	Fujikura	40 S
Fusion Splicers	CT-20 Fiber Cleaver	Alcoa-Fujikura	CT-20
	FSM-17S Fusion Splicer	Alcoa-Fujikura	FSM-17S
Bar Code Reader	Bar Code Scanner	Hayton Systems or Boeing	Scan Pack
Generator	Portable generator	Parektec	PM0431800.01

- **Develop detailed list and recommendation on appropriate parts and spares to be maintained by agency for maintenance and repair of system**

We will collaborate with the STECS to collectively determine any items that will be needed. With our established engineering and management teams we can offer a list of recommendations that will be needed in the case of a system outage / repair or for regular maintenance.

- **Research and provide assistance in recommend appropriate training courses for service and maintenance of system**

We ensure that our employees are properly trained on site-specific systems and currently scheduled training for our internal personnel.

Project References / Experience

Northrop Grumman References and Experience

Northrop Grumman is a \$30B company with 122,000 employees operating in 50 states and 25 countries. We are one of the top three defense contractors in the United States and one of the top two IT providers to the federal government. The Figure shows our business areas. Our IT sector has over 5000 contracts and is rated #1 by Federal Computer Week's Top 20 Federal Systems Integrators (9/2006). We are Capability Maturity Model Integration® (CMMI®) Level 5 certified which is the largest number of units for any corporation worldwide (36 Level 5 rankings).

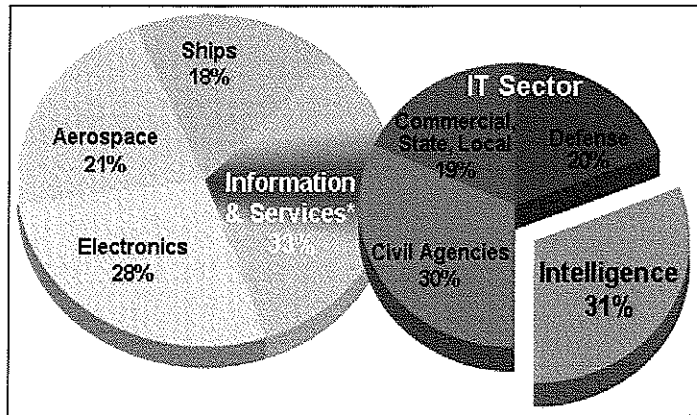


Figure 1 – Northrop Grumman Business Areas

Northrop Grumman has established relationships with Harris, Alcatel, Ceragon and many of the applicable microwave equipment providers. We are vendor agnostic to any one company or product. For this effort we are teaming with Goodman Networks to provide the best of breed solutions to our customers. It is difficult to overstate the importance of vendor independence in a complex system development program. Value added systems integrators understand the advantages of integrating hardware and software products from several vendors into one system that meets all of the owner's requirements in the most cost effective manner.

Some manufacturers of communications subsystems have limited product lines while others offer an extensive line. Experience is that the best solution for the owner in many communications programs is to integrate subsystems from several manufacturers rather than to accept the limitations of a single product line. This demonstrates the value of vendor independence and the advantage a systems integrator offers to an owner in a complex communications system program.

Although some major manufacturers are moving in the direction of systems integration, no single vendor can supply all hardware, firmware, and software necessary to produce a system that economically satisfies the owner's requirements. Nor will most major manufacturers agree to integrate their products with those of a competitor, modify a standard product so that another manufacturer may do so, or license and disclose proprietary details which will, in turn, allow another manufacturer to design an interface.

This situation illustrates why systems integrators will not enter into any distributorship or strategic alliance form of agreements. Such agreements often inhibit their ability to match appropriate products to the system's needs.

