SECTION 17790
COMMUNICATIONS NETWORKS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Section includes requirements for the Caltrain WAN/LAN network equipment and components required to connect station system and service to the assigned Central Control Facility (CCF) and Caltrain headquarters in San Carlos. The network shall be based on the TCP/IP suite of protocols.

B. Section also includes requirements for Clipper WAN/LAN network equipment and components required to connect station Card Interface Devices to the Clipper WAN.

1.02 CALTRAIN COMMUNICATIONS NETWORKS SYSTEM DESCRIPTION

A. In the station, provide new (or update the existing) data T1 service with serving speeds of upto a "full" T1 (1.544 Mbps) to connect the TVM/VMS/PA/CCTV to the Caltrain WAN (Wide Area Network).

B. Provide all necessary conduits, cables, and cabinets to inter connect the local communications provider MPOE (Main Point of Entry) to the station CER (Communications Equipment Room). Note that, in absence of CER, some Caltrain stations may still utilize outdoor Station Communications Cabinets (SCC) also sometimes referred to as Communications Interface Cabinets (CIC). It is the intent that the SCC's/CIC's be phased out and upgraded to CER's. In this Section, for simplicity, the terms "SCC" and "CIC" are omitted. The term "CER" is used instead and it covers all types of station central Communications equipment implementation.

C. Coordinate with the local communications provider in the design phase to setup the MPOE in the station under the local communications provider requirement.

D. Provide all necessary material, labor, and equipment to affect the frame relay service in the station.

E. Provide dual 1000 Base Managed Ethernet switches at each station CER to interconnect the router and all other network devices. The station CER Ethernet switch shall have minimum capacity of twenty-four 10/100 Base T/TX port (12 of which shall be PoE compliant) and four single-mode fiber capable GBIC-based ports. Each switch shall be sized for an adequate number of GBIC, 10/100 Base T ports and PoE enabled 10/100 Base T ports to service the required number of subsystem devices assigned, plus 50% spare ports. At the current stage, the Station design will not include the interconnection by a Caltrain wide area fiber network. However, the station CER Ethernet Switches shall have two (out of four) single mode GBIC expansion ports assigned and programmed as spare for this future wide area fiber network.

F. Provide Dual 1000 Base Industrial Managed Ethernet switches at each station distribution cabinet. Each switch will be sized for an adequate number of 10/100

Base T ports and PoE enabled 10/100 Base T ports to service the required number of subsystem devices assigned, plus 50% spare ports.

G. Use a single-mode fiber optic ring topology for all station 1000 BASE FX switch interconnectivity.

H. GBIC modules shall be provided for each GBIC-based port in the switch.

I. In a new station, furnish and install a router device with the necessary CSU/DSU (Channel Service Unit/Data Service Unit) and Ethernet module. The router shall interconnect the station network equipment in the station to Caltrain WAN. The router shall has minimum of four expansion slots with four built-in 10/100 Ethernet ports.

J. Dual 1000 Base (GigE) Ethernet switches shall be installed in the Communications Equipment Room (CER) and each field communications distribution cabinet per the Contract Drawings. Station CER and DC GigE switches shall be assigned to the single-mode fiber optic backbone and interconnected in a dual redundant physical ring topology. For redundancy, station field devices (such as TVM and VMS) serviced by these dual switches shall be divided into two groups: first group will be served by one distribution switch; the second group will be served by the second distribution switch. The dual switches shall be programmed in such way that, if one of them fails, field devices connected to the failed switch could be manually reconnected to the remaining (healthy) switch ports.

K. All switching networking equipment will be located in the station Communication Equipment Room (CER) and station distribution cabinets (DCs). Subsystem devices shall be serviced from the distribution cabinet using copper (TIA/EIA Category 6) cable. Where required by design, the subsystem devices shall be PoE powered by the switches over the Category 6 cables. Subsystem devices with integrated networking (switching) and direct fiber interfaces shall be serviced directly from the CER using single-mode backbone cable, eliminating the need for intermediate network electronics.

L. All network equipment, related protocol/media converters and any other active equipment connecting Station systems to the Station network require UPS-backed power, which shall be rated for provision of non-interrupted service for at least 90 minutes in the event of loss of utility power.

