MATERIAL SPECIFICATIONS FOR WIRELESS LINK

SECTION 1 – GENERAL

The Wireless Link specification is for the listed components to be used in the Wireless Link pay item. Each component includes the antennae and appurtenances for a complete functioning system based on the design requirements. Each component meets the general requirements plus any specific requirements in its respective section. ITS devices are to integrate into each respective multiplexor type component.

1-1 GENERAL

Wireless Link Types
SR = Serial Link
PP = Ethernet Bridge Link
GB = Gigabit Back Haul Link
BH = Low Band Data Back Haul Link
MS = Mesh Link
AP = added to any above designations denotes, Access Point with one link
BS = added to any above designations denotes, Base Station with multiple links
RP = added to any above designations denotes, Repeater unit that receives & retransmits signals to extend link range and/or go around obstacles.

Antenna Types
A = Sector Antenna
B = Panel Antenna
C = Omni Directional Antenna
D = Directional Antenna
E = Parabolic
F = Yagi Antenna

Comm Cable type **WL**, Cable from wireless link unit to antenna, specified by manufacturer of Link Unit
Comm Cable type **BH**, Cable from wireless link unit to equipment cabinet, specified by manufacturer of Link Unit.

- MTBF: 100,000 hours
- Warranty 2-year on parts and labor AFTER PROJECT ACCEPTANCE

1-2 STANDARDS

- IEEE networking features:
  o 802.1d (Ethernet Bridging)
  o 802.1p (Traffic Prioritization)
  o 802.1q (VLAN)
  o 802.1s (Spanning Tree)
  o 802.lx (PNAC)
  o 802.1w (Rapid Spanning Tree)
  o 802.3ac (802.1q & 802p support)
  o 802.3ad (Link Aggregation)
  o 802.3i (10Mbps Ethernet)
  o 802.3u (100Mbps Ethernet & Auto-Negotiation)

- o 802.3x (Full Duplex and Flow Control)
- o 802.11a (Wireless Networking)
- o   802.11b   (Wireless Networking)
- o 802.11e (WMM & QoS)
- o 802.11g (Wireless Networking)
- o 802.11h (DFS & TPC)
- o 802.11i (WPA2)
- o 802.11n (Wireless Networking)
- o   802.16 (WiMAX)
- FCC Part 15
- IP 65, IP 66, IP67
- EIA RS-232, RS-422/485
- UL listed for outdoor use

1-3 <u>NETWORKING FEATURES</u>

- Modulation: DSSS, OFDM with BPSK, QPSK, QAM16, QAM64
- Operating Mode: Master, Remote, Repeater, Remote/Repeater

<u>Wireless Signal Encryption and Authentication</u>:
- WEP, WPA/WPA2, WPA/WPA2-PSK, TKIP, 128/256/512-bit AES encryption,
  RADIUS authentication, EAP-MD5, EAP-TLS, PEAP-TTLS
- Packet Filtering MAC, Ethertype, IP address filtering, Layer 2, QoS, IP address filtering, VLAN, IP
  discovery tool with remote management, Remote SSH, SNMP, FTP
- IP discovery tool with remote management, Remote SSH, Layer 2 Switching & Traffic Isolation,
  DHCP, Boot P, Etherlike MIB, 802.11 MIB, Bridge MIB, MIB-II ,
  SNMPv3, SSH, HTTPS, RFC-1213, RFC-1215, RFC-2790, RFC-2571, RFC- 3412, RFC-3414,
  Private MIB, Web GUI and SSL, TFTP
- QoS: VLAN, TOS bit, IP Protocol, UDP port, TCP Port, 4 Queues, Multicast Efficiency Handling

<u>Management</u>:
- Local Management Port: RS232, RS-422/485, 10/100/1000 Base-T Ethernet (RJ-45)
- Remote Management: HTTPS, SSH, CLI
- Web-based Management (HTML): Setup, security, status, statistics, software update,
                                                    SysLog and SNTP support
- Voltmeter test points: Receive Signal Level and Link Quality

<u>Software Requirements</u>:
- IP Discovery Tool
- Local and Remote Configuration
- Bandwidth Test Tool
- Spectrum Analysis / AP Scan Tool
- Real Time RSSI
- Client Connection Quality
- Audio Aiming Tool
- Configuration File Management
  - o View/Save/Print Configuration Files
- Network-Wide Diagnostics:
  - o Noise Levels
  - o Received Signal Strength
  - o Connection Quality
  - o Alarm logging of diagnostic values which exceed user settable thresholds
  - o VSWR readings
  - o Input Voltage readings (Max/Min)
  - o Temperature readings

1-4 <u>ENVIRONMENTAL</u>

- Weather, Water, & Dust Proof: IP65
- Relative Humidity: 95% (non-condensing)
- Operating Temperature Range: -33°C to +60°C
- Wind Loading: 125 mph

1-5 <u>INTERFACES</u>

- Ethernet Connection options:
  - One (1) Auto MDI-X 10/100/1000 Mbps port
  - Two (2) Auto MDI-X 10/100/1000Mbps ports
    - Port #1 with PoE in & Data
    - Port #2 with PoE out (802.3af pin out) & Data
- Management Port: RS232, RS-422/485, 10/100/1000 Base-T Ethernet (RJ-45)
- Antenna Connection: Type-N, female connector, SMA-Connector, TNC-Connector, Integrated MIMO Antenna or other Internal Type.

