



RAPID TRANSIT SYSTEM EXTENSIONS
COMPENDIUM OF DESIGN CRITERIA

VOLUME VII
SYSTEM EQUIPMENT DESIGN CRITERIA

CHAPTER 7
COMMUNICATIONS DESIGN CRITERIA

INTERIM RELEASE

REV 1

OCTOBER 30, 2008

PROGRAM MANAGEMENT CONSULTANT

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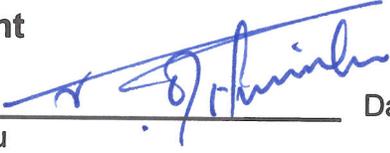


VOLUME VII – SYSTEM EQUIPMENT

CHAPTER 7 – COMMUNICATIONS DESIGN CRITERIA

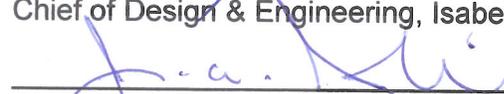
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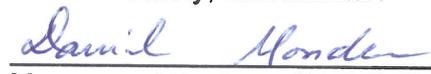
Submitted  Date 4/16/2009
Project Manager, Soji Tinubu

**Miami-Dade Transit
Engineering Review Board Members**

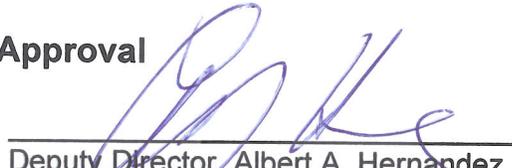
Approval  Date 4-16-09
Chief of Design & Engineering, Isabel Padrón

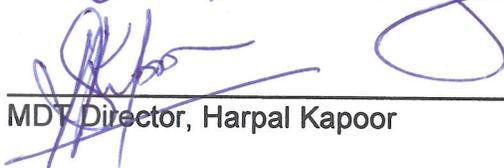
FOR  Date 4/16/09
Chief of Construction, Ron Steiner

 Date 4-16-09
Chief of Safety, Eric Muntan

 Date 4/16/09
Manager of Systems Engineering, Daniel Mondesir

Director Approval

Approval  Date 4/20/09
Deputy Director, Albert A. Hernandez

Approval  Date 06/01/09
MDT Director, Harpal Kapoor

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VOLUME VII – SYSTEM EQUIPMENT CRITERIA
CHAPTER 7 COMMUNICATIONS
REVISION 1

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7.01 INTRODUCTION

7.01.1 SCOPE

This Chapter identifies the criteria which will apply to the design and implementation of the MDT communications system.

Other MDT design criteria impact the communications system and should be referenced during the design process. They include, but are not limited to;

- Volume I, chapter 7, System Safety
- Volume I, chapter 8, System Security
- Volume I, chapter 9, Fire Life Safety
- Volume II, chapter 4, Station Electrical
- Volume III, chapter 4, Guideway Electrical
- Volume VII, chapters 1,2, & 3, Traction Power Equipment
- Volume VII, chapter 6, Train Control
- Volume VII, chapter 4, Fare Collection System

In general, the following comprise the basis of the MDT communications system:

A systemwide backbone communications network consisting of;

- Fiber optic cables routed from the Central Control Facility (CCF) to each station or other wayside facility
- Layer 3 Network Switches with Ethernet interfaces

In this document, this backbone communications network is referred to as the “Metrorail Communications Network” or “MCN” and provides the communications interfaces to all MDT sub-systems.

STATION communications subsystems, consisting of;

- A. Voice - to include telephones, intercoms and the Public Address (PA) system.
- B. Data –
 - 1. Discrete PLC inputs, the commands and indications, and
 - 2. Equipment with Ethernet interfaces for IP data exchange with the Central Control Facility.
- C. Video – The Closed Circuit Television (CCTV) Subsystem

Station in this document includes the passenger stations, traction power substations and wayside facilities.

Central Control Facilities (CCF) communications subsystems, consisting of;

- A. Voice – PABX, Digital Cross Connect, PA equipment and telephones
- B. Data - PLCs with I/O interfaces and related computer equipment, and equipment with Ethernet interfaces for IP data exchange with stations
- C. Video – Monitors, recorders and switchers

The design will include all supporting hardware, software, interfaces, conduits, cabinets, cables and connectors to form a complete system to support the communications needs of the MDT subsystems.

7.02 BACKGROUND - CABLE TRANSMISSION SUBSYSTEM (CTS) AND DATA TRANSMISSION SYSTEM (DTS)

The original MDT Phase I Cable Transmission System (CTS) was a T1 system implemented in a “star” configuration. Two copper T1 cables were routed, one in each guideway cabletray, from the CCF to each station to provide 100% CTS redundancy. Channel banks were connected to the T1 system to provide voice (telephone, PA & intercom) and data interfaces. Telephones, PA, and Data from the Data Transmission System (DTS) connections were routed through an A-B switch. If a failure was detected on the primary T1 channel, the A-B switch automatically switched the interfaces to the backup T1 channel, thereby providing continuous operation and high system availability.

In 1997, this T1 cable system was replaced with a fiber optic cable system in a ring configuration with an OC-3 SONET multiplexer at each station providing similar T1 services. Channel banks and A-B switches were upgraded. A Programmable Logic Controller (PLC) system replaced the DTS system. This PLC system is also referred to as the SCADA (Supervisory Control and Data Acquisition) system.

Later, an Ethernet switch was installed at each station and at the CCF to provide Ethernet connectivity for data transmission of select systems. Voice (telephones, PA & intercom) and some data transmission remain on the channel bank/SONET system.

“CTS” and “DTS” terminology still appears within MDT drawings and documents. Within these new design criteria, the older CTS and DTS terminology is replaced with “Metrorail Communications Network” or “MCN”.

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7.03 GENERAL

- A. The information within this criteria when used in conjunction with the applicable specifications, drawings and documentation of the existing MDT communications configuration, codes and other applicable system design criteria (from other MDT subsystems requiring communications), will assist the designer in creating the technical contractual documents. Equipment quantities are to be provided by the designer. The criteria presented herein are minimum requirements not intended to supplant the exercise of engineering judgment by the Engineer of Record.
- B. The Designer must perform the design to a specification level – furnish and install with instructive diagrams, processes and procedures to include single line diagrams of signals, description of the types of signal; e.g. discrete command or indication, Ethernet or serial type of communications, video signals and voltage levels for power, etc.
- C. Requirement of specific projects which may conflict with these design criteria must be brought to the attention of MDT in a timely manner for resolution.
- D. All new designs must be consistent in design and compatible in operation with the existing MDT communications system and MDT subsystems. Exceptions to these design criteria must be submitted to MDT for approval.
- E. Communications subsystems are to be designed to include all supporting hardware, software, interfaces, cabinets, conduits, cables and connectors to form a complete communications network in support of all MDT subsystems requiring communications.

- F. The designer should consider impact to MDT revenue service during construction and cutover. Such work must be identified by the designer and minimized.

- G. Test and Acceptance Plan - An extensive test procedure is required with detailed test results to be recorded. These initial test results will become the system's baseline performance to be used as a reference for future maintenance.

- H. The current adopted version of these codes, standards and regulations shall apply, and unless otherwise directed, all addenda, interim supplements, revisions and ordinances by the respective code body shall also apply. Where conflicts exist between these requirements, the more stringent requirement shall take precedence, unless otherwise directed by MDT.
 - o National Electrical Code (NEC)
 - o National Electrical Safety Code (NESC)
 - o Local Codes and Authorities Having Jurisdiction
 - o American National Standards Institute (ANSI)
 - o National Electrical Manufacturers Association (NEMA)
 - o Institute of Electrical & Electronic Engineers (IEEE)
 - o Insulated Cable Engineers Association (ICEA)
 - o Association of American Railroads (AAR)
 - o Rural Electrification Administration, Telephone Engineering and Construction
 - o Joint Electron Device Engineering Council
 - o Electronic Industries Association (EIA)

- NEBS
- TELECORDIA
- Underwriters' Laboratories, Inc. (UL)
- Electronic Industries Alliance (EIA)
- Federal Communications Commission (FCC)
- Federal Railroad Administration (FRA)
- Illuminating Engineering Society (IES)
- Occupational Safety and Health Administration (OSHA)
- International Standards Organization (ISO)
- Department of Environmental Resource Management (DERM)
- American with Disabilities Act (ADA)
- Construction Specifications Institute (CSI)

In addition, the following specific standards shall apply;

ANSI/IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance, And Earth Surface Potentials of a Of A Ground System (Part 1)