M. Provide any required stand-alone field media converter/switch for each subsystem device requiring protocol conversion. Interfaces and network topology for subsystems are described in Division 17 Specification Sections related to that subsystem. Fiber Optic Media converters and single-mode cabling shall be used when the Category 6 cable run to the subsystem device exceeds 300 feet from the serving Ethernet Switch in CER or DC (whichever is closer). If such subsystem device requires PoE power, the Media Converter shall support provision of 10/100Base-T with PoE output. For such applications, the single-mode runs shall be accompanied with power wiring delivering UPS-backed power to the remote Media Converter with PoE.

N. Wireless equipment to connect an extended range system device to the distribution cabinet where conventional UTP or fiber cable placement is not

possible shall be furnished and installed with Engineer's approval. For example, where a required CCTV camera placement would exceed the cable distance limitations set forth in TIA/EIA 568-B, a wireless link can be used, with the Engineer's approval.

O. Access requests to the Caltrain network require consultation with the Engineer; upon Engineer's approval, provide a firewall router to access the Caltrain network.

P. Should network equipment specified herein become obsolete or should an upgrade model become available, replace the specified equipment with most current available model with Engineer's approval. Submit full technical specifications for the replacement equipment for Engineer review prior to purchase.

Q. Test and make operational all specified equipment required to operate all communications subsystems in a station using the TCP/IP Ethernet network.

1.03 CLIPPER COMMUNICATIONS NETWORK SYSTEM DESCRIPTION

A. Clipper station communications network is independent from Caltrain station communications network. Clipper establishes the frame relay service in a station to connect the Clipper WAN to the station Clipper CID (Card Interface Device) LAN. Clipper provides for the station CID Router, CID Ethernet Switches and CID devices (Caltrain provides for the CID poles and poles temporary covers). The typical design of the CID network is of traditional non-redundant star topology, which includes: CID Router at CER for WAN/LAN interface connected to the CER Ethernet Switch, which in turn utilizes station single-mode fiber backbone for connection to the CID Ethernet Switches placed within DCs. The CID Ethernet Switches within DCs provide for CID LAN connection to the adjacent CID card readers over Category 6 cabling, utilizing existing Category 6 patch panel equipment within DCs. The CID devices have to be powered by 24VDC power supplies installed within the DCs. The actual project Clipper communications network implementation may vary, see the project Contract documents for the Clipper network design requirements and implementation details.

B. Provide all necessary rack space, conduits, 24VDC power supplies, patch cords and cables to inter-connect the Clipper station communications network devices between MPOE (Main Point of Entry) to all station CIDs. Install all necessary poles and temporary pole covers. Note that, since Clipper communications network utilizes some of the Caltrain backbone cabling and patch-panel equipment, such Caltrain network equipment design shall accommodate these additional connections.

1.04 CALTRAIN COMMUNICATIONS NETWORK DESIGN REQUIREMENT

A. All network equipment shall be commercially available through multiple sellers or distributors. The manufacturers shall have implemented a standard Quality Assurance program such as ISO 9001 certification.

B. All network equipment shall include an SNMP agent for management. Management protocols supported shall include SNMP, RMON, and Telnet.

C. All network equipment shall have a minimum of five (5) years warranty from the manufacturer.

D. The network equipment shall be 19 inch EIA rack-mountable or DIN rail mountable.

E. All switches shall auto-detect full and half-duplex operation on all ports.

F. All switches shall support VLAN (IEEE 802.1Q), Rapid Spanning TreeProtocol (IEEE 802.1W), and Multiple Spanning Tree Protocol (IEEE 802.1S). The Ethernet dual redundant rings shall be configured for detection of failure and switchover to the healthy side of the ring within a few milliseconds of a failure.

G. The switch shall have embedded web-based management software with the ability to manage up to 16 switches at once.

H. No network equipment which has been retired from production, or reached End-of-Life, by the manufacture is acceptable for installation. Network equipment which has been scheduled for production End-of-Life shall be accepted only by Engineer's approval.

I. All Ethernet switches shall be environmentally rated for operation within internal temperatures, vibration and shock, dust, surge and noise immunity ratings of the station CER and DCs.

J. All outdoor copper cabling connected to the CER or DCs switches shall utilize lightning/surge protection equipment at the point of entrance into those facilities.

1.05 SUBMITTALS

A. Refer to Section 17000, Basic Communications Technical Requirements, for related and additional submittal requirements.

B. Submit performance data descriptions or samples of all products furnished under this Section for Engineer review.

C. Submit application to the local communications provider and Engineer for the frame relay circuit, and PVC (Permanent Virtual Circuit) service in the station. The circuit shall meet the specification and requirement of the system in the station.