Of particular relevance to the West Virginia Microwave Backbone requirement was our work performed on the Ohio Statewide Multi-Agency Radio Communication System (MARCS). The \$245M effort started in 2003 and ended in 2005, was awarded to Northrop Grumman IT to develop requirements, engineer, furnish, and install a multi-agency radio communications system to update Ohio's 50-year-old radio communications system and improve statewide emergency response. The network was designed to provide mission-critical voice and data communications statewide. Now fully deployed, it operates over a two-way, secure, interference-free 800 MHz digital-trunked radio system. Mobile data service is provided by an 800 MHz digital conventional radio system. Over 200 radio tower sites are used with Ohio's existing Synchronous Optical Network (SONET), which delivers 97.5 percent coverage to all counties.

The team also integrated the state's highway patrol officer dispatch system. As call-takers receive incident reports, the Computer-Aided Dispatch (CAD) system prioritizes and logs the incident and determines the nearest available patrol car via the MARCS automated vehicle location (AVL) system. The system then forwards the information and recommended response to the patrol's dispatcher.

The team was responsible for network design, systems integrations and overall program management. Tasks included network simulation, integration, test, construction management, training, maintenance, and data management. Northrop Grumman IT worked extensively with the public safety community to ensure that the system met all operational needs. As the lifeline for public safety users, NG tested the system extensively and worked closely to ensure users were trained in its operation under both routine and emergency situations.

Goodman Networks References and Experience

Goodman Networks has provided a wide range of network and telecommunication services for a variety of telecommunication companies, both large and small. Our Wireless Division has provided wireless services for over 15,000 wireless sites in the US and has provided other services worldwide. In 2007 thru 2008 we have performed over 100 new site & co-location builds (turn-key) and over 5000 site modifications nationwide supporting over \$70 million dollars in wireless services for our customers. Goodman Networks was recently awarded a turf trial of AT&T Mobility's entire North Texas market. This is roughly 2000 linear miles in which Goodman Networks will run and maintain ALL aspects of their network. Furthermore Goodman Networks is well seasoned in working with legacy equipment through our Wireline Division which has over 150 years of combined experience working in Central Offices, Remote Terminals, Central Equipment Vaults and Cabinets across the country. We have performed thousands of system adds, removals, additions, software / hardware upgrade, DC power work, build-outs, system / circuit migrations, etc.

We have a history of project successes with AT&T Mobility (formally Cingular Wireless), T-Mobile, Verizon Wireless, Cricket, Ericsson, Nokia, Microwave Networks, Alcatel-Lucent, Harris Stratex, General Dynamics and other companies. Our wireless services include but not limited to: Microwave Communications System Engineering including LOS path design, trouble shooting, critical and reflection point analysis, Site Surveys and Reports, Path Surveys and Reports, Frequency acquisition

and coordination, Complete Deployment, Installation, Commissioning and acceptance testing of radios and other network equipment, Tower Services for installing microwave antenna systems, Spectrum clearing and relocation services, Maintenance and Operation and De-commissioning Services.

We have also preformed services at many DoD military installations, including Eglin AFB, Nellis AFB, Tinker AFB, US Army Picatinny Arsenal, Ft. Huachuca and ten US Army bases in South Korea.

Some of the projects we have completed are summarized below: (Others can be provided if necessary)

1. Verizon Wireless

Current:

Hwy 59 (5) hops of NEC NLite 16 T1's 6 GHz

Schertz – Austin (4) hops of Harris Constellation 4 DS3 with three radios per antenna system space diversity 6 GHz

Waco (9) hops of NEC NLite 28 T1's 6 & 11 GHz

Proxim GX 5.8GHz spread spectrum (15) hops

Four to ten foot HP on all above projects (Antenna)

2006-2007:

We have installed a total of approximately (85) hops the combination of 6 to 38 GHz frequency bands

Network capacities from 2 E1 to STM-1 (CEPT) or 4 DS1 to OC3 (ANSI)

2 to 190 Mbps; 6 - 38 GHz, Split-mount or all-indoor, Mixed DH/SDH/Ethernet, Integrated loop switch, Drop/Insert.

