ITEM 683.8010 03 M – SONET DIGITAL MICROWAVE RADIO UNIT

DESCRIPTION:
This work shall consist of furnishing and installing SONET Digital Microwave Radio Units at the locations indicated on the plans. The SONET Digital Microwave Radio Unit shall contain all of the components described in the Material Specification and shall be configured as indicated on the plan sheets.

MATERIALS:
The SONET Digital Microwave Radio Unit shall be a microwave system that operates on a licensed frequency channel. The operational frequency of the SONET Digital Microwave Radio Unit is the approved FCC licensed frequency for this project and will be in the 18 GHz frequency band. Alternatively, a 23 GHz frequency band can be utilized as the operational frequency, if the 18 GHz channel is not available. The SONET Digital Microwave Radio Unit shall be the latest product manufactured by Alcatel, NEC, Harris, or equivalent vendors that are in compliance with these specs and approved by the Engineer.

The SONET Digital Microwave Radio Unit shall include an In Door Unit (IDU), an Out Door Unit (ODU), a Microwave Antenna, an RF Cable and Network Management Tools (NMT). The ODU shall include radio data transmitter/ receiver modules and may be integrated with an IDU that is compliant with the requirements in this specification. The SONET Digital Microwave Radio Unit shall meet international SDH/SONET Standards confirming to applicable ETSI, ITU-R, ITU-T, FCC and Bellcore recommendations. The SONET Digital Microwave Radio Unit shall be compliant with the IEEE 802.3 Ethernet standard on its Ethernet interface output. The SONET Digital Microwave Radio Unit shall be equipped with two 100 Base-TX/FX Ethernet interfaces for full delivery of the data payload.

The assembly shall include provision for system configuration, setting for Antenna Alignment, ability to set up Tools for Network Management, and ability to monitor the System Alarm and System Performance Testing. The Contractor shall provide a fully operational assembly with all cabling and terminations matched to support the selected components. The SONET Digital Microwave Radio Unit shall consist of the following major components.

(a) In Door Unit (IDU)

Frequency Modulation: 16 QAM or 32 QAM and 128 QAM
Standard: 1. ITU-TG 703, G 707, , G824, G 957 and G 958
2. ETSI ETS 300 147, ETS 300 417
3. ANSI T1. 105, ANSI T1. 102-1993
4. Bellcore GR-253-core, or equivalent ANSI standard.
Standard Interfaces:

1. Data Network Interface, 100 Base-TX/FX
2. Wayside data channels for DS-1, Port RJ-45 or RJ-48
3. Wayside data channel for DS-3, Port RJ-45 or RJ-48

NOTE: Two 100Base-TX/FX ports for delivery of all data payloads are required. The payload assignment between two 100 Base-TX/FX ports shall be 50/50 or as directed by the Engineer.

4. Relay Alarm Output and External Input, connector as specified by the manufacturer
5. Network Management Tools, 10Base-T, RJ 45 Connector and RS-232 Port, RJ-45 Connector
6. Auxiliary Data Channel, EIA RS-232 Data in Port RJ-45

7. Auxiliary service channels including:
   - 64 kb/s G703 data channels
   - Voice party line channels
   - 64 kb/s V.11 data channel
   - 9.6 kb/s V.24/V.28 data channel

Alternative: As an alternative Interface, the Contractor may provide an external SONET Multiservice Access Platforms (SMAP) Unit for delivery of all SONET OC-3 payload to Ethernet (Ethernet over SONET). The SMAP Units shall complaint all general Electrical and environment requirement of the IDU, which are specified in this specification and complaint with following technical requirements:

1. User Interfaces; 10/100/1000 base T, IEEE 802.3, 802.3U, 802.3X
2. User Interfaces; Gigabit Ethernet, Line Connector 1310 nm or 850 nm, standard IEEE 802.3z
3. Network Interface; 155 Mbps line rate optical connector compatible with IDU unit.
4. Network Services:
   - SONET, ANSI T1.105, Telcordia GR-CORE
   - Ethernet Over SONET, Generic Framing Protocol (GFP), Virtual Concentration (VCAT), Link Capacity Adjustment
Scheme (LCAS), ITU-T G.7041/Y.1303, ITU-T G.7042/Y.1305

- Low Order Concentration, VT 1.5
- High Order Concentration, STS-3c, STS-1

5. Management

- Agents, TL-1, Telcordia GR-199-CORE, GR-833, SNMP: v1, v2c, HTTP Web Server/GUI
- Remote Management, RS-232, Ethernet 10Base-T, Telnet/FTP, Software Download

