

Indoor Unit. Sub-Category 5.1

Nokia has a long Global history in the design and manufacture of telecommunications equipment. Our microwave radio design experience in North America began with Collins Radio in 1951 and continues today not too far from the original location in Richardson Texas. The Texas base of operations continues to include Business Development, Program Management, Network Engineers, Transmission Engineers, Product Management, Customer Technical Support and Research and Development resources. Over the last 69 years we have implemented microwave systems for Service Providers and Mission Critical Operators. Nokia's current customer list includes the largest US based mobile operators such as AT&T and Verizon Wireless as well as Mission Critical operators such as the State of California, Florida, Michigan, and Mississippi. Utilities such as Southern California Edison, Dominion Energy, Southern Companies, and Duke Energy. Managing these large projects built the practices and processes to effectively and efficiently implement smaller projects.

Nokia's innovative vision, dedicated resources and the financial stability of a multi-technology company are the key reason why Nokia has maintained the number one microwave market position in North America for over nine years. Nokia is unique in the industry as we manufacture telecommunications equipment to transport your data. As a network solutions supplier, we can supply the microwave transmission, switching, routers, optical, LTE and antenna equipment and their associated services.

Nokia complies to Section 3 of the 00318 AMD4-Exhibit B2-System Solution document and presents a scenario within the Carrier Grade, Packet Data (Native IP) category for an indoor radio hardware configuration. The scenario provides a complete single-hop system that includes all necessary components for the system to function.

A County IT department desires to improve the reliability of their data network by increasing the number of alternate routes their traffic may take in case of multiple failure scenarios. The advantage of an IP/MPLS network is the ability to utilize a mesh concept to increase the number of paths a router can select thus ensuring the mission critical traffic is successfully transported.

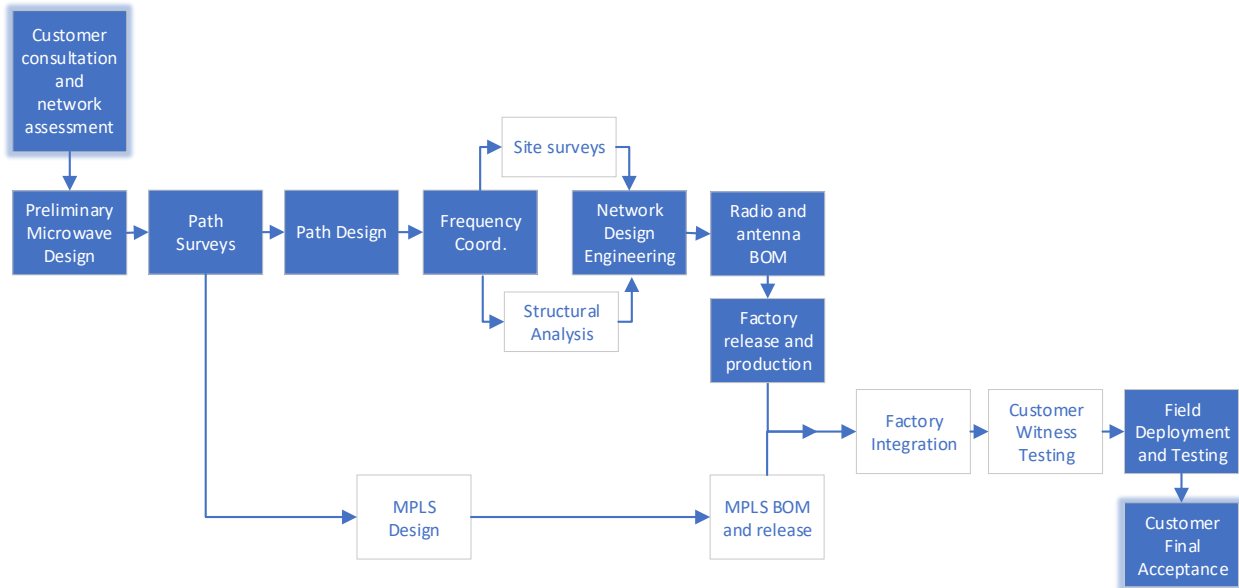


The County and Nokia meet to gather the requirements for adding the new path into their Nokia network and ensure that the scope of work is well defined. From the meeting it is learned that the desire to add the new microwave path is high however the IT budget for this addition is very constrained. To accomplish this goal will require the County and Nokia working together. From this meeting the data and scope of responsibilities were documented. It is from this starting point that the preliminary design and quote can be assembled and submitted to the County for approval. Below were the key points from the meeting.