ANSI/TIA/EIA-568-A Commercial Building Telecommunications Cabling Standard

ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces

ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications

IEEE C62.41 IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

IEEE C62.45 IEEE C62.45 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

IEEE Green Book; IEEE STANDARD 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems

IEEE Orange Book; IEEE STANDARD 446 IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications

MIL-HDBK-419A Communications Facilities Design and Construction

NFPA 70 National Electrical Code® Articles 250, 280, 285 and 800

NFPA 780 Standard for the Installation of Lightning Protection Systems

Motorola document 68P81150E62 Grounding Guideline for Cellular Radio Installations

UL 467 Grounding and Bonding Equipment

UL 497A Secondary Protectors for Communication Circuits

UL 497B Protectors for Data Communication and Fire Alarm Circuits

UL 1449 Transient Voltage Surge Suppressors

NFPA 72 National Fire Alarm Code

NFPA 130 Fixed Guideway Transit and Passenger Rail Systems

NFPA 76 Fire Protection of Telecommunications Facilities

NFPA 101 Life Safety Code

NFPA 110 Emergency and Standby Power Systems

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7.04 VOICE, DATA and VIDEO OPERATIONAL CRITERIA

7.04.1 OPERATIONAL CRITERIA

MDT requires that no subsystem is dependant upon the Communications system for safe operation. Specifically;

- A. The Communications System shall be designed such that any failure or malfunction cannot cause an unsafe condition or adversely affect operation of the train control or traction power subsystems.
- B. Communications Interfaces shall be designed to allow local operation of the subsystems at the station by onsite MDT personnel. That is, train control, traction power and other functions can be controlled locally at the stations in a safe manner without the Communications System operating.
- C. The Fire alarm system, access control system, and local Public Address (PA) System announcements at the station are also not to be dependent upon communications to or from central control for safe local operation either autonomously or by a station attendant or MDT personnel. Any communications requirements for emergency systems and code compliance shall be addressed and given special consideration where needed.
- D. Brown outs, power up, power down and interruptions are to be handled in a safe and orderly manner.
- E. Availability – The availability of the communications system's core network layer (the backbone) for each station to CCF communications link shall be 99.999%.

The availability of the network access layer for all station Ethernet interfaces to CCF Ethernet interfaces shall be 99.99%.

- F. Maintainability – the target MTTR (Mean time to Repair) shall be less than 30 minutes after a MDT technician arrives on site. This target MTTR should be considered by the designer when specifying spares, training, documentation, diagnostic programs, etc. Dependant upon design specifics, the target MTTR can be adjusted accordingly.
- G. Reliability – No single point of failure shall interrupt communications. This includes access layer communications to MDT subsystems, e.g., communications interfaces and cabling from the Ethernet patch panel to each fare collection machine shall be separate and independent of any other machine.
- H. No local Ethernet hubs are permitted outside of the TC&C room without approval of MDT. All connections to Ethernet interfaces on the subsystems are to be home run back to the Ethernet patch panel in the TC&C room with their own independent, labeled cable.
- I. Communications from each station shall be independent of other stations, with the exception of Hubs at key locations.

Commentary: *MDT preference is to migrate from the SONET ring configuration to a star configuration of Ethernet switches, with each station having its own separate fiber path to the CCF. Hubs at key locations are acceptable upon approval by MDT.)*

- J. Provide Multiple Control Center Facility Capability – Capability of handing off control from CCF to another location within the MDT communications network.
- K. Provide the capability and access at multiple locations within the MDT Communications Network to monitor the system’s data and video and with proper password protection to control the subsystems.
- L. Provide Multicast video capability – A video feed to others, e.g. law enforcement.

7.04.2 COMMUNICATIONS SYSTEM CONFIGURATION CRITERIA

The communications system configuration criteria will be designed to incorporate, as a minimum, the following requirements, unless otherwise approved by MDT:

- A. Modular construction will be utilized wherever possible with commonality of modules provided to the highest degree attainable.
- B. Off the shelf equipment which follows industry standards shall be utilized. All equipment to be installed shall be new, listed in the manufacturer’s most current catalog, and in current production.
- C. The system must be Scalable – Bandwidth and interfaces can be increased with only incremental cost of the new equipment. Equipment Chassis shall be sized for expansion of 25 % to include power requirements, cooling, etc. Empty slots shall have blank covers.

- D. A Train Control & Communications (TC&C) electrical panel (PP1) supplying power to all communications equipment shall be directly powered by the station's Uninterruptible Power Supply (UPS) to ensure no-break in power application during primary power source interruption. The UPS shall contain its own internal Automatic Transfer Switch (ATS)
- E. Individual communications subsystem protection will be included through proper fusing or circuit breakers at the TC&C electrical distribution panel – PP2.
- F. Primary and backup power loss at any station or stations shall not affect communications between the CCF and any other station. If needed, the backbone communications equipment shall also be powered by its own 4 hour battery supply in addition to the TC&C room's backup power source to avoid such an interruption.
- G. Non Volatile memory (or an equivalent method) is required for configuration and application software and operating data, such that a power failure and restoration will not adversely affect MDT operations.
- H. Estimated heat load of equipment in TC&C room is to be calculated and provided to the Architect to assist in proper sizing of the HVAC unit.
- I. General purpose receptacles are to be provided on the cabinets for maintenance personnel use – a separate circuit, GFI protected.
- J. Metal Cabinets with locks (keys to be common to existing MDT keys)

- K. Cable Management and structured cable practices per EIA/TIA- 568/569 specification are to be followed.
- L. Environmental spec – Backbone equipment to be carrier class equipment; temp range of 0 C to + 40 C or better with non-condensing humidity of 95%. Backup A/C units shall be provided in the equipment room. If needed, cooling fans are to be provided within the cabinets.
- M. Over temperature indicator within TC&C room (A/C fail) to report to CCF is required. Equipment Communications to CCF are to be alarms from the Stations to the CCF through the SCADA system, or via the equipment's an equipment "smart" Ethernet interface- if so provided.
- N. Outdoor equipment to be a minimum NEMA 4X rated.
- O. All conduits in public areas are to be concealed.
- P. Pullboxes are to be readily accessible or accessible as defined by NEC.

7.04.3 INTERFACE STANDARDS

- A. The communications system shall transmit and receive EIA standard signal levels at interface points.

Commentary: *MDT has adopted TCP/IP over Ethernet as their communications standard. To the maximum extent possible, MDT desires Convergence, that is, all types of communications signal are to be transmitted as IP data packets over the communications network, to include;*

1. *Voice over IP – VoIP*

2. *Ethernet interfaces on subsystem equipment .*
3. *Video as MPEG2, or MPEG4 data (See Section 7.05.9*

MDT presently uses a proprietary Vicon standard (for security reasons) and MPEG2 encoding for video data. Designer shall coordinate with MDT to assure compatibility of new designs with the existing system.

- B. All MDT subsystems connected to the MDT communications system shall be IP addressable.
- C. The standard interface at the access layer will be the Ethernet interface on the layer 3 switch. For equipment not providing an Ethernet interface, serial RS-232 and RS-422 interfaces are acceptable as an alternative. Equipment using serial interfaces shall be routed into a port server. The port server is then connected to the MDT access layer Ethernet interface thereby providing IP addressability to the equipment.

Distance limitations are to be observed, typically;

1. Ethernet over copper (100BaseTX) has a 100 meter limitation.
 2. RS-422 over shielded twisted copper pairs has a 4000 foot limitation.
 3. Ethernet over Multi Mode fiber optic cable has a limitation of 2 Km at 5 Mhz.
- D. For discrete PLC inputs and outputs, wire size for commands and indications to the PLC modules shall not be less than AWG #20. For this wire size, a distance limitation of 100 feet shall apply to PLC inputs from MDT systems. For longer distances, the wire size may need to be

increased. The voltage drop must be calculated to stay within the acceptable operating range of the PLC modules and the MDT system.

- E. For discrete PLC inputs and outputs originating in a building other than the TC&C room, a remote PLC I/O module is acceptable. The remote PLC I/O module will then transmit the data to the station's PLC in the TC&C room.
- F. For all wiring entering the TC&C room proper surge protection is required on both ends of the conductors. This includes communications signal and power wiring.
- G. Clear demarcation points between the Communications interfaces and MDT subsystem interface are required, as follows;
 - 1. For Discrete commands and indications, Wiedmuller type termination blocks with knife switches are required. On the PLC modules, LED type Indicators are to show the status of each input or output.
***Commentary:** See existing MDT configuration at a station*
 - 2. For telephones and intercoms, a board with 66 or 110 type punch down blocks with protectors at the de-marcation point.
 - a. For data cables, Patch panels are required for inputs to the Ethernet switch interface.
 - b. For the Fiber Optic backbone cable, Patch panels with cable termination and distribution is required.
- H. Automatic A-B switching of interfaces, dual communications interfaces, or an equivalent method is required to provide communication redundancy to MDT subsystems. Single points of failure are to be

avoided. MDT shall be made aware of any potential single points of failure exist within the design.