Payload Capacity: 150 Mbps Ethernet, 155 Mbps SONET

Payload Delivery: Two Fast Ethernet Ports or OC-3 Optical with SONET Multiservice Access Platforms Unit Alternative

Payload Type:

1. IP Over SONET (IP Over Packet)
2. SONET: OC-3/ STS-3, OC-3C/ STS-3C
3. SDH: STM-1
4. ATM: ATM Over SONET / SDH
5. TDM: DS-3, DS-1

Equipment Architecture: Split In Door and Out Door Units

Equipment Configuration: Non-Standby (1-0)

- Hot-Standby (1+1) Optional

Safety Compliance: UL, EIA – 310-D, IEC 60950, GR-63, GR-1089

Digital Interface: Two 100Base-TX/FX, Compliance with IEEE 802.3, 802.3U

DS-1 and DS-3 per ITU Rec.G. 703

Data Connector: Ethernet port RJ-45, DS-1 and DS-3 port RJ-45 or RJ-48

Diagnostic Connector: Ethernet port RJ-45, utilized for Ethernet connection for access to the Network Management Tool (SNMP or HTML).

Diagnostic Connector: RS-232 port DB-9 or RJ-45, utilized as serial interface port (RS-232) to the SONET Digital Microwave Radio Unit, IDU. This port
provides configuration and maintenance information about the SONET Digital Microwave Radio Unit to a connected computer or terminal via Telnet.

Low Speed Data Port: This is an optional serial interface port RS-232, which allows the user to connect auxiliary serial data from one point in the wireless network to another.

Temperature: -5°C to 45°C or better
Humidity Range: 0 to 95% non-condensing at 45°C or better
DC Power: ± 24 or -36 to 60 VDC with 100 Watts (maximum)
AC Power: 120 Volts 60 Hz

The power supply module can be an external power supply unit. The power supply unit shall be compatible with the SONET Digital Microwave Radio Unit equipment and compliant with applicable requirement of this specification.

Dimension: Maximum 65 mm (H) x 305 mm (D) x 482 mm (W), 19” standard rack
Weight: Less than 5 kg.

b) Out Door Unit (ODU)
The Out Door Unit (ODU) shall comply with the following specifications:

Regulatory Information: FCC Rule Parts 101, ETSI EN 301 751
Frequencies: 18 GHz and 23 GHz

Frequency Stability: less than 10 PPM
Frequency Channel Selection: Software Control
Radio Transmission Delay: Less than 150 µs
Channel Spacing: 40 or 50 MHz meets FCC Channel plan
Transmitter/ Receiver Spacing: 1560 MHz for 18 GHz, 1200 MHz for 23 GHz
Minimum Transmission Capacity: 150 Mbps for each frequency channel per polarization
Transmission Output Power with or without Automated Transmission Power Control (ATPC)
With ATPC:  15 dBm to 20 dBm for 18 GHz, by approval of the Engineer
Without ATPC:  15 dBm to 18 dBm for 18 GHz, by approval of the Engineer

System Gain with ATPC:
At 10⁻⁶ BER:  +89 dB or better (Including branching losses)
At 10⁻³ BER:  +87 dB or better (Including branching losses)
(Protected branching losses should not exceed more than 3.5 dB for TX or RX)

Receiver Noise Figure:  Max. 5.5 dB at 18 GHz and 6. dB at 23 GHz

Threshold Receiver Signal Level on Antenna Input
At 10⁻⁶ BER:  -73 dBm or better (16 QAM)
-70 dBm or better (32 QAM)
-67 dBm or better (128 QAM)
At 10⁻³ BER:  -75 dBm or better (16 QAM)
-72 dBm or better (32 QAM)
-68 dBm or better (128 QAM)

ATPC Range:  Minimum 8 dB
Transmit Branching Loss:  1.5 dB, 3.5 dB by the Engineer approval
Receive Branching Loss:  1.5 dB, 3.5 dB by the Engineer approval
Maximum RSL 10⁻³ BER:  -5 dBm, or as approved by the Engineer
Maximum RSL 10⁻¹⁰ BER:  -5 dBm or as approved by the Engineer

C/I Ratio at:
Co-Channel:  30 dB or better
1st Adjusted Channel:  -4 dB

C/N @ 10⁻⁶:  18 dB
C/N @ 10⁻³:  22 dB

Test Function:  Bit, BERT, Loop Back
RF Connector:  N type Connector or equivalent as approved by the Engineer.