- The sites have existing Wavence Microwave installed. The installed Microwave Service Switch (MSS) has the available ports to accommodate the new link. The County requires 160 Mbps of traffic across the link at a two-way availability of 99.9995%.
- The County's preference on the equipment configuration is to proceed with an indoor mounted RF unit.
- The sites have existing 100' self-supporting towers with space to accommodate new antennas and waveguide runs. The County provides the tower latitude and longitude locations required for the preliminary path calculation.
- The County IT organization takes on the responsibility of configuring their exiting routers and Network Management System to recognize the new equipment. Nokia need only configure the MSS to map the new VLAN designated 101 to the slot 2 EAC card port #2 and provision the SNMP addresses.
- The Nokia Scope of Work is to provide a Turnkey solution for the one microwave radio link connecting the IT Central site to Capitol site. This scope to include the path design, path survey, frequency coordination, deliver the equipment to the site, install the new Ultra Broadband Transceiver (UBT) into the existing rack and install new waveguide and antenna. Nokia is to perform a sweep of the new antenna system and align the path. Nokia is to perform a standard test to confirm operation.
- The County declines the need for additional spare units or training as they have sufficient inventory and their technicians are already trained on the Wavence product line.
- The County confirms tax exempt status and prevailing wage requirements do not apply

With this information in hand the Nokia representative begins the process of providing the County a Nokia Wavence microwave radio solution. Providing a full turnkey microwave radio solution involves so much more than just providing hardware. The company entrusted to provide

a full turnkey Mission Critical solution must have established policies, processes, quality standards, accreditations, and the proper mindset as to the importance of the network reliability. A full turnkey Mission Critical solutions provider understands and accepts that they will be held accountable from the beginning of the project to end. Nokia excels in all these categories as presented throughout our RFP response. The below process flow diagram and explanation highlights the Nokia process when providing a full turnkey Mission Critical solution.



Preliminary Design and Quote

The path is 4' miles and the design places the antenna center line at 70' and there is a 30' horizontal run from the tower into the shelter and equipment rack location. Thus, the waveguide run between the new Ultra Broadband Transceiver (UBT) to be mounted indoors is 100'. The path design utilizes an 11 GHz RFS 3' Category A antenna. The scope of the installation and test effort will consist of mounting the new UBT RF unit into the existing equipment rack and mounting the antenna at the towers 70' centerline, run the 11 GHz waveguide to the new UBT, sweep the antenna system, align the antennas, provision the MSS shelf for the new service and test the link. Below is a high-level summary of the Hardware, Software and Services pricing required to implement the new link

Link Pricing Summary

Item	Description	Price
1.00	ENGINEERING	SubTotal: \$3,200.00
2.00	MATERIAL	SubTotal: \$18,211.54
3.00	IMPLEMENTATION SERVICES	SubTotal: \$30,715.04
Project Total:		\$52,126.58

