DIVISION 8

WIRE COMMUNICATION AND SIGNAL SYSTEM

8.1 TELEPHONE SYSTEM

8.1.1 GENERAL

Section 7.1, “Electrical General Requirements” of Division 7, applies to this section, with the additions and modifications specified herein.

8.1.1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. National Fire Protection Association (NFPA)

   NFPA 70 (2007) National Electrical Code

2. U.S. Defense Information Systems Agency (DISA)

   DCA DCAC 370-V175-6 Basic System Interface Criteria

3. U.S. Department Of Agriculture (USDA)

   RUS 345-165 (1996) Digital Stored Program Controlled Central Office Equipment (Form 522)

4. U.S. Federal Communications Commission (FCC)

   FCC Part 68 Connection of Terminal Equipment to the Telephone Network (47 CFR 68)

   IEEE Institute of Integrated Electrical Engineers of the Philippines. (IIEE)

   PEC (2002) Philippine Electrical Code (IIEE)

8.1.1.2 SYSTEM DESCRIPTION

Telephone distribution system shall consist of voice switching equipment, inside plant cables, voice instruments, power equipment and batteries, telephone management system, and other auxiliary equipment. System shall be [directly connected] [connected via base dial central office (DCO)] to public

switched network in accordance with the rules set forth by FCC Part 68, and other appropriate authorities such as Public Utilities Commission and local telephone company.

1. Performance Requirements

    a. Reliability

        Electronic Private Automatic Branch Exchange (EPABX) shall have a minimum acceptable system Mean-Time-Between-Failure (MTBF) of [4000] [_____] hours. A failure is defined as the complete loss of the capability of the switch to handle or process calls.

    b. Maintainability

        EPABX shall have maximum acceptable system Mean-Time-To-Repair (MTTR) of [_____] minutes. Repair time is defined as the clock time from the occurrence of the failure to the time when the switch is restored to service either by repair or substitution of the failed component.

8.1.1.3 SUBMITTALS

The following shall be submitted;

1. Shop Drawings

    Telephone system installation drawings

2. Product Data

    a. Digital switching system
    b. Cables
    c. Standby battery
    d. Connector blocks
    e. Terminal blocks
    f. Instruments
    g. Features

3. Test Reports

    a. Test procedures and reports
    b. Test plans

4. Certificates

   a. Installer's qualifications;
   b. Instructor's qualifications;

5. Manufacturer's Instructions

   a. Installation procedures;

6. Operation and Maintenance Data

   a. Telephone distribution system,

8.1.1.4 QUALITY ASSURANCE

1. Evidence of Experience and Qualifications

   a. Installer's Qualifications

      Show that the installer who will perform the work has a minimum of 2 years experience successfully installing telephone distribution system of the same type and design as specified herein. Include the names, locations, and point of contact of at least two installations of the same type and design as specified herein where the installer has installed such systems. Indicate type of each system and certify that system has performed satisfactorily in the manner intended for a period of not less than 12 months. Submit data of installer's experience and qualifications.

   b. Instructor's Qualifications

      Show that the instructor, who will train operation and maintenance personnel, has a minimum of 24 hours training from a recognized technical organization, and 2 years experience in installation of telephone distribution system of the type specified. Submit data of the instructor's experience and qualifications.

2. Telephone System Installation Drawings

   Submit shop drawing complete with wiring and schematic diagrams, and other details required to demonstrate that system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, equipment relationship to other parts of the work including clearances for operations and maintenance, and terminal assignment of inside wiring.

3. Test Plans

Submit for approval at least 30 days prior to commencement of formal operational testing a test plans specified in paragraph entitled "Field Quality Control."

4. Installation Procedures

Where installation procedures, or any part thereof, are required to be in accordance with manufacturer's instructions, submit these instructions to the Engineer prior to installation of the equipment.

8.1.1.5 DELIVERY AND STORAGE

Provide protection from weather, humidity and temperature variations, dirt, dust, and other contaminants for equipment placed in storage.

8.1.1.6 SITE CONDITIONS

1. Environmental Requirements

Install equipment indoors in a protected environment. Electronic equipment designed for office environment shall be rated for continuous operation under ambient environmental conditions of 10 degrees C to 30 degrees C and 35 to 65 percent relative humidity, non-condensing.