D. Submit shop drawings showing the details of interfacing the frame circuit from the MPOE to the station devices.

E. Submit network diagrams of the system including all interfaces and devices. Include specification cut-sheets for all proposed network components.

F. Submit the IP and VLAN addressing scheme for the station subsystems. The scheme shall be consistent with Caltrain network and assignment conventions.

G. Submit a Network list for all devices, showing proposed network addresses, subnets, gateways, mask assignments, VLANs and terminal address of each device

H. Submit cabinet equipment vertical profile drawings depicting equipment placement in each cabinet. Submit thermo calculations showing that internal temperature of the cabinets will never exceed maximum allowed temperature ratings for the chosen switches and other network equipment.

I. Submit a complete bill of materials (BOM) for all network equipment and accessories.

J. Submit manufacture warranty documentations of all proposed network equipment described in this Section to the Engineer.

K. Submit a system cutover plan for approval no later than 30 days prior to the cutover.

L. Submit documentation to prove and demonstrate that the required steps prior to cutover specified in this Section have been completed seven (7) days prior to the cutover.

PART 2 – PRODUCTS

2.01 STATION ETHERNET SWITCH

A. The switch shall be furnished and installed in the station distribution cabinet. The switch shall be rugged switch designed for the harsh, rugged transit.

B. The switch shall be compliant with IEC-61850-3 and IEEE 1613 specifications for extended environmental, shock/vibration, and surge ratings; with a focus on redundancy; and convection cooling (no fans) with temperature ratings up to +60 degrees C (measured as continuous operating temperature range)

C. The switch shall be sized for an adequate number of 10/100 Base T ports and PoE enabled 10/100 Base T ports to service the required number of subsystem devices assigned, plus 50% spare ports.

D. The switch shall be equipped with at least two Single-mode GBIC modules.

E. The switch shall support IEEE Rapid Spanning Tree (802.1W) and Multiple Spanning Tree Protocol (IEEE 802.1S) for high resilience redundant fiber backbone connections.

F. The switch shall support PVST layer 2 load sharing on redundant ring links.

G. The switch shall support VLAN trunking protocol and 802.1Q.

H. The switch shall be the Cisco CGS-2520 series or Engineer approved equal.

2.02 STATION AGGREGATION ETHERNET SWITCH

A. Provide dual aggregation switches in the station CER. Each switch shall be connected to the Station LAN Ethernet switch using two GBIC-based ports via a Single-mode fiber ring topology (with additional two single-mode GBIC-based ports programmed as spare for connection to future Caltrain fiber WAN network).

B. The switch shall be sized for an adequate number of 10/100 Base T ports and PoE enabled 10/100 Base T ports to service the required number of subsystem devices assigned, plus 50% spare ports.

C. The switch shall be equipped with dual power supplies with hot swap capability and automatic failover.

D. The switch shall provide for routing and uninterrupted performance at Layer 2 and Layer 3.

F. The switch shall provide for ability to upgrade uplink bandwidth to 10 Gigabit Ethernet.

G. The switch shall provide for multitude of redundancy features, such as 1:N master redundancy; network resiliency and redundant fiber backbone connections through Rapid Spanning Tree IEEE Protocol (802.1W), etc.

E. The switch shall be the Cisco Catalyst 3750 series or Engineer approved equal.

2.03 STATION ROUTER

A. Router shall be a rack-mountable.

B. The router shall be a highly reliable with IP LAN connection and proper WAN interface module.

C. The router shall have two high speed Ethernet ports or modules.

D. The router shall be equipped with a minimum of 2GB memory to support remote and local VLAN's and required security configurations.

E. The router shall be equipped with dual power supplies with hot swap capability and automatic failover.

F. The router shall be CISCO 2900 integrated services or 3900 integrated services series or equal. Router is dependent on the type of network interface (T1, DSL, ADSL, OC3) used.

2.04 GBIC MODULES

A. The GBIC modules shall be furnished and installed to connect among the Station Aggregation Ethernet Switch and distribution Ethernet switches

B. The GBIC modules shall meet or exceed the following specifications:

1. Support VLAN (IEEE 802.1Q), Rapid Spanning Tree (IEEE 802.W) and Multiple Spanning Tree Protocol (IEEE 802.1S) protocols

2. Support Layer 3 routing

C. The GBIC modules shall be provided with LC type fiber connector or SC type fiber connector if the LC type is not available from any manufacture and with the permission of the Engineer.