Wavence Link Bill of Material

Part Number	Manufacturer	Description	Quantity
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3MU00180	Nokia	RTU 160 Mbps UBT-S Capacity	2
3MU00085AD	CPE Italia	6 ft RJ45 Cat5e Cable	2
3CC50318AA	Nokia	Nose adapter UBT 11GHz	2
3CC50351AA	OMP Mechtron	10.5/11 GHz E-Bend Kit WR90 R100	2
3CC50345AA	Nokia	Rack Mount Kit (for UBT-S, UBT-T)	2
1AF02957ABAA	Commscope	1 meter Twistflex - PBR100/UBR100 (F090KMS4)	2
10049683	Nokia (RFS)	Antenna 3' 11 GHz SC3-W100BC	2
815487-001	Nokia (RFS)	Standard Elliptical Waveguide E105 (10.0 - 11.7 GHz)	200
399503-101	Nokia (RFS)	Connector, Tunable (C90-105TG)	2
399503-103	Nokia (RFS)	Connector, Non-Tunable (top) (C90-105FG)	2
916533-108	Nokia (RFS)	Hoisting Grip (HOIST1-105L) - Lace-up (E105,E78)	2
921234-108	Nokia (RFS)	Grounding Kit - 60in wire, E105 (GKIT-60-105)	6
920981-007	Nokia (RFS)	Hanger Kit for E105, 7/8in coax (CLAMP-105) (10 pack, bolt-on)	6
920745	Nokia (RFS)	Wall/Roof Feed Thru E/EP105 - 1 per boot (WFT-105)	2
400130	Nokia (RFS)	Pressure Window (WPW-090EP) - mates to CPR90G	2
400124	Nokia (RFS)	2ft Twistflex (TF090-CC1-024I) - CPR90G/CPR90G	2
915665	Nokia (RFS)	4in Boot with 1 Hole for E105 (BOOT4-105)	2
915006-w	Nokia (RFS)	Hardware Kit, HDWK3/8-16X1, 3/8 - 16 x 1 bolt (915006) - 10 each lock washers, hex nuts and fillister head screws	6
CEIL12-5I	Nokia (RFS)	Ceiling Adapter Kit, 12in (CEIL12-5I, 514608-003) (5 pack) - waveguide only	2
915255	Nokia (RFS)	Angle Member Adapter Kit, 3/8in Stainless Steel (ANGLE-CLPI) (10 pack)	6
WPFG-1	Nokia (RFS)	KIT WTHPRF CONNS&SPLICE	2
409081635	Valmont	UNIV ADJ LEG MT- UP TO 10 3/4 LEG (Ant. Pipe Mount/Ice Shield)	2

Preliminary Microwave Design

Path feasibility studies are prepared by Nokia's Transmission Engineering Group using preliminary microwave path information provided by the customer, U.S. Geological maps, Nokia US Tree height database, or other sources. Feasibility studies are created using the industry

recognized PathLoss design tool and form the baseline for equipment and radio frequency system design. This baseline can then be used for budgetary estimates.

Path Surveys

Microwave path surveys are conducted to determine or verify site coordinates, ground elevation, on-path obstructions (location and height), tower information, and other parameters required to develop the final design of a radio link. The present and anticipated future effect of on-path obstructions, such as tree growth, is evaluated by Nokia and incorporated into the path design where applicable. The results of the path survey are documented and presented in a formal survey report. Nokia warrants the path survey the geodetic coordinates to be accurate to within +/- 1-second of latitude, +/- 1-second of longitude, ground elevations are accurate to within +/- 1 meter, and that heights of identified on-path obstructions at critical points are accurate to within 5-feet.

Path Design

Path design services conducted by Nokia are based on formal field survey data gathered as described above. Path designs are considered final. The project can move to the deployment stage based on the recommendations within the final design report.

Frequency Coordination

Frequency planning Services include frequency selection, prior coordination, interference case resolution, and FCC license application documentation preparation. Interference studies will be conducted utilizing industry accepted methods, hardware, and software to build a database that is as accurate as possible at the time of the study.

Site Surveys (available service but not included in the proposed scenario)

Site Surveys cover visual inspection of the equipment location, review of customer provided documentation, and collection of information or data relevant to the preparations for the subsequent installation tasks included in the project.

Structural Analysis (available service but not included in the proposed scenario)

Structural and tower loading analysis is performed to determine if the tower is structurally sound to accommodate new radio and antenna equipment loading, determination of reinforcements or modifications that are required in existing towers are made.

Radio and antenna Bill of Materials

Radio and antenna BOMs from the preliminary design are revised and validated against the final design.

Factory Release and production

Once the BOM is updated, the Nokia Network Design Engineer releases the material in the supply chain system for manufacturing, allocation and shipment scheduling.

MPLS Design (available service but not included in the proposed scenario)

Nokia works with the Customer to produce a network detailed design which reflects the Customer objectives and requirements. The design work is done at a Nokia R&D center where design options can be verified in a lab and discussed among the Nokia team of architects. This Service could also include a network migration strategy. The migration strategy is developed in accordance with the network design and aims at preserving the capability and services offered to existing customers.