8.1.2 MATERIAL REQUIREMENTS

8.1.2.1 MATERIALS AND EQUIPMENT

Material and equipment shall be the standard products of a manufacturer regularly engaged in manufacture of the products and shall be the manufacturer's latest standard design.

8.1.2.2 DIGITAL SWITCHING SYSTEM

Provide equipment consisting of stored program, processor controlled Electronic Private Automatic Branch Exchange (EPABX) Telephone Switching System utilizing pulse code modulation (PCM) architecture.

1. Switching Network

Switch shall be a stored program, processor controlled PCM system utilizing solid state construction. Switching network shall be of modular type construction to allow additions to the network or system without interruptions or downtime to the system.

2. Processor

Switching network and other associated functions of the system shall be under the control of [dual] [a single] central processor[s] utilizing stored program control. Stored system control program shall automatically reprogram and restart the system in the event of power failure. Programs which control functions of the user system shall utilize language which is oriented toward a person-machine interface.

a. Control Programs

Control programs such as trunk routing, digit sending and receiving, and assigning trunk quantities shall be locally or field programmable by means of an interface with a terminal. Programs shall be flexible to the extend that line assignment and class of service type changes can be made in the field by way of this terminal interface.

b. Maintenance Diagnostic Program

Provide system with maintenance diagnostic program for complete system tests. Program shall be in continuous operation and structured so that any fault that is detected is immediately printed out on a maintenance terminal or indicated on a cathode ray tube (CRT). Diagnostic tests that contain no-fault conditions shall be printed out during specified times of day or upon demand. Program shall be integrated into the processor control system so that when faults are registered an automatic transfer of equipment will take place within the system to remedy a fault condition. Automatic transfer of equipment to remedy a fault condition is required only for equipment that would affect a common control portion of the switching system. Diagnostic and maintenance program shall be accessible by way of field located maintenance terminal.

3. Transmission Requirements

Transmission requirements are expressed in terms of analog measurements.

a. Input Impedance

Nominal input impedance of subscriber circuits and analog trunks of the EPABX shall be 600 ohms. When connecting facility or equipment is other than 600 ohms, Contractor shall provide required impedance matching devices for proper operations.

b. Insertion Loss

Insertion loss: Between 0 dB and 2.0 dB for 2-wire to 4-wire, and 4-wire to 4-wire trunk connections. Between 0 dB and 2.0 dB for trunk-to-line connections, and 0 dB to 6.0 dB for line-to-line terminations or connections.

c. Stability

Components shall have long term loss variation of specified transmission levels of not more than plus or minus 0.5 dB. Long term stability requirement is defined as more than 10 years.

d. Frequency Response

Frequency response loss reading relative to 1004 Hz signal shall not exceed the following:

Frequency	Trunk-to-Trunk	Trunk-to-Line	Line-to-Line
200 Hz	2.0 dB	2.0 dB	2.5 dB
300 Hz - 3 kHz	1.3 dB	1.3 dB	1.5 dB
3.4 kHz	0.5 dB	0.8 dB	0.8 dB

e. Return Loss

Return loss measured at 600 ohms shall not exceed the following:

	Trunk-to-Line	Line-to-Line
Echo Return Loss (ERL)	20 dB	24 dB
Singing Return Loss (SRL)	14 dB	16 dB

f. Longitudinal Balance

For frequencies of 180, 540, 1000, and 2000 Hz, minimum balance shall be 60 dB; at 3400 Hz minimum shall be 50 dB.

g. Steady Noise

Idle channel noise with C-Message weighing at 600 ohms impedance measured on terminated call shall be as follows:

Maximum	23 dBrncO
Average	18 dBrncO or less

h. Impulse Noise

Switching system shall meet an impulse noise limit of not more than five counts exceeding 54 dBrncO voice weighed in a 5-minute period on six measurements made during busy hour. Measurement shall be made by establishing connection from impulse counter through the switch into a quite 600-ohm termination.

i. Crosstalk Coupling

In the range of 200 to 3400 Hz the worst case equal level crosstalk level shall not exceed 75 dB below the reference signal.

j. Absolute Delay

Absolute one-way delay through the switching system at 1800 Hz shall not exceed 1000 microseconds.

k. Digital Error Rate

Digital switching system shall produce an error rate into digital connections that shall not exceed 10 to minus 8 bits averaged over a 5-minute period.