- I. Access to maintenance alarms, indicators and test points are to be provided for testing of all major and critical circuits and assemblies. Front panel LEDs on the equipment to indicate a normal/fail condition are desirable.

7.05 COMMUNICATIONS SUBSYSTEMS FEATURES

Major features of individual communications subsystems are enumerated below with descriptions of how each subsystem is to accomplish its primary function.

In general, the MDT communications subsystems are defined as:

- A. Voice – The voice system will transmit:
 - 1. Two-way voice - Radio, telephone, and intercom communications
 - 2. One-way voice - Station public address communications

- B. Data – Consisting of:
 - 1. Discrete commands and indications between the station and the CCF using the PLC I/O interfaces (SCADA) and,
 - 2. Data packet exchanges, typically IP data packets over Ethernet.

- C. Video – CCTV for system security.
 - 1. The video system will transmit color video signals from the stations to Central Control. At locations where PTZ cameras are required, the communications system will provide two way data communications to support CCTV camera Pan, Tilt, Zoom (PTZ) and management.

7.05.1 RADIO SUBSYSTEM

- A. The Radio subsystem will utilize an individual base station for each channel with remote control capability from Central Control and multi-channel portable mobile and personal transceivers capable of communicating on any of the available channels assigned to the transit system. All equipment will be of modern solid state design. Base station

transmitters and receivers will be single channel equipment. Mobile, portable and personal radio transceivers will have multi-channel operational capability with automatic transmitter identification. Receiver voting equipment will be used to select the active receiver with the highest signal to noise ratio in order to obtain greatest system operational reliability.

- B. Radio communications within structures such as the station's TC&C rooms shall be assured of quality reception between the station and the CCF. Conduits for "leaky coax" or an equivalent alternative system to improve reception shall be installed where conditions may cause radio dropouts. Contractor shall perform a radio test and install the leaky "coax" or an equivalent system, as needed, to provide reliable two way communication from the location to the CCF.

- C. RADIO system expansion requirements - No new design requirement at this time.
Commentary: MDT may require procurement of additional radios within the extension contract.

- D. Automatic Vehicle Location (AVL) requirements – No new design requirement at this time - Designer to confirm with MDT.

7.05.2 PRIVATE AUTOMATIC BRANCH EXCHANGE (PABX) SUBSYSTEM

Commentary: The MDT PABX is a Nortel Meridian Option 61. All lines are presently in use, but expansion capability exists. A Tellabs Digital Cross Connect (DCS) is presently installed to groom the voice and data lines from the stations into separate DS 1 lines at central to be routed to

either the PABX for voice , or to channel banks populated with data circuit cards for SCADA data exchange with MDT subsystems at the CCF.

For the PA system, E&M type circuit cards are used at each station and at CCF to detect when the PA at the station is not busy with another higher priority announcement, and to "key" the station PA for an announcement from central.)

- A. The existing PABX subsystem with its related equipment to include the Digital Cross Connect (DCS) will require expansion to accommodate the new telephone sets, intercoms, and PA equipment needed for each Metrorail expansion project. The new equipment must meet the specific operational characteristics required of each new telephone, intercom or PA line and also interface to the existing equipment where required.
- B. Coordinate assignment of Extension numbers for new telephones with MDT.
- C. All telephone voice lines will be routed to the CCF PABX. If the VoIP implementation requires otherwise, approval is required from MDT.
- D. Direct Lines (Automatic Ringdown) between selected locations and central control will be provided to fulfill operational requirements. These are typically; the Passenger Assistance Telephone (PAT), The Emergency Telephone (ET), the Elevator Intercom (EI) and Bathroom Intercom (BI), where applicable.

- E. Coordinate with BellSouth for an assessment to assist in determining the Direct In Dialing (DID), and Direct Out Dialing (DOD) lines needed for the planned system expansion.

7.05.3 TELEPHONE SUBSYSTEM

- A. MDT has adopted Voice over IP (VoIP) technology for future telephone and intercom expansion. New VoIP must be compatible with existing MDT equipment. Incompatible equipment shall be replaced under the expansion contract.
- B. Emergency Telephone (ET) subsystem will consist of red hanger mounted hand sets with armored cables which will be mounted in each of the Emergency Trip Station equipment boxes referred to as “Blue Light Stations”. These telephones are to be configured as Direct Line Telephones (DLTs) to the CCF Operations console.
- C. The emergency telephone will also contain ringing equipment which will be activated at Central Control upon receipt of emergency trip station activation. This ringing system will act as part of the alarm acknowledgement function for traction power trip action having taken place.
- D. These emergency telephones will be:
 - 1. Collocated at each Blue Light Station (also referred to as Emergency Trip Stations),
 - 2. In the Station Attendant's booth.
 - 3. At the Fire Management Panel (FMP)
 - 4. At each fire hose station.

- E. At the Palmetto Yard, similar equipment will be installed to ring in the yard control tower

7.05.4 PASSENGER ASSISTANCE TELEPHONE

Each station shall be equipped with Passenger Assistance Telephones (PAT). The PATs will consist of blue, hanger mounted hand sets with armored cables mounted within a callbox with a cover which will be mounted at the station;

1. Within the passenger area – at least one telephone for every 200 feet of platform
2. At the attendant’s booth or console.

These shall be Direct Line Telephones (DLTs) to the CCF Stations Operations console.

7.05.5 INTERCOMS

Intercoms are to be installed in the following areas. Intercoms are to be connected to Station Attendant’s Booth or console and to the CCF

1. Elevator intercom - Assure compliance with codes for the elevator intercom
2. Bathroom intercom

The Intercommunication subsystem will consist of several flush mounted wall units connected to the control panel in the Station Attendant's booth or console. When a passenger depresses a call button, the Station Attendant will be alerted. Activation of the specific intercommunication unit by the

Station Attendant depressing a switch on his control panel will enable the caller and the Attendant to carry on a conversation without further use of hand controls.

Intercoms shall be configured to also communicate with CCF operations console in cases where the attendant is not at the booth or console.

Speakers/ microphones will be integrated units within call boxes with covers to reduce susceptibility to vandalism.

7.05.6 OTHER TELEPHONES

- A. At least one extension telephone with direct inward and outward dialing capability with telephone numbers assigned are to be installed in the following areas:
 - 1. TC&C Room telephone
 - 2. MDT Lounge telephone (where applicable)
 - 3. Revenue Room (where applicable)
 - 4. Any other Equipment Rooms

- B. Review the Safety & Security Design Criteria, the Fire Life Safety Criteria, ADA requirements and applicable codes for additional telephone requirements. Early in the design process, coordinate the telephone placement with the MDT Office of Safety and Security. Additional telephones may be required by codes and/or the Authority Having Jurisdiction (AHJ).

7.05.7 PUBLIC ADDRESS AND AUDIO-VISUAL SUBSYSTEM

- A. The Public Address subsystem at each station shall consist of several loudspeakers positioned throughout the station and on the platform in strategic locations to assure complete sound coverage. Amplifiers of suitable power output capacity will be installed in the Train Control and a Communications room. A Control Panel with a microphone/preamplifier will be provided in each Station Attendant's booth or console. The capability for Central Control to make announcements to individual selected stations, groups of stations, or announcements to all stations simultaneously shall be provided with priority control at the stations.

- B. A Digital Auto Announce system shall be implemented. The Auto Announce recorder shall be capable of recording a minimum of 16 messages both locally at the station and from the CCF. Auto announce messages shall be triggered by the FMP and the train control track circuits (... "train approaching the station"). The relay contacts of the specific track circuits at each station shall be coordinated with MDT and the train control system designer.

- C. A separate Public Address System to include separate speakers that are part of the Fire Alarm System will be used to make fire announcements, unless otherwise directed by MDT.