The network design documentation addresses networking aspects, such as:

- *Physical architecture*
- *IGP topology and IP addressing scheme of the IP/MPLS network*
- *MPLS topology and LSP infrastructure*
- *Element and network security requirements*
- *QoS configuration requirements*
- *Service definition*
- *Resilience model*
- *Synchronization design*
- *Failover mechanisms*

Nokia utilizes the approved Network Design to develop the per-network element configurations, including system, routing, interface and network services needed. Nokia tests the configurations and verify successful integration and conformance with the Network Design.

MPLS Bill of Materials (available service but not included in the proposed scenario)

MPLS BOM from the preliminary design is revised and validated against the final design, the Nokia Engineer releases the material in the supply chain system for allocation and shipment scheduling.

Factory Integration (available service but not included in the proposed scenario)

Nokia radio equipment is staged in the microwave factory and any non-radio (e.g. Nokia routers, NSP server, TSM 8000, etc.) equipment is integrated into the racks per network design. The customer system is provisioned, integrated and tested until is running traffic end to end. The network is tested using a Network Acceptance Test Plan that is specified by the Customer and Nokia. Test Results are provided to the Customer prior to shipment. Staging and Integration testing in a control environment such as the factory provides network performance assurance and reduces installation issues and potential field troubleshooting delays.

Customer Witness Testing (available service but not included in the proposed scenario)

Performed for Customers requesting to observe how the overall network performs prior to shipment.

This process is identical to Integration Testing, with the addition of an onsite witness of the Network Acceptance Test Plan execution, on a network sample, by Nokia and the Customer or the Customer's representative. CWTs are traditionally performed over a 3-day testing interval. Nokia partners with Sanmina to provide an efficient factory staging and CWT experience. Conveniently located in Carrollton, Texas, the microwave factory is within 10-15 miles of the DFW and Dallas Love airports.

Field Deployment and Testing

Nokia has a dedicated team of professionally trained and factory certified installers that efficiently and accurately perform field installation and testing. Upon shipment, the Nokia Project Manager will engage Nokia's expert field installation team, based on the mutually agreed project schedule, to inventory the equipment and begin field installation. The Nokia field installation force will install the equipment according to Nokia's certified field installation practices that ensures the highest quality installation as possible.

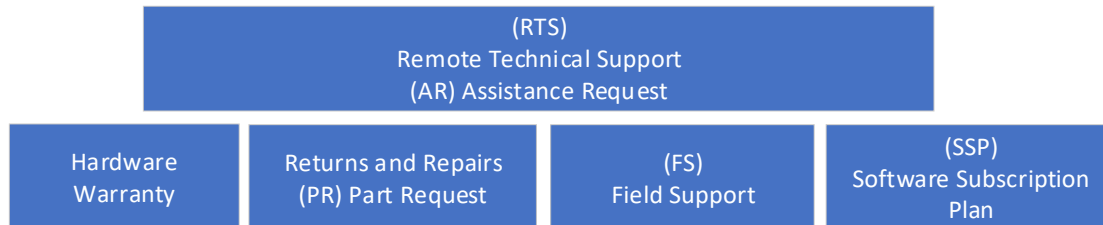
Nokia's Certified Installation Technicians follow all industry guidelines as well as Federal and State Occupational Security, Safety and Health Administration regulations. Their complete design and task execution approach utilize detailed planning and reporting which enables many aspects of the project to be worked in parallel to streamline the process and eliminate delays. Constant oversight and communication by the Program Management Office (PMO) and Deploy Project Manager (DPM) teams ensure all equipment design, manufacturing, and delivery align with civil construction and equipment installation timelines. Onsite project supervision by Construction and Installation Managers enable Nokia to ensure all designs and services meet high quality standards and an availability required.

In the event factory integration is not included in the project scope, all materials will ship to a Nokia Customer designated storage facility and moved to the field for assembly, installation and testing post integration.

Customer Final Acceptance

Once the equipment is installed and inspected, final field acceptance testing is executed with documented test results provided to the customer. The assigned Deploy Project Manager (DPM) manages the creation of closeout packages which include as built drawings and test records and ensures all deployment activities are completed before any necessary resources are released. The assigned Project Manager (PM) verifies that all activities within the scope of Nokia's responsibility have been completed to the customer's satisfaction.