8.1.2.3 HARDWARE REQUIREMENTS

1. Equipment Mounting Cabinets

Provide modular type cabinets to house the EPABX processor, memory cards, lines, trunks, and miscellaneous items. Height of cabinets shall not exceed 2440 mm including cable trays. Equip cabinets with front [and rear] covers which are easily opened or removed.

2. Cabinet Mounting Shelves

Equip mounting shelves within cabinets with coded card slots to prevent accidental insertion of plug-in cards into improper slots which could result in damage to the system or the plug-in card. Identify each slot to indicate which cards are usable in that particular slot.

3. Plug-In Cards

Provide identification on each card to indicate specific function. Label each card with model identification and issue number.

4. Overall Capacity

Provide system capacity as specified in the following table:

	Equipped	System Wired	Capacity
Voice Lines	[_____]	[_____]	[_____]
Central Office (CO) Trunks	[_____]	[_____]	[_____]
Direct Inward Dial (DID) Trunks	[_____]	[_____]	[_____]
Autovon Trunks	[_____]	[_____]	[_____]
Federal Telephone System (FTS) Trunks	[_____]	[_____]	[_____]
Tie Trunks	[_____]	[_____]	[_____]
	[_____]	[_____]	[_____]

Provide interconnection of proposed system with existing system when required. The following are definition of each item:

Voice line: System shall provide separate line and number assignment for each of the instruments required.

Equipped: System contains sufficient cards to support the specified lines and trunks in a fully operational basis.

Wired: The only type of equipment required to reach this size is cards on a plug-in basis. System shall contain sufficient processing power, memory, shelf space, card slots, and all other equipment necessary to accommodate this size.

System capacity: System can grow to these sizes by additions in the form of memory, cabinets, and other circuit boards. Excludes systems which require additions of a tandem switch where tie trunks are required.

5. Traffic

Provide system switching matrix, processors, processor memory, and miscellaneous equipment based upon the following traffic criteria:

a. CCS Quantities

Circuit Type	CCS
Voice Line	8
Attendant Console	34
Trunks	36

b. Traffic Ratio

Determining switch and trunk quantities the following ratios shall be used:

Type of Call	Ratio
Intra-EPABX	35 percent usage
Trunk	65 percent usage

c. Grade of Service

Provide trunks, switch quantities, and lines with a P.001 grade of service as indicated on RUS 345-165, Erlang Traffic Table, Lost Calls Cleared.

6. Numbering Plan

Provide a flexible numbering plan that will allow for numbers to be changed via terminal interface. Numbering plan for the system shall consist of seven-digit numbers.

a. Dialing Plan

Assign DID stations with seven-digit numbers for public directory lists. Calls within the system shall be accessed by dialing the last three or four digits of the listed station number. Calls to stations outside the system shall be completed by dialing [an access code and then] the published number, such as four digits for base calls, seven digits for off-base local calls, FTS, and Autovon, or ten digits for Direct Distance Dialing (DDD) calls.

b. Translation Functions

System software shall have the capability to prefix at least three digits or delete at least three digits from the originating and terminating trunk.

c. Subscriber Data Base

Contractor shall gather, develop, and load the subscriber data base. Assignment of class of service and associated features and capabilities shall be subject to approval by the Engineer.

8.1.2.4 DIRECT DIGITAL INTERFACE

System shall interface directly with tie trunks on T1 carrier without the use of channel banks. System shall be equipped with a synchronous clock for interfacing with other digital switching equipment on a direct digital basis. Clock shall be stable to no more drift than one bit in 10 to the 8th power per day.

8.1.2.5 CONNECTOR BLOCKS

Connector blocks shall be 66 type equipped with punch down clips.

8.1.2.6 TERMINAL BLOCKS

Provide wirewrap type for terminating line circuits, trunks, and inside cabling.