- D. The Station PA system is to be priority encoded w/local and CCF announcements as follows:
 - 1. SQUELCHED - When PA at FMP Panel is in use.
 - 2. Emergency auto announce messages local to the station (triggered by the FMP)
 - 3. Voice input from station attendant microphone

4. Auto announce Train Arrivals messages (triggered by track circuits)
 5. Voice input from PA test microphone in TC&C room
 6. Voice input from CCF operations console – either pre-programmed or live announcements.
- E. The PA System shall employ ambient noise level (ANL) detection and adjustments to deliver clear announcements.
- F. The PA System shall be configured as two completely independent redundant amplifiers and speaker systems to assure announcements are broadcast at an acceptable sound level to all parts of the passenger areas in the event of a failure of one of the two systems.
- G. A supervisory tone is required to monitor the health of the PA system throughout the station. The PA alarm shall be connected to the SCADA system to notify the CCF in the event of a PA failure. See the example data point listing in Appendix A.

7.05.8 VARIABLE MESSAGE SIGNS

- A. With each audio announcement an accompanying visual message is required. Audio and visual messages and equipment are to be ADA compliant.
- B. At each station, Variable Message Signs are required with the capability of:
1. Programming and initiating messages locally by the attendant at the booth or console.
 2. Displaying pre-programmed messages when triggered by the FMP and other systems

3. The ability to receive and display messages sent from the CCF.
- C. More than one VMS may be required, dependant upon station design. Early in the design process, the designer will provide to MDT an analysis of the sign coverage at the proposed station.
 - D. Required new equipment, software, and interfaces to existing equipment at CCF shall be provided.

7.05.9 CLOSED CIRCUIT TELEVISION SUBSYSTEMS (CCTV)

- A. For security purposes, Color Closed Circuit Television (CCTV) cameras are to be installed at each station for security to cover:
 - All areas of the passenger platform
 - Elevator doors
 - Elevator cab – A hidden camera,
 - Fare collection equipment
 - Station entrances and exits,
 - Stairwells and walkways
 - Exterior of the station
 - Plaza and all other areas open to the public, including the parking area (See Parking Structures Section – 7.06)
 - Guideway areas immediately adjacent to the station including special trackwork areas.
 - Blue Light Stations
- B. Primarily, Fixed position cameras shall be used. Pan, Tilt, Zoom (PTZ) cameras are acceptable in select locations upon approval of MDT.

- C. Final camera locations will be driven by the Safety & Security Criteria. A worksheet with each camera's location and coverage overlaid onto the stations plans shall be provided to MDT for approval during the early stages of design.
- D. The cameras must be capable of functioning properly over a wide range of lighting conditions, as expected at the proposed locations. All station CCTV subsystems shall be wired to use CCTV recorders installed within the TC&C Room.
- E. A Local video recorder in the TC&C room shall be provided with capability of recording all videos over a **90** day period, user programmable.
- F. Video monitors and CCTV camera controls are to be installed at the station attendant's booth or console. Typically two monitors are to be installed within the booth or console with room for additional monitors, if needed. Refer to the attendant's booth design criteria for further information.

The CCTV subsystem shall instantaneously present on monitors in the Station Attendant's booth or console the video images of areas of the station and platform not directly visible to the Attendant. Equipment shall provide the attendant the capability of:

- o Selection, control and recording of any station camera
- o Sequencing the display of cameras on the booth monitors
- o Displaying multiple videos per monitor – Selectable 1, 4, 9 or 16.

For maintenance and troubleshooting purposes, equipment with the same capabilities as the Attendant's booth or console shall be provided in the TC&C room at the CCTV equipment cabinet.

- G. All necessary hardware and software to include conduits pull boxes, and cables, and related equipment needed for a complete CCTV system shall be provided.
- H) At each station, the videos are to be routed to the Ethernet switch in the TC&C room.
- I) At CCF, Provide expansion of the existing system to accommodate the added station CCTV cameras, to include:
 - 1. Capability of selecting, viewing and controlling the station cameras from CCF.
 - 2. Capability of CCF selecting, viewing and copying videos stored within the station's video recorder.
 - 3. Capability of downloading and recording videos from the rail cars (so equipped) while the rail cars are within range of the VMCS wireless link at a station or the Yard.

(Commentary: MDT is in the process of updating their CCTV system from the MPEG-2 to the MPEG-4 standard. Designer shall coordinate with MDT to provide the latest hardware and software compatible with the existing system. Compatibility with the existing system is a requirement.)

7.05.10 FIRE ALARM COMMUNICATIONS

- A. The Fire Alarm System is to be compliant with NFPA 72, and all codes and regulations of the Authorities Having Jurisdiction (AHJ), and the

MDT Office of Safety and Security. The Fire Alarm System will be designed as part of the Station's architectural design, but Fire alarm installation must be coordinated to provide communications to the station attendant and to CCF to support MDT operations and procedures.

- B. As a standard, MDT has adopted Fire panels which use Single Mode fiber interfaces for communications. At each station, the Fire Management Panel's communication interface will connect to the next station by way of two fibers in a ring configuration. Fiber interfaces to the MCN are to be accessible at the fiber termination panel within the TC&C room. Refer to the MDT drawings of the existing configuration.
- C. Local Fire Panel control and indications shall be provided at the station, both at the panels and at the Attendant's booth or console.
- D. Design must assure software compatibility of the panels with the existing system for proper operation and indications at the CCF.
- E. The Fire alarm system shall have supervisory alarm signals to indicate any system malfunctions or lack of communications from the station to the CCF.

7.05.11 ACCESS CONTROL SYSTEM with INTRUSION ALARMS

- A. The Access Control system with the Intrusion Alarms must be compliant with all codes and regulations and the requirements of the MDT Office of Safety and Security. The Access Control System will be designed as part of the Station's architectural design. Operation of the access control system with intrusion alarms must be coordinated to provide required

communications to the attendant's booth or console and to the CCF to support established MDT operations and procedures.

- B. As a standard, MDT has adopted Intrusion panels which use Ethernet 100Base TX interfaces with RJ-45 connectors. At each station the Intrusion Panel's communication interface will connect to the Ethernet switch.
- C. Design must assure software compatibility of the panels with the existing system for proper operation and indications at the CCF.
- D. Local control and indications shall be provided at the station, both at the panel and at the Attendant's booth or console.
- E. Management software must be compatible with existing MDT systems.
- F. The system shall have supervisory alarm signals to indicate any system malfunctions or lack of communications from the station to the CCF.

7.05.12 ATTENDANT'S BOOTH OR CONSOLE

The Station attendant's booth or console design must be coordinated to accommodate the requirements of the communication system, to include conduits, cables, electrical UPS power. The communications related equipment within the station attendant's booth or console will typically be;

- 1. CCTV monitors and video controllers
- 2. A Variable Message Sign workstation
- 3. Emergency telephones, Passenger assistance telephones, intercom stations.

4. A Public Address Microphone

Covered in separate criteria are:

1. Fire Alarm Control Panel (FACP – Not part of the communications system)
2. Intrusion alarm Panel – (Interfaces to, but is not part of the communications system)

The Station attendant's booth or console design may have other requirements not covered within this criteria. Refer to each subsystem's respective section within this and the other design criteria for more detailed information.

7.05.13 SUPERVISOR'S BOOTH

At stations with a Supervisor's booth, the booth design must be coordinated to accommodate the requirements of the communication system, to include conduits, cables, electrical UPS power. The communications equipment within the booth will typically be;

1. Emergency telephone
2. A Public Address Microphone
3. VMS sign controller

A remote Train Control Dispatch Panel may be installed in the booth. This is covered in separate criteria.

The Supervisor's booth or console design may have other requirements not covered within these criteria. Refer to the each subsystem's respective section within this and the other design criteria for more detailed information.

7.05.14 DATA BETWEEN THE STATIONS AND THE CCF

The Metrorail Communications Network (MCN) will provide the required equipment for exchanging the different signals and data types transmitted between the stations and other wayside facilities to the CCF. The different signals and data types are to be converged into IP data packets using the Ethernet transmission protocol.

7.05.14.1 At the Stations – The SCADA system

Each station shall with have a PLC equipped with an Ethernet interface for connection to the MCN. The station's PLCs, through its I/O modules, will receive signals from local equipment and transmit, over the MCN, the status or position information which is then displayed in the CCF. These are referred to as INDICATIONS within the system. Conversely, control signals originating at the CCF will be transmitted over the MCN to the station's equipment. These are referred to as COMMANDS within the system. The PLC with its input and output (I/O) modules and all related equipment is also referred to as the SCADA (Supervisory Control and Data Acquisition) system.