Safety Compliance:  UL, EIA – 310-D, UL 60950

Emission Designator:  40M0F7W
Temperature:  -30°C to 50°C or better
Humidity Range:  0 to 90 non-condensing at 50°C
DC Power: Feeding from IDU
Dimension: Maximum 300 mm (H) x 350 mm (D) x 300 mm (W)
Weight: Less than 6 kg.

(c) Microwave Antennas
Type: Parabolic high performance all frequency
Dimension: 610 mm diameter dish
Polarization: Horizontal or vertical
Weight: Less than 15 Kg
Survival Wind Speed: Minimum 200 Km/h
Antenna Type: FCC Class A
Alignment:
  Azimuth: ± 15° degrees
  Elevation: ± 35° degrees

As recommended by the SONET Digital Microwave Radio equipment manufacturer, the Contractor may submit the equivalent antenna specification to the Engineer for review and approval.

(d) RF Cable
Type: LMR-400 for distance up to 100 M
      LMR-600 for distance up to 150 M
      LMR-900 for distance up to 225 M.
      LMR-1200 for distance up to 350
      or equivalent as approved by the Engineer.

Connector: N type Connector or equivalent as approved by the Engineer.

(e) Mounting Configuration
The Out Door Unit (ODU) and Antenna shall be installed on the CCTV pole at the Antenna’s lowering attachment or utilizing a Roof/Wall Mounting Kit for the building location. A typical mounting configuration and connection to the Antenna lowering device’s junction box shall be as shown on the CCTV Pole detail plans. The Contractor shall install the Antenna and ODU based on the manufacturer’s recommendation or as directed by the Engineer.
The Contractor shall install the antenna at a permanent position on the Antenna Lowering attachment and then attach the ODU mounting plate and mount the ODU itself. The antenna and ODU assembly must be mounted on the CCTV pole at a position that provides line-of-sight path clearance to the far-end location. The antenna system shall be installed according to the manufacturer’s instructions. The ODU shall be grounded using the CCTV pole grounding system.

The Contractor shall utilize the manufacturer’s Antenna Roof/Wall Mounting Kit specified for the building site requirement. The Contractor shall mount the antenna rigidly, with adequate room for azimuth and elevation adjustment from the rear. The Contractor shall provide a specification of the mounting kit that includes the details on how to mount and adjust azimuth and tilt. The Contractor shall utilize the existing Building Grounding and ensure this grounding is adequate for lightning protection of the Antenna.

The antenna polarization must be the same at both ends of the link, either vertical or horizontal.

(f) Network Management Tool

The Contractor shall install the Network Management Tool for operation and maintenance of the SONET Digital Microwave Radio equipment. The Network Management Tool system shall be developed by the SONET Digital Microwave Radio equipment manufacturer for management and maintenance of the wireless network. The Contractor shall install, configure, operate and test the Network Management Tool for the project network.

The Network Management Tool shall include the following functionality or components:

- An intuitive, pro-active element network management system with enhanced diagnostic and performance monitoring tools.
- Provision for open, reliable and user-friendly GUI-based SNMP management and Craft Terminal Interface (CTI).
- Fault Management, Alarm reporting via SNMP traps and SONET MIB.
- Three level password protection, Challenge protocol (CHAT) security.
- Physical interface, PPP over RS-232 modem port (up to 56 kb/s) and 10 base T Ethernet port.
- Performance Statistic; Ability to support local and remote terminal configuration, status/alarm reporting, traps, statistics (per G.826) and diagnostics.
- Proactive management of all links from a single operator console, over IP, using the SMNP tool.
• Operating System that runs on Microsoft Windows XP Professional with the latest service packs.
• An embedded SNMP agent in each IDU that implements standard IETF/RFC MIB II Ethernet, E1/DS1 and E3/DS3 MIB’s extensions that enable remote monitoring and control of the entire link or complete network from a single point.
• An incorporated RIP Protocol that enables simultaneous management of all radio links. An equivalent protocol may be applicable if approved by the Engineer.
• Performance Management; Alarm based on adjustable threshold such as RSL, BER, Temperature.
• Radio links that are easily controlled (in-band or out-of-band) from the management station.
• Performance Log, Minimum 30 days performance data captured at 15-minute intervals.
• System parameters that are software configurable.
• HTTP or Trivial File Transfer Protocol (TFTP) that enables remote software upgrading. An optional solution for remote access over the Internet may be acceptable if approved by the Engineer.