8.1.2.7 POWER SYSTEM

EPABX voltage rating: 230 volt plus or minus 10 percent, 60 Hz. Power system shall be contained within the switch cabinets. Provide a negative 48 Vdc power supply with [_____] ampere chargers. Chargers shall be sized to supply the full load requirements of EPABX, ancillary equipment plus [_____] amperes. When two chargers are provided each charger shall have the capacity to supply the full load requirement should one charger fail. Transfer of power to one charger shall be automatic and without loss of system functions. Provide distribution power panel. Panel shall be equipped with a low voltage cutoff circuit to disconnect the negative 48Vdc when the voltage falls below minus 44 volts.

8.1.2.8 STANDBY BATTERY SYSTEM

Consist of nominal number of [_____] [24] battery cells. Battery float voltage: [_____] [48] volts. High performance [lead calcium sealed maintenance-free] [lead calcium] type, multicell construction. Discharge rates: [_____]amperes minimum for 15 minutes minimum and 8 hours maximum to [_____] volt per cell at 25 degrees C. Float voltage acceptable range shall be [_____] [2.2] to [_____] [2.3] volts per cell at [_____] [1.28] specific gravity. Battery cell shall have safety flame arrestor. Provide inter-cell connectors[, and hydrometer].

1. Battery Rack

   [Two tier] [step] rack. [Three] [_____] frames per rack. Rated for [seismic, zone [2] [_____]] [non-seismic] location. Length: [_____]meters(feet).

8.1.2.9 TELEPHONE MANAGEMENT SYSTEM (TMS)

System shall provide records for later retrieval of the number of the calling line, [access code,] all digits of the called number, date, starting time and duration of all outward calls to the public switched service network, FTS, and Autovon. Capacity to store [_____] call record is required. System shall also provide off-line storage. Provide console printer for exclusive use of the TMS.

1. Summary and Detail Reports

   The following shall be available from internal report generators:

Station	Department	Division
Single station	Single department	Single division
All station	All department	All division
Selectivity for Date, Trunk Groups and Time of Day	Selectivity for Date, Trunk Groups and Time of Day	Selectivity for Date, Trunk Groups and Time of Day

2. Call Tracing

   The TMS shall have specified software requirements that shall allow for the tracing of calls made within the particular EPABX area. All DCO or external call tracing shall be coordinated with responsible personnel at the DCO or local telephone company.

8.1.2.10 FEATURES

1. System Features

   EPABX shall include the following as minimum into the basic system:

   a. Alternative routing providing for automatic selection of alternate trunk group if all trunks in the first-choice group are busy.

   b. Common control switching arrangement (CCSA) providing access for private network services.

   c. Class of service treatment providing for [32] [_____] class of service.

   d. Direct inward dialing providing incoming call to directly access a telephone station, bypassing the EPABX operator.

e. Direct outward dialing providing extension to access trunk groups directly, bypassing the EPABX operator.

f. Distinctive ringing providing identification of incoming calls as external, intra-system, or feature by the type of audible signal provided to the station.

g. Dial pulse (DP)-to-dual tone multi-frequency (DTMF) conversion providing system the arrangement to receive dial pulse then convert them to DTMF tones for outpulsing over other trunks.

h. DTMF-to-DP conversion providing system the arrangement to receive DTMF tones and convert them to dial pulses.

i. Full availability providing all stations, unless restricted, availability to all lines, trunks, and features.

j. Intercept providing routing of unassigned or changed numbers routed to the EPABX operator or recorder.

k. Paging system providing interface via subscriber circuits. Access to paging system shall be by code dialing.

l. Least cost routing providing outgoing calls to be automatically routed over the trunk groups that provide the least cost service.

m. Call conferencing providing attendant the capability to establish up to 6 parties (including trunk circuits) per conference, with up to [_____] conferences in progress simultaneously.

n. "Meet me" conference circuit providing a single-digit access code. Any stations dialing that code at a predetermined time, or upon direction by the attendant, shall be connected in conference.

o. Station Message Detail Recorder port providing capability for printer interface.