The PLC will be configured with input and output (I/O) modules to transmit and receive the following discrete COMMANDS & INDICATIONS signals;

1. Traction Power interface at the Supervisory Control Interface Terminal Cabinet (SCITC) within the TPSS
2. Status of the Emergency Trip Station (ETS) button at the Blue Light Station.
3. Failure Alarms on equipment
4. Miscellaneous Station (facility) commands and Indications

See attached APPENDIX A, TABLE 1 - EXAMPLE DISCRETE DATA POINT SCHEDULE for a typical listing of the discrete commands and indications at a station.

For purposes of the data transmission, COMMANDS originate from the CCF. The stations which are considered the remote locations return INDICATIONS to the CCF.

At each station, at least 16 spare PLC inputs (INDICATIONS) and 16 spare outputs (COMMANDS) are to be provided. The requirements for PLC expansion at the CCF shall be reviewed by the Designer and specified accordingly.

7.05.14.2 At the Stations – The Data system

The following is a listing of the typical IP addressable equipment at the station. Communications between central will be TCP/IP over Ethernet)

- A. Train Control
- B. Fare Collection System
- C. Electronic signs (w/ local & CCF messages)
- D. Kiosks
- E. Management of Communications Equipment
- F. PLC communications (SCADA) – Station to/from CCF
- G. VMCS – Vehicle Monitoring and Control System – A Train to Wayside Communication unit mounted at the platform which will communicate wirelessly with the train cars.
- H. Voice over IP (VoIP) – station telephones and intercom
- I. Smart UPS
- J. Auto Announce Equipment

- K. Parking Structure Ethernet hub
- L. Other miscellaneous subsystems requiring data exchange between the stations and the CCF.

At each station, at least 8 spare 100Base TX Ethernet interfaces are to be provided on the Ethernet switch.

7.05.14.3 CCF Requirements –

Commentary: *Expand the following as required for the number of added stations)*

CCF Communication equipment will be provided with interfaces to:

- A. Station Operations Console for;
 - 1. PA & Electronic Signs
 - 2. CCTV Monitors
 - 3. Telephones – DLTs and Dial up numbers
 - 4. Miscellaneous Station Commands and Alarms Panel

- B. Rail Control Console
 - 1. Train Control
 - 2. Traction Power & ETS functions
 - 3. Telephones – DLTs and Dial up numbers

- C. Mimic Panel expansion for the added stations

7.05.15 UNINTERRUPTABLE POWER SUPPLY

Volume II, Chapter 4, Station Electrical Design Criteria covers the UPS and emergency power requirements. In general;

- A. Each communications equipment cabinet shall be on a separate Circuit Breaker from the TC&C distribution panel – PP2. The TC&C Panel shall have UPS backup. The panel will serve as a source of power to:
 - 1. The SCADA system (PLC and related equipment) system
 - 2. Train Control equipment
 - 3. Communications equipment
 - 4. Fire Alarm System (unless Fire Alarm has its own emergency power)
 - 5. Access and Intrusion System
 - 6. Traction Power Supervisory Control (SCITC Panel)
 - 7. Public Address System & Electronic Signs
 - 8. Fare Collection Equipment

- B. The communications system power requirements shall be supplied to the Station Architect’s MEP designer to determine the UPS requirements.

- C. The communications system shall provide Ethernet interfaces to support “Smart UPS” installations.

7.06 COMMUNICATION CRITERIA FOR PARKING STRUCTURES

The following parking garage subsystems require communications to a hub at the Garage Operation Center (GOC) and connection to the MCN at the TC&C room for communications to the CCF. Coordination with the Parking Structures designer is required to provide adequate conduits, pullboxes, electrical power, and other necessary equipment to support the parking structures communications requirements.

7.06.1 VEHICLE COUNTING AND DISPLAY SYSTEM

The system shall count the incoming and outgoing traffic at the facility using sensors at the entrances and exits. It should provide a large format sign for informing the customers of the parking spaces that remain available at the facility. The system should provide auxiliary LED “FULL” signs at the entrances to be illuminated when the facility has reached its capacity.

7.06.2 PARKING STRUCTURE CCTV SYSTEM

The Parking Structure CCTV System design shall be consistent with the Passenger Station CCTV design (See section 7.05)

- A. Closed Circuit Television (CCTV) cameras are to be located at each parking garage for security. Fixed position color cameras shall be installed to cover:
 - 1. All levels of the garage facility
 - 2. Elevator Doors
 - 3. Elevator cab – A hidden camera
 - 4. Garage Entrances and Exits
 - 5. Rail Station to Garage facility interfaces
 - 6. Stairwells and walkways

- B. Final camera locations will be driven by the Safety & Security Criteria. A worksheet with each camera's location and coverage overlaid onto the stations plans shall be provided to MDT for approval during the early stages of design.
- C. The cameras must be capable of functioning properly over a wide range of lighting conditions, as expected at the proposed locations. All garage facility CCTV subsystems will be wired to use Digital Video Recorders (DVR) installed within the Garage Operations Center (Monitor Room).
- D. The DVRs in the Garage Operations Center must be capable of storing all the video from the installed cameras for a period of 90 days.
- E. A CCTV workstation with the ability to select and view any camera at the facility will be provided inside the Garage Operations Center.
- F. All necessary conduits pull boxes, cables and related equipment needed for a complete CCTV system shall be provided.
- G. The CCTV system will be connected with the MDT enterprise network through an Ethernet switch located in the Garage Operations Center.
- H. At CCF Provide:
 - 1. Capability of selecting and viewing the garage cameras from CCF
 - 2. Capability of selecting, viewing and copying videos stored within the Garage DVR.

- I. The CCTV system should be compatible with the existing CCTV system used throughout the MDT Rail System.

7.06.3 PARKING STRUCTURE FIRE ALARM PANELS

Communications design for the Parking Structure Fire Alarm panels shall be consistent with these criteria's Fire Alarm requirements in section (7.05.10).

- A. The Fire Alarm System is to be compliant with NFPA 72, and all codes and regulations of the Authorities having Jurisdiction (AHJ), and the MDT Office of Safety and Security. The Fire Alarm System will be designed as part of the garages architectural design, but Fire alarm installation must be coordinated to provide communications to the CCF.
- B. As a standard, MDT has adopted Fire panels which use Single Mode fiber interfaces. Each Fire Management Panel's communication interface will connect to the next location by way of two fibers. All fiber terminations are to be accessible at the fiber termination panel.
- C. Local Fire Panel control and indications shall be provided at the garage.
- D. Design must assure software compatibility of the panels with the existing system for proper operation and indications at the CCF.
- E. Management software must be compatible with existing MDT system.
- F. The Fire alarm system must have supervisory alarm signals to indicate any system malfunctions or lack of communications from the garage to the CCF.

7.06.4 PARKING STRUCTURE UPS SYSTEM

Communications design for the Parking Structure UPS System shall be consistent with the Uninterruptible Power Supply section (7.05.15). UPS requirements shall be coordinated with the Parking Structure designer.

- A. Each communications equipment unit is to be on a separate Circuit Breaker from the Garage Operations Center distribution panel. The panel will serve as the source of power to:
 - Vehicle Counting and Display System
 - CCTV System
 - Fire Alarm System
 - Network Equipment

- B. The communications system shall support “Smart UPS” installations with Ethernet interfaces.

7.06.5 PARKING STRUCTURE NETWORK CONNECTIVITY

Parking Structure Network equipment and design shall be consistent with the Network Equipment section (7.08.3).

- A. An Ethernet hub shall be provided at the Parking Garage Operations Center.

- B. A fiber optic communications link between the parking structure hub and the MCN equipment in the TC&C room is required.

- C. A diverse path from the hub to the MCN is required for redundancy to avoid a single point of communications failure.

7.06.6 PARKING FEE COLLECTION

Communications to the Parking Garage hub shall be provided for parking fee collection equipment, typically an Ethernet connection.

***Commentary:** The Technical Specifications for the Universal Automated Fare Collection System includes a Parking Collection System that emulates the present "pay by space" system with the introduction of an electronic payment system using Credit-Debit Cards and new Fare Media technology offered such as Magnetic Tickets and Smart Cards.*

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7.07 REMOTE AND LOCAL MANAGEMENT OF SUBSYSTEMS

7.07.1 PERFORMANCE CRITERIA AND INTERFACE STANDARDS

- A. For each communications subsystem, a Management system shall be provided to transmit control, status and alarm indications between Central Control, all passenger stations and other remote equipment.

- B. The Design shall provide the capability of local and remote management of all communications equipment, to include configuration and diagnostic maintenance, with password protection and multiple access levels.

- C. Systems management and configuration software must be SNMP compatible.