D. The switch shall have Single-mode GBIC modules available for future Station to Station connectivity but not supplied under this contract. Data sheets shall be submitted.

2.05 FIREWALL ROUTER

A. The firewall router shall be optionally provided as require by the Station network design.

B. The firewall router shall have an integrated 4 port 10/100 switch.

C. The firewall router shall have a lifetime warranty from the manufacturer.

D. The firewall router shall be the Cisco PIX525 bundle 50 or Engineer approved equal.

2.06 MEDIA CONVERTERS

A. Media converters used to interface the single-mode fiber optic cable at the subsystem device will be placed in the distribution cabinet (DC) associated with that device per the site specific plans. Media converters for TVM, VMS, and CCTV subsystems shall be dual 10/100 Base FX port with automatic ring path switching protection.

B. For remote devices requiring PoE, Media Converters shall provide for an Ethernet 10/100Base-T ports with IEEE 802.3af PoE.

2.07 UTP CAT 6 DISTRIBUTION PANEL

A. The Cat 6 48-port UTP distribution panel in distribution cabinet shall meet the following Specification:

1. Qualified Cat.6/Class E

2. Permanent Link/Channel of TIA/EIA568B-2.1 Cat.6

3. ISO/IEC11801 2nd Edition

4. EN50173 2nd Edition

5. IEC60603-7

B. The UTP Cat 6 patch panel shall be LEVITON 48-PORT PANEL CAT6 BLK 3U or Engineer approved equal.

2.08 UTP PATCH CORDS

A. Patch cords shall be Category 6, factory made, and not spliced and terminated on-site. They shall come in non-resonant standard lengths of 6 or 7 feet.

B. The patch cords shall have strain-relief RJ-45 connectors. The patch cords shall be rated as a minimum, Category 6 unshielded twisted pair cabling, and shall terminate all eight positions of the connector.

2.09 FIBER PATCH CABLE

A. Patch cords shall be complete factory fabricated assemblies from manufacture's standard product line. They shall come in standard lengths of 6 or 7 feet.

B. Patch cords shall be of the same Fiber Optic characteristics as the backbone cable.

C. The patch cords shall consist of flexible cable with either SC or LC compatible connectors (as required for particular application).

D. The patch cords shall comply with the requirement of TIA/EIA-568-B.

E. Patch cords used for single-mode fiber will be colored yellow.

2.10 CABLE MANAGEMENT

A. Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19-inch equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lock-washer.

2.11 LCD CONSOLE DRAWER

A. Rack mount console used for programming the equipment shall be furnished and installed in station distribution cabinet for each station.

B. The rack mount console shall include a monitor, keyboard and touch pad.

C. The rack mount console shall meet or exceed the following specifications:

1. Compatible with most PS/2 or USB type of KVM switches, to match provided computer equipment.

2. Integrated KVM console (88 key keyboard and touch pad) in a 1U rack mountable slide-away housing

3. Rack mountable in 19" system rack (1U)

4. Built-in touch pad

5. Power Consumption: 120V~230V; 50Hz~60Hz

6. Monitor Resolution (minimum): 1024 x 768

7. Operating Temperature: 0° - 50° C

8. Metal enclosure

2.12 KVM SWITCH

A. Rack mount KVM switch used for programming the router, switch and other device shall be furnished and installed in station distribution cabinet for each station.

B. The KVM switch shall meet or exceed the following specifications:

1. Use of keyboard, monitor and touch pad to control up to eight computers

2. Multilevel password protection

3. Quick view scan mode for monitoring selected computers

4. Operating System-independent operation

5. Connected PC can be added or removed from the setup without powering off the KVM switch

6. Plug-n-Play monitor support

7. Video resolution up to 1900x1200

8. LCD, SVGA, VGA and multisync monitor support

9. Mouse and keyboard emulation for system bootup

10. No software required to operate

11. LEDs for easy status monitoring

12. Rack mountable in 19" (1U) system rack

PART 3 – EXECUTION

3.01 INSTALLATION

A. Topology:

1. Each station (node) on the network shall have a physical address (Ethernet address), and shall be assigned with a logical (e.g., IP) address or a terminal ID. Where required, it shall also be assigned to the corresponding VLAN.

2. Program the IP address and terminal address to each system device accordingly to the IP address scheme approved by the Engineer.