2. Station Features

System shall include the following as a minimum for station operation:

a. Call Forwarding-All Calls providing calls to one station to be forwarded to another station.

b. Call Forwarding-Busy providing calls to a busy station to be routed to an operator or another station.

c. Call Forwarding-Don't Answer providing calls to a station which are not answered after a programmed ringing interval to be routed to an operator or another station.

d. Call Hold providing a call in progress to be placed on hold, freeing the station user to initiate a second call or perform a second feature.

e. Call Pickup-Group providing station users in a station user group to answer any call in that group by dialing a code.

f. Call Transfer providing a station to transfer a trunk or station to another station, without attendant assistance.

g. Call Waiting providing a tone to a busy station to let the station know that a call is trying to reach it, permitting the station to place the call in progress on hold, and answer the calling station.

h. Speed Calling providing the station to call predetermined seven- or ten-digit numbers by dialing two digits.

i. Executive Override providing station user, upon encountering a busy condition on an internal station, to bridge into the busy connection after transmitting a warning tone.

3. Attendant Console

Console in addition to station-related features and functions, shall have the capability to perform the following functions:

a. Switched loop operation providing a common-loop circuit for all station and trunk lines in the system to permit the attendant to service any type of call and release from that call and connect to another.

b. Pushbutton dialing providing a keyset which allows the attendant to complete Autovon precedence calls as well as all types of calls normally associated with the console.

c. Local call identification providing visual indication of the calling number and class of service of the station originating the call.

d. Verification providing the console a trunk or line that will allow the attendant, by calling a code or the station number, to verify that the station is busy or in a trouble condition.

e. Console out-of-service providing the capability of removing the console from operation by a manual pushbutton located on the console or by removing the headset from the plug-in jacks.

f. Busy override providing the attendant the capability to enter an existing busy station. An override tone shall be provided to the busy station prior to the attendant entering the conversation and the tone shall be repeated every 5 seconds until the attendant leaves the conversation.

g. Call Hold providing the capability to place any trunk or station on hold while performing other functions.

h. Call Waiting indicator providing a visual indication of the number of calls waiting to be answered.

i. Camp-On providing the capability, on an incoming trunk call to the attendant which cannot be extended to a station because it is busy, to place the call in a waiting mode until the busy station goes on-hook. The telephone shall then ring automatically, and upon answering, be connected to the incoming trunk.

j. Transfer-All-Calls providing the capability to transfer all station and trunk calls to other stations when requested to do so by the station.

k. Trunk call identification providing a visual indication of the trunk number and trunk type on incoming trunk calls to the console.

l. Trunk group status indicator providing a visual indication when all trunks in a group are busy.

m. Two-way splitting providing capability of splitting a connection to talk to either end of connection without the other party hearing.

n. Answering priority providing capability to manually select the next incoming trunk call, recall or operator call.

o. Automatic recall providing incoming trunk calls, which have been camped on a busy station or unanswered for a prescribed time period, shall be directed back to the attendant.

p. Call privacy providing denial to the attendant of the ability to enter an established connection unless specifically called by the user or unless the busy override feature is used.

q. Simultaneous handset and headset operation.

r. Console clock providing for a digital clock located on the console panel.

8.1.2.11 TRAFFIC MEASUREMENT AND MONITORING SUBSYSTEM

System shall be equipped with a traffic measurement and monitoring subsystem to measure, store, manipulate, and print out traffic data for system design and performance analysis.

1. Traffic Measurement and Storage Subsystem

   Subsystem shall be controlled by a stored program and perform the traffic measurement and storage function automatically when activated.

2. Traffic Measurement Subsystem

   Subsystem shall provide printouts of the measured and stored traffic data at selected intervals of 15, 30, or 60 minutes. Subsystem shall also have the capability to store data and provide an accumulated total for one, 12, or 24 hours.

3. Subsystem

   Subsystem when activated, shall provide traffic data on a hard copy printout at the interval requested.

4. Traffic Measurements

   Traffic measurement provided by the subsystem shall provide the following data:

   a. Traffic data on trunks collected on a trunk group and individual trunk basis. Trunk data shall include usage, attempts, all trunks busy (ATB), and trunk overflow.

   b. Traffic data lines collected on an individual line and line group basis. Line data shall include usage and attempts.

   c. Dial tone delay measurements measured in dial tone delays that are in excess of one second.

   d. Operator console traffic measured in usage, attempts, and delays in answer of more than 5 seconds.

5. Traffic Usage

   Traffic usage shall be measured in CCS and other data, such as peg count, overflow, in unit measurements.

8.1.2.12 INTERCEPT FACILITIES

Provide EPABX with recorder-announcer to provide intercept facilities and announcements.