7.07.2 COMMUNICATIONS SYSTEM SECURITY

- A. Security of the Communications System will be per the MDT System Security Criteria. In general, the guidelines are;
 - 1. Locked rooms & equipment cabinets – key card access to the room w/key override
 - 2. Equipment maintenance consoles shall be password protected with different access levels; e.g.
 - a. Maintenance technician access for diagnostics;
 - b. Engineering level access for configurations; software updates, etc.

- B. MDT personnel can sign on to the network at multiple locations; at all stations, the CCF, and the Palmetto Yard.

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7.08 MISCELLANEOUS

7.08.1 RACEWAYS AND CONDUITS

- A. Communications raceway and conduit requirements shall be coordinated with the Station's Architectural design. Refer to Station Electrical Design Criteria Volume II, Chapter 4 for further raceway and conduit design requirements.
- B. No communications cables/circuits will be run in the same raceway, cable tray section or conduit containing power cables, power control circuits or train control circuits. A communications channel within the raceways or cable trays shall be used for communications cables/circuits.
- C. All communications cables/circuits will be contained in raceways, cable trays, ,conduits or other totally enclosed structures throughout the entire communications system to provide maximum shielding and protection from physical damage.
- D. All fiber cables shall be installed within innerduct. The innerduct shall be installed to be continuous, with couplers if needed to provide a closed path for pulling the fiber cables. Where fiber cables are underground, above ground identification markers shall be specified. Also, underground marker tape and tone wire shall be specified. Underground entries into building shall have a sign posted "Fiber Optic Cable Buried Below" on the side of the building.
- E. The communications conduits shall be filled to the max of 50%; with four 90 degree pulls maximum between vaults or pullboxes.

- F. A cable pulling plan shall be developed and submitted to MDT for approval.
- G. Within a conduit or innerduct, all cables are to be pulled as once to avoid chafing and damaging cables already installed. Only approved cable pulling lubricants may be permitted.
- H. Pull strings are to be left inside of conduits and labeled at both ends.
- I. Conduit ends shall be sealed to prevent water, rodent and vermin entry.
- J. Empty spare communications conduits shall be provided for runs from the TC&C room to the other equipment rooms, booths, platform area and plaza area. 25% additional conduits shall be provided as spares.

7.08.2 CABLES

- A. The communications designer shall specify all required communications cables and connectors. All cabling shall conform in every way to the specification section(s) and technical appendices which address cabling in this project. Refer to Volume II, Chapter 4, Station Electrical Criteria and other applicable documents.
- B. To mitigate cable damage caused by temperature cycling, all communication cabling installed outdoors within cable trays, troughs and/or duct banks shall be suitable for direct burial or duct installations in all wet and dry locations. Insulations shall be heat, moisture and chemical resistant, mechanically rugged compound.

- C. When tested in accordance with ICEA and UL requirements, the low smoke, non halogenated, flame resistant thermoplastic polyolefin (TPPO) jacket shall meet or exceeds the guaranteed values of ICEA, ASTM and NEC requirements.
- D. At the discretion of the Design Engineer, copper communications cabling shall be constructed with shielding and shall have excellent electrical properties, high di-electric strength, low power factor and high insulation resistance.
- E. All communications cables shall be identified by standard color coding or labeling
- F. Splicing of cables between terminal blocks is prohibited.
- G. Connection points shall be protected and accessible as defined by NEC, readily accessible preferred.
- H. For AC power distribution to the communications equipment, all conduits and cabling shall conform to the specification section(s) and technical appendices within Volume II, Chapter 4, Station Electrical Criteria and other applicable documents.

7.08.3 STANDARDIZATION AMONG STATIONS

- A. The installation techniques, cable runs and general positioning of equipment in each station shall be accomplished in as standard a manner and consistent with the structure in which equipment installation is being made. Existing MDT installations shall be used as examples.

- B. The numbering system and labels of all conduits, cable runs, terminal cabinets, equipment control cabinets, files and associated equipments shall be standardized in all stations and be consistent with existing MDT installations to ensure the MDT's ability to maintain and operate the system.
- C. Newly installed equipment documentation shall be consistent with MDT's existing data spreadsheets.
- D. Equipment among stations shall be standardized to the maximum extent possible to minimize the spare parts inventory and simplify maintenance. For example, Public Address system modules or chassis should not vary due to the varying station sizes, but rather one common size of chassis for all stations shall be specified. The chassis would then be populated with the proper number of amplifier modules to fit the size of the station.
- E. Communication system expansion shall be consistent and compatible with the existing MDT system, both at a hardware and software level, to include;
 - 1. To the maximum extent possible, new equipment hardware modules shall be interchangeable with existing modules.
 - 2. All new equipment must be compatible with existing Management and application software. If software upgrades are required, the upgrades shall be systemwide.
- F. Available documentation of existing MDT installations will be provided to the designer upon request. A Field survey of existing MDT installations by the designer for a consistent and compatible design is recommended.

7.09 THE MDT COMMUNICATIONS NETWORK (MCN)

7.09.1 GENERAL

The MDT Communications Network (MCN) will follow a hierarchy model of a Core layer and an Access layer.

7.09.1.1 Core Layer;

The Core of the MDT Communications Network will consist of the fiber optic backbone cable and the layer 3 network switch with associated fiber optic interface cards, terminations, patch panels, and related equipment.

7.09.1.2 Access Layer;

The Access layer is the Ethernet interface at the patch panel at the layer 3 network switch providing 100BaseTX service to the MDT subsystems.

Access layer equipment will include the Ethernet patch panels and cables, drop cables, cables, conduits and pullboxes required to go to the location of the MDT subsystem and other communications equipment, both in the TC&C room and outside the TC&C room, to include the Traction Power substation, the attendant's booth or console, the supervisor's booth, passenger platform, plaza level areas, parking garage, bathroom, Blue Light/ETS stations, and any other area local to the station requiring a connection to the communications network.

7.09.2 FIBER OPTIC BACKBONE CABLE

The fiber optic backbone shall be extended per the following criteria:

- A. Install two Single Mode Fiber Optic cables. The number of fibers shall be determined by an analysis of the requirements of the communications

equipment. The cable shall be specified with a minimum of 25% spare unused fibers for future use with no less than 48 fibers per cable.

- B. Each cable shall be installed within the cabletray or conduit along the path of the guideway within the MDT Right of Way from each station's TC&C room to the next..
- C. Cable shall be installed in within the cabletray or conduit with access under the guideway, so maintenance can be done without personnel going onto the guideway or interfering with revenue service.
- D. The two fiber optic cable installations shall be physically separated to minimize the risk of damage to both cables occurring at the same time.
- E. The fiber optic cable is to be installed within HDPE innerduct and protected over the entire length outdoors by an enclosure, conduit or cabletray. An extra (spare) innerduct with a pull string shall be installed within the same cableway or conduit for future use. No exposed fiber optic cables are permitted.
- F. Where total number of bends exceeds 360 degrees, install a pull box, or provide access for pulls. Pullboxes and enclosures shall be large enough to not exceed the cables bend radius for both pulling and storage.
- G. Use separate cable entries and exits in each TC&C room to create diverse paths. Within the TC&C room route the cables within innerduct in overhead ladder type rack.

- H. Provide fiber termination panels with lockable covers for each cable. Terminate Fiber into a patch panel with jumpers to the network equipment. Use cable management equipment and techniques to protect the cables, jumpers, and fibers. Label all fiber termination points.
- I. Provide slack – 100 feet minimum at each end, and at intermediate pull points.
- J. Utilize a closed physical loop from location to location. A diverse path ring is preferred. A collapsed staggered ring is acceptable if a diverse path is not achievable.
- K. Coordinate with MDT to provide a diverse alternate path, if feasible -
Commentary: *Through interagency cooperation w/ FDOT/ MDPW/ FTE/ MDX/ or others*

7.09.3 NETWORK EQUIPMENT

For expansion of the MCN, Install network equipment per the following criteria;

- A. Communications between the CCF and stations will be over layer 3 Ethernet switches in a star configuration. The switches shall be configured with fiber optic interfaces to the backbone for;
 - 1. One connection of 1 Gigabit for data, and
 - 2. One connection of 10 Gigabit for video
- B. LANs are to be established per the MDT plan – The latest version will be provided to the designer by MDT.