B. LAN cabling:

1. Ducts carrying LAN cabling shall be installed in accordance with TIA/EIA-569-B and properly grounded according to TIA/EIA-J-STD-607-A and MIL-HDBK-419A standards.

2. LAN cable shall be routed away from all sources of interference, including power lines, motors, radio interference, fluorescent lighting, and heavy machinery.

3. The LAN cable shall be installed in inner duct and routed via protected risers and overhead raceway. Network equipment shall be installed to provide sufficient immunity from all electromagnetic disturbances.

C. Tagging:

1. Wire and cable shall be permanently tagged as specified in Section 17120, Communications Wires and Cables. Network configuration records shall be created and maintained. Tag labeling and network records shall be in accordance with TIA/EIA-606-A.

2. All jacks shall be identified using permanently mounted white tags with permanent black 1/8-inch minimum height lettering.

D. Station network equipment installation:

1. Provide an Access Router (Cisco 2900 or 3900 series or equal) at the main distribution cabinet to interface the network carrier. Connectivity from the network carrier (MPOE) to the Access Router shall be made with new conduit and wring.

2. A Cisco 4-port 10/100 Fast Ethernet switch WIC (WAN Interface Card) card shall be installed to provide LAN connection to existing VMS matrix display. Provide the necessary software and hardware upgrade on the router to support the new module.

3. Install and position the station network equipment in cabinets or racks as shown on the Contract Drawings.

4. Install and position the distribution network equipment in cabinets or racks as shown on the Contract Drawings.

E. Central and station circuit upgrade and installation:

1. Be responsible for installing the Frame Relay services at the station, and shall establish and provide facility for setting up the frame relay service MPOE.

2. Install and setup a T1 circuit in the station.

F. Provide all equipment necessary, including router, WAN Interface Card, CSU/DSU, wiring and conduit for the Station and Central Control WAN upgrade.

G. Assist Clipper personnel with installation, termination and testing of the CID network devices.

H. Be responsible for the recurring cost of the new circuit during the test period and before the system and station cutover.

3.02 SYSTEM CUTOVER FOR A NEW AND REMODELED STATION

A. Submit a detailed system cutover plan based upon the requirements in this Section and the construction sequencing and cutover schemes.

1. This plan shall include all phases, and describe in detail how the objectives of elimination of system down time, and minimization of system disruption will be accomplished.

2. The new frame circuit and system shall be made operational and tested alongside the existing system in the station before the cutover.

3. The detailed cutover sequencing and order of work shall be subject to the Engineer's approval.

4. Plan shall take into account Work Window from 1 am to 4 am for the TVM LAN and Clipper LAN cutover work; plan shall minimize TVM and CID service disruption.

B. Steps Prior to Cutover: The following is a summary of the steps required to be completed and documented seven (7) days prior to cutover the TVM/VMS system:

1. The new circuit and private virtual circuit (PVC) provisioning at each station, including any network upgrade, shall be installed and tested.

2. All cabinets including the communication rack/cabinet shall be installed with proper grounding.

3. All cabinets including the communication rack/cabinet shall be equipped with protective electrical outlets.

4. The conduit from the Telco cabinet to the communication rack/cabinet shall be provided.

6. The fiber cables from the station distribution cabinet to the distribution cabinets shall be installed and tested.

5. The UTP or fiber cable to the TVM machines, VMS signs, and other devices shall be terminated and tested.

6. UTP and fiber cable test result shall be submitted to the Engineer.

3.03 OPERATIONAL TESTS

A. General: Perform all manufacturers recommended equipment and cable testing. Perform all available equipment built-in unit and communications paired tests. Exercise and demonstrate as operational all equipment configuration, management, and diagnostic functions.

B. For new station Router and the new Ethernet Switches, perform the following additional tests:

1. Verify proper routing of network data from the WAN to the appropriate Station LAN and Node. Verify that the sub-net design allows test data to appear only at the intended destination(s).

2. Measure maximum throughput from the WAN to each station load under normal operating conditions.

3. Measure maximum throughput from each Distribution cabinet to central racks/cabinet.

4. Test all router and switch ports (including spares) to assure complete functionality at installation.

5. Observe the switch and router operating systems for indications of port errors and report all error rates above the vendor recommended maximum.

C. Assist Clipper personnel with their testing.

D. For station with wireless infrastructure, perform the following tests for all wireless links:

1. Transfer a minimum of a 500-MB file through each wireless link.

2. Measure and record transfer speeds.

END OF SECTION