CONSTRUCTION DETAILS:
The Contractor shall prepare a shop drawing, which details the complete installation of the SONET Digital Microwave Radio Unit assembly and all components to be supplied. Particular care shall be given to the interconnection of all the components and cabling. The Contractor shall allow a minimum of four weeks for the Project Engineer to review and approve shop drawings and catalogue cuts.

The Engineer reserves the right to inspect and/or factory test any completed assemblies prior to delivery of the material to the project site. Any deviations from these specifications that are identified during such testing shall be corrected prior to shipment of the assembly to the project site.

The SONET Digital Microwave Radio Unit’s In Door Unit (IDU) will be installed in the equipment cabinet as indicated in the contract documents. The Contractor shall install the SONET Digital Microwave Radio Unit’s Out Door Unit (ODU) and Antenna at the locations indicated in the contract documents.

The feed to the SONET Digital Microwave Radio Unit shall be connected to a 120 VAC power source. The Contractor shall furnish and install required RF and power cable that runs from the Antenna to the ODU and runs from the ODU to the IDU under this item. The RF and power
cable shall be of sufficient length to terminate all required functions in the equipment cabinet. Appropriate connectors must be supplied to interface the in-cabinet components to the SONET Digital Microwave Radio Unit being installed.

Warranty

A warranty certificate shall be supplied for each component from the designated depot repair site indicating the start and end dates of the warranty. The certificate shall be supplied at the conclusion of the System Acceptance Test and shall be in effect for a minimum of two years subsequent to that date. The certificate shall name NYSDOT as the recipient of the service. NYSDOT shall have the right to transfer this service to other private parties who may be contracted to perform overall maintenance of the facility.

All components to be supplied under this specification shall be warranted for a minimum of two years from the conclusion of the System Acceptance Test. This warranty shall include repair and/or replacement of all failed components via a factory authorized depot repair service. All items sent to the depot for repair shall be returned within two weeks of the date of receipt at the facility. The depot location shall be in the United States. Repairs shall not require more than two weeks from date of receipt and the provider of the warranty shall be responsible for all return shipping costs. The depot maintainer designated for each component shall be authorized by the original manufacturer to supply this service.

Stand-Alone Test

A Standalone Test shall be performed for each completed SONET Digital Microwave Radio Unit. The test shall first be conducted from the equipment cabinet utilizing the standard communication Ethernet protocol and laptop computer. The Standalone Test shall verify that the SONET Digital Microwave Radio Unit is fully operative and can achieve its full throughput and bandwidth. In addition, with the use of the Network Management Tool the unit performance and characteristics shall be demonstrated to be in accordance with specifications. The Contractor shall provide the SONET Digital Microwave Radio Unit Standalone Test Checklist to the Engineer for review and approval prior to the test.

Central Operations Test

The Central Operation Test shall be performed after establishing all communication links between network Hubs and establishing the wireless network backbone as specified and shown on the plans. The Central Operation Test shall be performed using the Network Management Tool at the Traffic Management Center to manage and operate all SONET Digital Microwave Radio Units. The Contractor shall provide the Central Operation Testing Procedure to the Engineer for review and approval prior to the test.
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System Acceptance Test
The Contractor shall perform the System Acceptance Test after all construction and installations have been completed and the Central Operations Test has been passed for all contract items. As part of this test, all ITS elements and the communications network shall be tested in order to verify the overall system operations in accordance with the contract documents. The System Acceptance Test shall be considered to have passed after six (6) months of operation of the ITS equipment from the Traffic Operations Center without any failures.

Documentation
One copy of all operations and maintenance manuals for each SONET Digital Microwave Radio Unit component shall be delivered for each unit installed.

METHOD OF MEASUREMENT:
The SONET Digital Microwave Radio Unit bid item will be measured for payment by the number of SONET Digital Microwave Radio Units furnished, installed, activated, tested, and made fully operational.

BASIS OF PAYMENT:
The unit price bid for each SONET Digital Microwave Radio Unit shall include the cost of furnishing all equipment, material, delivery, testing, documentation and the labor for installation of a complete SONET Digital Microwave Radio Unit, as necessary to satisfactory complete the work.

Progress payments will be made as follows:

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<tr>
<th>Event</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Approval of Shop Drawings</td>
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<tr>
<td>Operational Stand-Alone Test of Assembly</td>
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<tr>
<td>Central Operation Test</td>
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<tr>
<td>System Acceptance Test</td>
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