- C. The IP assignment of equipment is to be per MDT IT department guidelines – The latest version will be provided to the designer by MDT.
- D. Open standards are to be followed. OSI data model to be followed – TCP/IP packet exchange over Ethernet or RS-232/422 interfaces with Ethernet as the preferred interface to MDT subsystems. Other types of communications interfaces require MDT approval.
- E. Firewalls or an Access Control List at each station for data protection are to be configured.
- F. For communications lines external to the TC&C room, Multimode FO cable for subsystem equipment drops is preferred over copper conductors.
- G. Data file types are to be non proprietary and must be compatible with existing MDT files.
- H. Communications equipment must have redundancy – Modules must be hot swappable. Equipment to have;
 - 1. Dual power supplies.
 - 2. Dual CPUs with automatic failover.
 - 3. Non Volatile memory required for configuration and application software

7.09.4 NETWORK INTERFACES

Interface to the MCN shall be as follows;

At each station, a minimum of 24 Ethernet interfaces will be provided at the layer 3 switch with a minimum of 8 interfaces reserved for future use.

The designer will complete a worksheet listing all equipment requiring communications interfaces to determine if an adequate number of interfaces are provisioned. If not, additional interfaces are to be specified to service the equipment and provide a minimum of 8 spare interfaces.

The bandwidth requirements at each station are to be determined by the communications designer by analysis.

The designer will prepare a bandwidth worksheet to confirm the adequacy of the layer 3 switch configuration as defined in the NETWORK EQUIPMENT section of this criteria - The communications system designer will list the communications requirements for all MDT systems at each station. Bandwidth utilization should not exceed 50% of the installed or proposed communications equipment capacity. If the utilization does exceed 50%, additional equipment is to be added.

Designer shall obtain the MDT spreadsheet template for data point listings. An example is given in Appendix A, Table 1. Designer shall enter PLC data points for the discrete commands and indications at each new station.

Commentary: *These generally are interfaces to the Traction Power SCITC panel relays, and discrete miscellaneous station signals, e.g. – Alarms on equipment, such as “PA fail”. As more types of equipment provide Ethernet interfaces for control and monitoring, the discrete I/O is less used.*

If equipment provides both Ethernet interfaces and alarm contacts, it is recommended to also connect the alarm contacts to the SCADA system as a back up indication of equipment failure or shutdown rather than a comm failure to that equipment.)

7.09.5 RESERVED

7.09.6 INSTALLATION TC&C ROOM

In general, the installation shall comply with the following requirements;

- A. Metal Cabinets with locks (keys to be common to existing MDT keys)
- B. General purpose receptacles on cabinets – GFI protected.
- C. Cable Management per EIA 568- 569
- D. Protectors on all external wiring routed into the TC&C room.
- E. Grounding / Lightning protection / Surge Protection is required
- F. Observe separate chassis and signal grounding connections for equipment.
- G. Single point grounding practices shall be observed.
- H. Equipment cabinets are to be insulated from the floor.
- I. 5 ohms to ground maximum resistance. Grounding to be done per ANSI/IEEE/UL standards

7.09.7 MAINTENANCE CONSIDERATIONS

- A. A Preventative maintenance plan is to be defined with Technical support & maintenance agreements (as required for specialized equipment)
- B. All specialized tools and test equipment is to be provided; OTDR, etc.
- C. Spares to be provided at 5% of modules, with no less than one spare module type for each piece of equipment.
- D. Extensive training of MDT maintenance personnel is required. MDT maintenance staff is to be trained to maintain all new equipment. Factory certification is required. Training materials are to be provided.

- E. Warranties are to be extended to 3 years minimum and be transferable to MDT. The 3 year Warranty period shall begin at final acceptance by MDT.
- F. Provide support software; AutoCADD, Microsoft products, etc. to read and edit the files provided by the Contractor. Provide site licenses for MDT maintenance.
- G. Software Licenses are to be transferable to MDT. The delivery media of software to be DVDs.
- H. Documentation – Paper and electronic media – Compatible with MDT document system.
- I. As built drawings with extensive documentation, maintenance manuals with troubleshooting procedures, diagnostic software, As-built drawings. Configuration datasheets and files are required.
- J. Provide maintenance interfaces to all equipment, simple Go/No-go indications/ self test capability.

7.09.8 OTHER

- A. Other than specific equipment identified within these criteria, no wireless or solar powered equipment is permitted without MDT approval.
- B. Where a Metrorail station is adjoining another nearby MDT facility, such as a bus terminal, provisions for a fiber optic communications bridge from the TC&C room to the facility shall be provided. As a minimum, the provisions shall include a 4” non metallic conduit with innerduct installed. Underground conduit shall be adequately protected with a concrete cover.
- C. MDT desires a portable temporary microwave (or other technology) link which can be used when a communication outage occurs. The

temporary link should be capable of up transmitting up to one gigabit/sec of digital data in Ethernet format up to two miles distance. Conduit to the roof for antenna coaxial cable and mounting is to be provided.

APPENDIX A –

Table 1 – EXAMPLE DISCRETE DATA POINT SCHEDULE*

STATION NAME: OKEECHOBEE (OKE) RTU# U101				NEW EQUIPMENT	
Addr	Descriptive Name	Type	Sub-System	Term Block	PLC Addr
0000	CATHODE FEEDER BREAKER 1 AMPS	ANA	TRAC PWR		
0001	CATHODE FEEDER BREAKER 6 AMPS	ANA	TRAC PWR		
0002	DC MAIN BUS VOLTAGE	ANA	TRAC PWR		
0100	HV01 HAS CLOSED	IND	TRAC PWR		
0101	HV01 HAS OPENED	IND	TRAC PWR		
0102	HV02 HAS CLOSED	IND	TRAC PWR		
0103	HV02 HAS OPENED	IND	TRAC PWR		
0114	DC11 HAS CLOSED	IND	TRAC PWR		
0115	DC11 HAS OPENED	IND	TRAC PWR		
0116	DC 12 HAS CLOSED	IND	TRAC PWR		
0117	DC 12 HAS OPENED	IND	TRAC PWR		
0118	DC 21 HAS CLOSED	IND	TRAC PWR		
0119	DC 21 HAS OPENED	IND	TRAC PWR		
0120	DC22 HAS CLOSED	IND	TRAC PWR		
0121	DC22 HAS OPENED	IND	TRAC PWR		
0130	FAILURE OF INCOMING 13.2 KV LINE 1	IND	TRAC PWR		
0131	FAILURE OF INCOMING 13.2 KV LINE 2	IND	TRAC PWR		
0200	DC SWITCHGEAR STRUCTURE GND / ENG	IND	TRAC PWR		
0201	RECT TRANSFORMER NO. 1 TROUBLE	IND	TRAC PWR		
0202	RECT TRANSFORMER NO. 2 TROUBLE	IND	TRAC PWR		
0203	LOCK OUT RELAY NO. 1 OPEN	IND	TRAC PWR		
0204	LOCK OUT RELAY NO. 2 OPEN	IND	TRAC PWR		
0205	RECT NO. 1 STRUCTURE GND / ENG	IND	TRAC PWR		
0206	RECT NO. 2 STRUCTURE GND / ENG	IND	TRAC PWR		
0207	RECT NO. 1 TROUBLE	IND	TRAC PWR		
0208	RECT NO. 2 TROUBLE	IND	TRAC PWR		
0209	BATTERY / BATTERY CHARGER TROUBLE	IND	TRAC PWR		
0210	AC POWER SUPPLY TO BATTERY CHARGER	IND	TRAC PWR		
0211	H103 LOSS POTENTIAL CONTACT RAIL	IND	TRAC PWR		
0212	H203 LOSS POTENTIAL CONTACT RAIL	IND	TRAC PWR		
0213	H104 LOSS POTENTIAL CONTACT RAIL	IND	TRAC PWR		
0214	H204 LOSS POTENTIAL CONTACT RAIL	IND	TRAC PWR		
0215	REMOTE / LOCAL CONTROL OF SWITCHGEAR	IND	TRAC PWR		