1-6 <u>POWER</u>

- Input Voltage: 100-250 VAC 50/60 Hz (POE Compatible – Optional)
- Power: 30 watts typical, 65 Watts max.
                                                      90 watts max. for Gigabit Backhaul or Backhaul Links
- Output Voltage: POE ≤1 A @ 18 VDC
                                                      Surge protection included in PoE Injector
- Maximum Radio Transmit Power: ≥ 1 watt

1-7 <u>ANTENNAS</u>

- Antennas are to be supplied with all mounting hardware for specified location
- Rated for frequency range compatible with radio
- Minimum Gain
  - Omni: 8 dBi
  - Sector: 10 dBi
  - Panel: 18 dBi
  - Parabolic: 28 dBi
  - Non-Omni: 14 dBi

SECTION 2 – SERIAL DATA TRANSCEIVER LINK

- Network Topology: Point-to-Point, Point-to-Multipoint
- Operating Mode: Master, Remote, Repeater, Remote/Repeater
- Outdoor Range: 0.5 - 10 miles
- Throughput Data Rate of no less than 9600 bps and no more than 115200 bps.
- Unlicensed Frequency:
  - 902-928 MHz
  - 2.4-2.4835 GHz
  - 5.25-5. 35 GHz
  - 5.47-5. 725 GHz
  - 5.725-5. 850 GHz
- Licensed Frequency:
  - 5. 85-5.95 GHz – Transportation (ITS)
  - 4.94-4.99 GHz – FCC Only (Public Safety Band)
- Serial Connection: RS-232/422/485, DB-9 port
- Dimensions not to exceed: 15" x 14" x 9"

SECTION 3 – ETHERNET BRIDGE LINK

- Network Topology: Point-to-Point, Point-to-Multipoint
- Operating Mode: Master, Remote, Repeater, Remote/Repeater
- Outdoor Range: 0.5 - 10 miles
- Data Rate: 1.5-54 Mbps, 108 Mbps, 300 Mbps
- Unlicensed Frequency:
  - 2.4-2.4835 GHz
  - 5.25-5. 35 GHz
  - 5.47-5. 725 GHz
  - 5.725-5. 850 GHz
- Licensed Frequency:
  - 5. 85-5.95 GHz – Transportation (ITS)
- Dimensions not to exceed: 12" x 10" x 6"
- Weight: 14lbs max
- Available Hardware Configuration:
  - Integrated Panel Antenna
  - Access Point Cluster (4 radio modules)
  - Stand-Alone Enclosure (1 or 2 radio modules).

SECTION 4 – GIGABIT BACK HAUL LINK

- Network Topology: Point-to-Point, Point-to-Multipoint
- Operating Mode: Master, Remote, Repeater, Remote/Repeater
- Outdoor Range: 0.5 - 10 miles
  Min Range: 1320 ft. (0.25 mi)
  Max Range: 15,840 ft. (3.0 mi) OR 20 mi
- Data Rate: Full duplex 1 Gbps
- Frequencies:
  - 71-76 GHz 'Light Licensed' E-band
  - 60 GHz
  - 72.500 GHz
  - 80 GHz
  - 82.500 GHz
- Antenna: Integrated 44dBi gain, 3 dB beam with no more than 0.9°
- Communications Port:
  - 1000 BASE-SX (MM Fiber Optic Cable)
  - 1000 BASE-LX (SM Fiber Optic Cable)
  - 1000 BASE-TX (CAT-6)
- Power: 90 watts max.
- Dimensions not to exceed:
  - 6" x 12" x 4"
  - 24" x 24" x 20" with dish and mount
- Weight:
  - 10 lbs max.
  - 22 to 38.5 lbs max with dish and mount
- Regulatory Safety:
  UL Listed, CE Mark, EN60950, meets FCC 1.1310 general population RF MPE limits
- RF Certifications:
  EN302217 (2008-11), U.S. FCC Part 15.255
- Link Budget (@ 1 Gbps)
  1' dish   172 dB @ 10-12 BER   174 dB @ 10-6 BER
  2' dish   186 dB @ 10-12 BER   188 dB @ 10-6 BER
- Data Latency:
  < 40 µs
- Maximum Ethernet frame length:
  1632 bytes

SECTION 5 – LOW BAND DATA BACK HAUL LINK

- Network Topology: Point-to-Point, Point-to-Multipoint
- Outdoor Range: 0.5 - 10 miles
- Data Rate: Full duplex 1.5-56 Mbps, 108 Mbps, 300 Mbps
- Unlicensed Frequency:
  - 2.4-2.4835 GHz
  - 5.25-5.35 GHz
  - 5.25-5.825 GHz
  - 5.725-5.85 GHz
- Licensed Frequency:
  - 4.94-4.99 GHz – FCC Only (Public Safety Band)
  - 5. 85-5.95 GHz – Transportation (ITS)
- Dimensions not to exceed: 12" x 10" x 6"
- Weight: 14 lbs max

SECTION 6 –MESH LINK

- Network Topology: Point-to-Point, Point-to-Multipoint
- Outdoor Range: 0.5 - 10 miles
- Data Rate: Full duplex 1.5-56 Mbps, 108 Mbps, 300 Mbps
- Unlicensed Frequency:
  - 2.4-2.46   GHz
  - 2.412-2.462 GHz
  - 5.15-5.850 GHz
  - 5.25-5.35   GHz
  - 5.25-5.825 GHz
  - 5.47-5.725 GHz
  - 5.725-5.85 GHz
- Licensed Frequency:
  - 4.94-4.99 GHz – FCC Only (Public Safety Band)
  - 5. 85-5.95 GHz – Transportation (ITS)
- Dimensions not to exceed: 12" x 10" x 6"
- Weight: 14 lbs max