2.Harris-Stratex

Current:

Schertz – Dilley (8) hops of Harris Megastar 3 DS3 Space diversity 6 & 11GHz

Arkansas Tri County (6) hops Constellation 28 T1's 6GHz

Colorado (4) hops of Constellation 28 T1's 6GHz

CPS (3) hops of Constellation OC-3 6 GHz

Four to ten foot HP on all above projects (Antenna)

2006-2007

We have installed a total of approximately (108) hops the combination of 6 to 38 GHz frequency bands

Network capacities from 2 E1 to STM-1 (CEPT) or 4 DS1 to OC3 (ANSI)

3.Microwave Networks Inc.

Current:

West Virginia (5) hops of CM6 3DS3 6 GHz

Howard County (7) hops of CM 6 28 T1's 6 GHz

Delaware stage 1 (14) hops of CM 6 & 11 28 T1's 6 & 11 GHz

2006-2007

We have installed a total of approximately (31) hops the combination of 2 to 190 Mbps; 6 - 38 GHz, Split-mount or all-indoor, Mixed PDH/SDH/Ethernet, Integrated loop switch, Drop/Insert

4. Alcatel-Lucent

MDR-8000 6 GHz

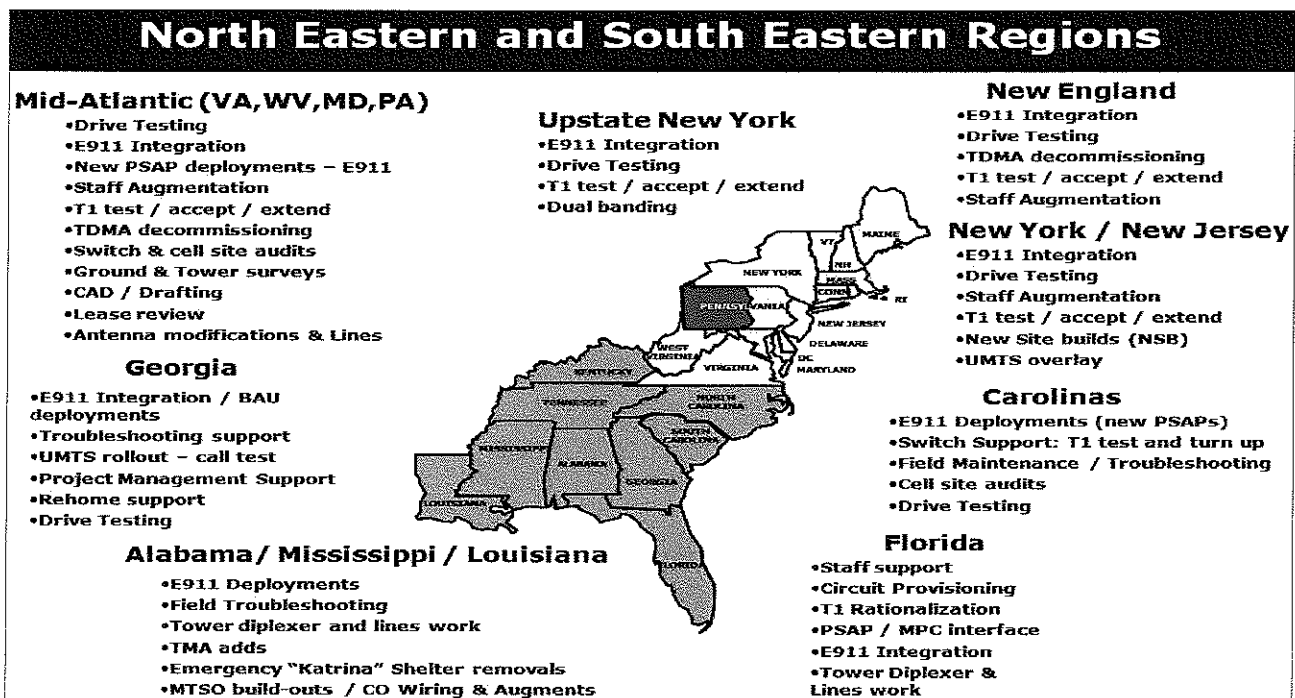
Over (150) site surveys

(9) Sites Furnish and Install MDR-8000

5. AT&T Mobility (Overall)

Over the years Goodman Networks has provided a wide range of wireless services for AT&T Mobility and our proven performance is an indicator of why Goodman Networks is one of their preferred service providers. We have performed wireless services on over 15,000 AT&T Mobility sites and counting over the past 2 years alone. Our ongoing support to related projects such as UMTS Fat Civils and New Site Builds, E911 LMU installs, Complex BTS expansions and microwave radio adds/removals, antenna adds & removals, continuing maintenance support is only a fraction of what we do overall as a company. Our wireless experience runs vast and deep, with that in mind the below lists and illustrations are examples of how we support AT&T Mobility on a day to day basis.

AT&T Mobility/Goodman Projects Across Eastern Regions



AT&T Mobility/Goodman Projects Across the Central Region

Central Region

Minnesota/Iowa/Nebraska

- e911 LMU installations and drive testing - 713 sites
- SAB - 29 sites- on time-ahead of schedule

Oklahoma/Arkansas

- e911 LMU installations WLS harvests - 278 sites
- e911 support for UMTS in Little Rock
- SAB New Builds - 28 sites
- Civils Decomm for 38 sites
- Staffing

South Texas

- UMTS build out - 235 sites
- e911 LMU installations and WLS harvests and drive testing 879 sites