0216	FAILURE PILOT WIRE TFR TRIP	IND	TRAC PWR		
0217	EMERGENCY TRIP STATION ALARM	IND	TRAC PWR		
0218					
0219	CTS HAS OPENED	IND	COMM ALARM		
0220	DTS HAS CLOSED	IND	COMM ALARM		
0221	ETS HAS OPENED	IND	COMM ALARM		
0222	UPS HAS OPENED	IND	COMM ALARM		
0223	PA HAS OPENED	IND	COMM ALARM		
0224	CCTV HAS OPENED	IND	COMM ALARM		
0225	RADIO HAS OPENED	IND	COMM ALARM		
0226	ET ALARM	IND	COMM ALARM		
0227	ROW EGT-1	IND	STA ALARM		
0228	GAP TIE EGT-2	IND	STA ALARM		
0300	ANCILLARY SPACES SMOKE DETECT	IND	STA ALARM		
0301	HALON FLOW SWITCH	IND	STA ALARM		
0302	SPRAY WATER VALVE	IND	STA ALARM		
0303	FLOW SWITCH PARK STRUCTURE	IND	STA ALARM		
0304	WATER VALVE PARK STRUCTURE	IND	STA ALARM		
0305	TC & C ROOM SMOKE DETECTOR	IND	STA ALARM		
0306	TROUBLE FACP	IND	STA ALARM		
0307	TROUBLE PA	IND	STA ALARM		
0308	MANUAL FIRE PULL STATION	IND	STA ALARM		
0309	TRACTION POWER DETECTION	IND	STA ALARM		
0310	TPSS HIGH TEMP DETECTION	IND	STA ALARM		
0311	GAP TIE SUMMARY DETECTION	IND	STA ALARM		
0312	GAP TIE HIGH TEMP. STAT.	IND	STA ALARM		
0313	GAP TIE BATTERY FAN	IND	STA ALARM		
0314	STATION ENTRANCE INTRUSION	IND	STA ALARM		
0315	ANCILLARY SPACE PERIMETER INTRUSION	IND	STA ALARM		
0316	PLATFORM END GATE INTRUSION	IND	STA ALARM		
0317	REVENUE ROOM AND CHANGE MACHINE	IND	STA ALARM		
0318	TPSS INTRUSION	IND	STA ALARM		
0319	GAP TIE STATION	IND	STA ALARM		
0320	TRANS A 2ND STAGE OVERTRIP	IND	STA ALARM		
0321	TRANS B 2ND STAGE OVERTRIP	IND	STA ALARM		
0322	TRANS A 3RD STAGE OVERTRIP	IND	STA ALARM		
0323	TRANS B 3RD STAGE OVERTRIP	IND	STA ALARM		
0324	MAIN BREAKER A TRIPPED	IND	STA ALARM		
0325	TIE BREAKER B TRIPPED	IND	STA ALARM		
0326	ELEC. ROOM HIGH TEMP.	IND	STA ALARM		
0327	EMERG. POWER TRANS. SW. MALFUNCTION	IND	STA ALARM		
0328	CHARGER MALFUNCTION	IND	STA ALARM		
0329	TC & C ROOM HIGH TEMP.	IND	STA ALARM		
0330	BATTERY ROOM FAN MALFUNCTION	IND	STA ALARM		

0331	ESCALATOR/ ELEVATOR DETECTOR	IND	STA ALARM		
1000	TPSS BATTERY FAN	IND	STA ALARM		
1001	TIE BREAKER OPENED	IND	STA ALARM		
1002	MAIN BREAKER B TRIPPED	IND	STA ALARM		
1003	EMERG TRIP RESET H-103 RESPONSE	IND	ETS		
1004	EMERG TRIP RESET H-203 RESPONSE	IND	ETS		
1005	EMERG TRIP RESET H-104 RESPONSE	IND	ETS		
1006	EMERG TRIP RESET H-204 RESPONSE	IND	ETS		
1007	EMERG TRIP RESET H-104 RESPONSE	IND	ETS		
1008	EMERG TRIP RESET H-204 RESPONSE	IND	ETS		
1009	EMERG TRIP RESET H-105 RESPONSE	IND	ETS		
1010	EMERG TRIP RESET H-205 RESPONSE	IND	ETS		
1011					
1015					
1310	TRACK CIRCUIT H1-xxx for auto announce	IND	TRAIN CTRL		
1311	TRACK CIRCUIT H2-yyy for auto announce	IND	TRAIN CTRL		
2006	POWER OFF	IND	TRAIN CTRL		
2007	GROUND DETECTION	IND	TRAIN CTRL		
2008	BLOWN FUSE	IND	TRAIN CTRL		
2009	(Gap Tie Station Indications start here)				
2016	DC21 HAS CLOSED	IND	TRAC PWR		
2017	DC21 HAS OPENED	IND	TRAC PWR		
2018	DC22 HAS CLOSED	IND	TRAC PWR		
2019	DC22 HAS OPENED	IND	TRAC PWR		
2024	DC SWITCHGEAR GND / ENG	IND	TRAC PWR		
2025	BATTERY / BATTERY CHARGER FAILURE	IND	TRAC PWR		
2026	FAILURE AC TO BATTERY CHARGER	IND	TRAC PWR		
2027	H104 LOSS OF POTENTIAL	IND	TRAC PWR		
2028	H204 LOSS OF POTENTIAL	IND	TRAC PWR		
2029	H105 LOSS OF POTENTIAL	IND	TRAC PWR		
2030	H205 LOSS OF POTENTIAL	IND	TRAC PWR		
2031	REMOTE / LOCAL CONTROL OF SWITCHGEAR	IND	TRAC PWR		
2100	FAILURE PILOT WIRE XFR TRIP	IND	TRAC PWR		
2101	EMERGENCY TRIP STATION ALARM	IND	TRAC PWR		
2102	FIRE ALARM	IND	TRAC PWR		
2103	INTRUSION ALARM	IND	TRAC PWR		
2331	(Commands from CCF start here)				
3000	EMERGENCY TRIP RESET H104	CMD	TRAC PWR		
3001	EMERGENCY TRIP RESET H204	CMD	TRAC PWR		
3002	EMERGENCY TRIP RESET H105	CMD	TRAC PWR		
3003	EMERGENCY TRIP RESET H205	CMD	TRAC PWR		
3004	ANNUN ACKN RESET	CMD	TRAC PWR		
3005					
3006	DC21 CLOSED	CMD	TRAC PWR		

3007	DC21 OPENED	CMD	TRAC PWR		
3008	DC22 CLOSED	CMD	TRAC PWR		
3009	DC22 OPENED	CMD	TRAC PWR		
3016	TERMINAL MODE 3	CMD	TRAIN CTRL		
3017	CENTRAL CONTROL MANUAL MODE	CMD	TRAIN CTRL		
3018	CENTRAL CONTROL AUTO OPERATION	CMD	TRAIN CTRL		
3025	HANDICAP GATE 1 OPEN	CMD	TRAIN CTRL		
3026	HANDICAP GATE 2 OPEN	CMD	TRAIN CTRL		
3027	HANDICAP GATE 3 OPEN	CMD	TRAIN CTRL		
3028	HANDICAP GATE 4 OPEN	CMD	TRAIN CTRL		
3029					
3216	EMERG. TRIP RESET H103	CMD	ETS		
3217	EMERG. TRIP RESET H203	CMD	ETS		
3218	EMERG. TRIP RESET H104	CMD	ETS		
3219	EMERG. TRIP RESET H204	CMD	ETS		
3220	ANNUN. ACK RESET	CMD	TRAC PWR		
3221	HANDICAP GATE NO. 2 OPEN	CMD	MISC EQUIP		
3222	CABLE TRANS. SYSTEM	CMD	MISC EQUIP		
3223	DATA TRANS. SYSTEM	CMD	MISC EQUIP		
3224	RESTROOM DOOR RELEASE	CMD	MISC EQUIP		
3225	FIRE AND INTRUSION ACK	CMD	MISC EQUIP		
3226	FIRE AND INTRUSION RESET	CMD	MISC EQUIP		
3231	HANDICAP GATE NO.1 OPEN	CMD	MISC EQUIP		
3300	HV01 CLOSED	CMD	TRAC PWR		
3301	HV01 OPENED	CMD	TRAC PWR		
3302	HV02 CLOSED	CMD	TRAC PWR		
3303	HV02 OPENED	CMD	TRAC PWR		
3314	DC11 CLOSED	CMD	TRAC PWR		
3315	DC11 OPENED	CMD	TRAC PWR		
3316	DC12 CLOSED	CMD	TRAC PWR		
3317	DC12 OPENED	CMD	TRAC PWR		
3318	DC21 CLOSED	CMD	TRAC PWR		
3319	DC21 OPENED	CMD	TRAC PWR		
3320	DC22 CLOSED	CMD	TRAC PWR		
3321	DC22 OPENED	CMD	TRAC PWR		
3330	TPSS VENTILATION SHUTDOWN	CMD	TRAC PWR		
3331					

*This listing is from a Phase I installation and reflects the equipment installed at that time. It is expected that the communications implementation on new equipment will vary. For example, for the Train Control system, Ethernet communications may replace the discrete commands and indications shown in this listing.

For any equipment that is equipped with discrete alarm contacts, they shall be connected to the SCADA system.