1. Recorder-Announcer

   Recorder-announcer shall be of solid state construction and easily installed in cabinets or relay racks. Recorder-announcer shall be equipped with a handset and jacks to facilitate change of announcements and [6] [5] [4] [3] [2] channels. Channels shall be assigned the following functions:

   a. Channel 1: To announce stations that have been disconnected or are no longer in service.

   b. Channel 2: To announce changed station numbers.

   c. Channel 3: To announce improperly called numbers or area codes.

   d. Channel 4, 5, and 6: To announce a Government recorded message.

2. Recorder-Announcer Messages

   Message on the recorder-announcer shall be capable of having at least a 15-second message on each channel. Channels 1, 2, and 3 shall be accessed automatically from the system when a disconnected station, wrong number or invalid number is dialed. Channel 4, 5, and 6 shall be accessed by a directory number or code.

8.1.2.13 AUTOVON NETWORK

System shall be able to interface directly with the Autovon Network via dedicated Autovon trunks. System software shall process incoming and outgoing calls via Autovon trunks as specified. Most Autovon interfaces will be a 4-wire precedence network inward dial (PNID) and precedence network outward dial (PNOD), with precedence calls above routine placed with attendant assistance. Certain subscribers shall be class marked to permit direct PNOD. PNID and PNOD to and from Autovon shall employ DTMF with E & M supervisory signalling. Interface impedance shall be 600 ohms plus or minus 10 percent.

1. Outgoing Direct PNOD Calls

   For outgoing direct PNOD calls the trunks shall be scanned first for idle conditions and, when an idle trunk is not found, preemption shall be

accomplished in accordance with DCA DCAC 370-V175-6 starting with the lowest precedence trunk available. Preempt tone, in accordance with DCA DCAC 370-V175-6, shall be transmitted to each involved subscriber line automatically by the preempting switch at the time preemption occurs.

2. Incoming Autovon Calls

Incoming Autovon calls shall attempt completion to the called subscriber. Any busy conditions encountered shall result in return of busy tone to the incoming Autovon trunk.

3. Incoming Precedence Calls Above Routine

Calls above routine, from the Autovon, shall attempt connection, including preempt, to the called subscriber. When the subscriber or intervening trunks are busy at an equal or higher level of precedence, the calls shall be immediately diverted to the DCA console for assistance. Where a "do not answer" condition is encountered, the precedence call shall be diverted to the DCA for assistance after 30 seconds.

8.1.2.14 SYSTEM ALARMS

System shall provide visual indication of high and low voltage alarm and EPABX failure alarms discovered by self-diagnostics. [System shall provide these visual alarms on the EPABX cabinet panels.] [System shall also provide a visual alarm on the attendant console.] [EPABX shall include dry contacts for remote transmission of any system.]

8.1.2.15 CABLES

Provide cables in accordance with EIA/TIA standards for cabling configuration requirements.

8.1.2.16 STATION JACKS

FCC Part 68, modular eight-wire type.

8.1.2.17 STATION LINE CORD

FCC Part 68, modular between station jack and base of instrument, at least 1830 mm(6 feet) in length.

8.1.2.18 INSTRUMENTS

1. Single Line

   Voice instruments shall be fully modular and equipped with a DTMF dialing pad and a pre-timed feature access button which simulates hook flash.

2. Electronic

   Voice instrument shall be equipped with [_____] keys which may be independently programmed as feature or line appearance keys. Instrument shall utilize a maximum of four pairs and shall not require any intermediate hardware between the set and EPABX.

3. Attendant Console

   Each console shall utilize construction technology of the same state-of-art of the EPABX and shall operate up to 305 meters(1000 feet) from the EPABX as well as individually or in parallel with adjacent consoles. Provide handset and headset with each attendant console.

4. Speakerphone

   Stand-alone or integrated speakerphones shall provide for on-hook, hands free, two-way conversation for users at least 3050 mm(10 feet) away from the instrument.