- LMU Health Check - 255 sites
- New Builds - 8 sites
- Tower Work - 255 sites
- SA work on 45 sites
- Misc: HVAC, Cab Adds, Staffing, Tower Lighting, Power/Generator, COWs, Disaster Recovery

Illinois/Wisconsin

- New Builds and CoLos - 19 sites
- Tower Modifications - 14 sites

Michigan/Indiana

- e911 LMU installations, WLS harvest, drive testing 605 sites

Ohio/Western Penn

- e911 LMU installations, WLS harvests, drive testing- 254 sites
- 86 sites prep and partial work

Kansas/Missouri

- Ready to support AT&T

North Texas

- e911 LMU installations/WLS harvests/drive testing- 482 sites
- LMU Health Checks - 876 sites
- Cable/Cab adds- 251 sites
- Staffing

Cingular/Goodman Projects Across the Western Region

Western Region

Northern/Central California

- E911 Site Prep (Fresno) *325 sites
- E911 Site Prep/DSO Testing *1100 sites
- Operational Sustainment-TDOA -Switch & cell site support
- Network (Switch & Cell level)
- E911, RF & OSS Project Management
- Warehouse Logistics
- Transport Engineering Services
- UMTS Site Audits

Southern California

- TDOA Switch-Scout Engineering & Field Testing Sustainment Services
- Equipment Swap Project Management & Field Support
- Andrew Network on cabinet Rip, NSB & UMTS Projects
- Warehouse Asset Inventory
- Site Audits "Physical" - 500 sites
- UMTS Site Audits - 394 sites
- E911 Site Prep & DSO Testing, conduit installs extended cable runs -715 sites

Washington/Oregon

- Network Integration
- Surveys/Site Prep/DSO & PSAP Testing
- RAN Deployment Testing
- NOC Engineering Support - Softswitch
- Transport Support
- T1 Circuit Testing WA/OR
- T1 Test & Turn-up
- Core Network Drive Testing WA/OR
- Re-home Drive Testing
- Full Turnkey-476 sites
- Site Surveys
- LMU Install & Commission
- WLS Cutover and Harvest
- Dual Band Installation
- PSAP Call Tests

Colorado/Utah

- Integration Project Management
- Implementation Project Management
- BTS Technicians
- LMU Installation & Commissioning

San Diego/Las Vegas

- E911/Andrew Support & PSAP Drive Testing
- Scout Engineering
- Rips, Re-homes, NSBs & UMTS Field & Engineering support
- E911 Site Prep & DSO Testing

Arizona/New Mexico

- BTS Technicians
- Drive Test Services

*NOTE: All projects listed above are actual projects completed by Goodman Networks between 2006-2008. We are happy to provide all details of any project when requested.