Post Implementation Services



The dedication to our customers extends past the final acceptance with support options available ensuring NASPO Partners know we have a vested interest in your network performance. These services include preventative and emergency maintenance/repair supported by our CTAC (Customer Technical Assistance Center) as well as network monitoring options from our Network Operations Center (NOC). To ensure constant transfer of product knowledge and simplifying the process Nokia maintains the OLCS (Online Customer Support) website to support downloading manuals, software, release information, technical notes and product alerts for any revision of any product 24 hours a day, seven days a week. Diagnostic tools, white papers and remote license upgrades are also available and accessible through OLCS.

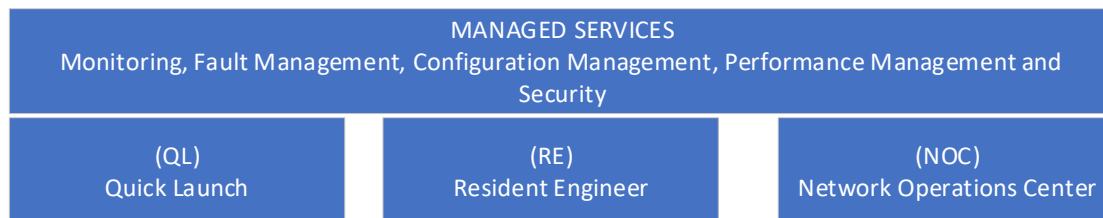
These Services consist of providing support within the agreed response times for the Nokia supplied products. Support, by way of example: Answering product-related questions, troubleshooting assistance, providing diagnostic procedures, investigating suspected software defects and remedying errors and malfunctions providing access to Patch- and / Maintenance-Releases as may become available. For situations where part or all the network's functionalities are not available, the Service offers fast restoration of Customer's end-user services or network equipment for Supported Products, including investigation, troubleshooting and continuous remote support by Nokia's experts until the functionality is restored. Services are offered for repair or replacement of Field replaceable units (FRUs). Customer will return a reported FRU to Nokia who'll repair or replace the FRU. Nokia offers multiple SLA options (advanced replacement, 30 - 90 days options) for the repair or replacement services.

Nokia has industry leading defined response time KPI benchmarks that may be chosen based on Service hours and service access with hours that best fit the Customer's needs. All requests for assistance are considered as Ticket Requests and classified as Critical, Major, Minor and Information Requests. Nokia provides several easily accessible options to Customers (via phone on 24*7, email and web access) and tracked against the services defined KPI's.

Software Subscription Plan or Software release subscription service will make available all Feature Releases of software for network/node elements, management systems for specific network elements or families of network elements, and other network-related applications for

Customers network. Feature Releases may also include provision of third-party software upgrades, as may be made available by the third-party software manufacturer, if the third-party software is supported by Nokia and was licensed by Nokia.

Managed Services



Nokia Managed Services has been operating communications networks for over 20 years. Business and organizations across industries (enterprise, energy, government, and telecom sectors) leverage our capabilities to realize any combination of OPEX reduction, operations expertise, and/or reduction of risk when introducing new/unfamiliar technologies into their network. Today, Nokia operates over 1 million network elements (of which 70% are non-Nokia products) which over 700 million users communicate every day.

The Managed Services solution assumes operational fault management responsibility over all or a subset of an enterprise or Microwave IP/MPLS network through a central NOC (Network Operation Center), applying state-of-the-art operations processes and tools. We provide 24*7 network surveillance and trouble resolution via our Network Operation Centers (NOCs) that have the capability to cover every fault detection and resolution aspect of running your network operations. The Managed Network Operations solution offers enterprise, energy, government and telecom sectors targeted fault management operational support when needing to:

- Migrate from legacy to next- generation operations
- Reduce time to market
- Minimize risk involved in new deployment projects
- Improve network key performance indicators and service level agreements
- Ensure optimum service availability, without increasing internal staff and associated costs
- Introduce new technologies in existing environments
- Launch new services

Nokia's Managed Services can be delivered from its onshore Delivery Center in Texas or from its Global Delivery Center in India. As part of our solutions we offer a comprehensive OSS platform that introduces advanced and sophisticated levels of automation, intelligence, correlation, and filtering driving quality and efficiency. Our services are provided against committed Service Level Agreements to which we hold ourselves accountable

Additionally, our onshore organization also helps our customers with consultative services including Operations maturity assessments, on the job operations knowledge transfer, and NOC Resident Engineering services for staff augmentation.