5. Instrument Requirements

   The following instruments shall be provided:

Quantity	Description
[_____]	Single line - desk
[_____]	Single line - wall
[_____]	Electronic - desk
[_____]	Electronic - wall
[_____]	Attendant Console
[_____]	Wall speakerphone
[_____]	Desk speakerphone

8.1.2.19 FIBER OPTIC TRANSMISSION AND MULTIPLEX EQUIPMENT

1. Optic Equipment

   Optical span line terminal equipment shall be a T3 rate transmission system with optical span line office terminals equipped to accept up to

28 T1 (1.544 Mb/s) signal lines multiplexing/demultiplexing them for transmission/reception over a pair of optical fibers. Provide transfer switching unit to dual, identical, redundant fibers in the event of damage to the primary optical fibers. Provide a minimum of two optical transmitting and two optical receiving units. Provide an alarm display for indication of malfunctions or failures. Provide automatic transfer to the redundant transceiver in the event of primary transmitter or receiver malfunction. Provide dual, identical, redundant optical transmitters and receivers at each end of each span.

a. Transmitter and Receiver

Provide transmitter and receiver in accordance with Section 8.3 STRUCTURED TELECOMMUNICATION CABLES AND PATHWAYS.

2. Multiplex Equipment

Equipment shall provide an interface between DS-1 and DS-3 signals and conform to the following:

Low Speed Interface (DS-1)

Channel Capacity	(28) DS-1 Signals
Line Rate	1.544 Mb/s plus or minus 0.5 b/s
Line Code	Half-width Bipolar
Line Impedance	110 ohms, plus or minus 5 percent resistive nominal balanced

High Speed Interface (DS-3)

Channel Capacity	(1) DS-3 Signal
Line Rate	44.736 Mb/s plus or minus 0.33 b/s
Line Code	B3Zs
Line Impedance	75 ohms, plus or minus 5 percent resistive

8.1.3 EXECUTION

8.1.3.1 INSTALLATION

Install system components and appurtenances in accordance with manufacturer's instructions and NFPA 70. Provide necessary interconnections, services, and adjustments required for a complete and operable telephone distribution system.

8.1.3.2 INTERIOR WIRING

Install interior electrical work for telephone distribution system as specified in Section 7.5 INTERIOR WIRING SYSTEM.

8.1.3.3 GROUNDING

Provide copper ground bus for equipment ground. Total ground resistance shall be 5 ohms or less.

8.1.3.4 FIELD QUALITY CONTROL

Furnish test equipment, instrumentation, personnel, and supplies necessary to perform all testing. Engineer shall be given [5] [_____] working days notice prior to [each] [_____] test[s].

1. Test Plans

   Develop a test plans defining all tests required to ensure that system meets technical, operational, and performance specifications. Plans shall define milestones for each test, equipment, personnel, facilities, and supplies required. Plans shall identify the capabilities and functions to be tested.

2. Test Procedures and Reports

   Develop test procedures from the test plan and design documentation. Procedures shall consist of detailed instructions for the best setup, execution, and evaluation of the tests. Procedures shall consist of visual inspection, basic system operation, trunk call-through, station feature operations, attendant console verification, and maintenance and administrative operations. Visual operations can begin at any period during installation and are used to list all newly installed equipment. Submit reports to the Engineer within [7] [_____] working days after completion of each test.

   a. Basic System Tests

      Tests shall verify that basic types calls can be made and to ensure confidence in system operations. Selected lines shall be verified to receive dial tone, receive ringback tone, talk to the called line, receive ringing, and trip ringing as required.

   b. Trunk Call-Through Tests

      Verify all trunk groups can be accessed as required, and that trunks interface properly with connecting system.

c. Station Feature Tests

Verify that the equipped station and system features function as required. Tests require the use of several telephones with each being assigned classes of service to verify the appropriate feature.

d. Attendant Feature Tests

Verify that all attendant features function as required. Tests require that several calls be placed to and from attendant console from local stations, to attendant console from incoming trunks, and from attendant console to outgoing trunks.

e. Maintenance and Administrative Tests

Verify that all maintenance and administrative operations can be accomplished as specified.

8.1.3.5 MEASUREMENT AND PAYMENT

The payment for the telephone system equipment to be paid for shall be made in lump sum basis as listed in the Bill of quantities complete, tested and accepted by the Engineer. Payment shall constitute full compensation for all labor, materials, tools and equipment and other incidentals necessary for the successful operation of the whole telephone system.