

16.11 TELECOMMUNICATIONS SYSTEMS

TABLE OF CONTENTS

PART 1 – GENERAL

- 1.01 REFERENCE REQUIREMENTS 1.02 SECTION INCLUDES 1.03 RELATED SECTIONS
- 1.04 REFERENCES 1.05 QUALITY ASSURANCE 1.06 SUBMITTALS
- 1.07 PROJECT RECORD DOCUMENTS 1.08 QUALIFICATIONS 1.09 MAINTENANCE SERVICE
- 1.10 DEFINITION-STRUCTURED CABLING SYSTEM

PART 2 – PRODUCTS

- 2.01 TELEPHONE TERMINATION BACKBOARDS 2.02 STATION COPPER CABLE
- 2.03 RISER COPPER CABLE 2.04 UNDERGROUND COPPER CABLE
- 2.05 CABLE PROTECTORS FOR COPPER CABLE 2.06 FIBER OPTIC CABLE
- 2.07 OPTICAL FIBER TERMINATIONS 2.08 OPTICAL FIBER PATCH CORDS 2.09 CONNECTION BLOCKS
- 2.10 EQUIPMENT RACKS 2.11 INTRABUILDING COAXIAL CABLE
- 2.12 INTERBUILDING COAXIAL CABLE 2.13 VIDEO SYSTEM PARTS AND ACCESSORIES
- 2.14 OUTLET BOXES 2.15 VOICE/DATA OUTLETS AND COVER PLATES
- 2.16 HORIZONTAL DISTRIBUTION CABLE MANAGEMENT SYSTEM 2.17 DUCTBANK INNERLINERS
- 2.18 CABLE LUBRICANT 2.19 CASES AND SPLICES 2.20 FIRESTOPPING 2.21 ELEVATOR PHONE
- 2.22 OUTDOOR EMERGENCY PHONE

PART 3 – EXECUTION

- 3.01 SYSTEM DESIGN 3.02 FORBIDDEN WORK 3.03 EXAMINATION
- 3.04 INSTALLATION OF BACKBOARDS 3.05 CABLE PULLING
- 3.06 COORDINATE WITH OTHER TRADES 3.07 CONDUIT INSTALLATION
- 3.08 COMMUNICATIONS EQUIPMENT ROOMS 3.09 STATION CABLING AND INSTALLATION
- 3.10 RISER CABLING AND INSTALLATION 3.11 UNDERGROUND CABLING AND INSTALLATION
- 3.12 OUTLET BOX INSTALLATION 3.13 DUCTBANK DESIGN, CONSTRUCTION, AND UTILIZATION
- 3.14 MANHOLES 3.15 CONNECTION TO EXISTING SYSTEM
- 3.16 RE-ROUTING OF EXISTING UNDERGROUND CABLES
- 3.17 VIDEO SYSTEM INSTALLATION-BUILDING INTERIOR 3.18 VIDEO SYSTEM ADJUSTING
- 3.19 CABLE PLANT LABELING 3.20 TESTING AND ACCEPTANCE 3.21 AS-BUILT DOCUMENTATION

PART 1 – GENERAL

1.01 REFERENCE REQUIREMENTS

The provisions of the General Conditions, Special Conditions, Program Requirements and Division 1, General Requirements, apply to the work of this Section.

1.02 SECTION INCLUDES

- A. Telecommunications service entrance.
- B. Premises wiring system.
- C. Broadband type cable video system.

1.03 RELATED SECTIONS

- A. Shop Drawings, Product Data and Samples
- B. Product Record Documents
- C. Cast-In-Place Concrete
- D. Painting
- E. Wiring Materials and Methods
- F. Outside Power Transmission and Distribution

1.04 REFERENCES

- A. Building Industry Consulting Services International (BICSI), "Telecommunications Distributions Methods Manual," Tenth Edition.
- B. ANSI/TIA/EIA 568-B.1 – Commercial Building Telecommunications Cabling Standard – Part 1: General requirements, April 1, 2001
- C. ANSI/TIA/EIA 568-B.1-1 – Commercial Building Telecommunications Cabling Standard – Part 1: General Requirements – Addendum 1 – Minimum 4-Pair UTP and 4-Pair ScTP Patch Cable Bend Radius, July 1, 2001
- D. ANSI/TIA/EIA 568-B.2 – Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted Pair Cabling Components, April 1, 2001
- E. ANSI/TIA/EIA 568-B.2-1 – Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted Pair Components – Addendum 1 – Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling, June 1, 2002
- F. ANSI/TIA/EIA 568-B.2-2 – Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted-Pair Cabling Components – Addendum 2, December 1, 2001
- G. ANSI/TIA/EIA 568-B.2-3 – Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted-Pair Cabling – Addendum 3 – Additional Considerations for Insertion Loss and Return Loss Pass/Fail Determination, March 1, 2001
- H. ANSI/TIA/EIA 568-B.3 – Optical Fiber Cabling Components Standard, March 1, 2000

- I. ANSI/TIA/EIA-568-B.3-1 – Optical Fiber Cabling Components Standard – Addendum 1 – Additional Transmission Performance Specifications for 50/125 um Optical Fiber Cables, April 1, 2002
- J. ANSI/TIA/EIA 862 Building Automation Systems Cabling for Commercial Buildings, April 11, 2002
- K. ANSI/TIA/EIA 569 – Commercial Building Standard for Telecommunications Pathways and Spaces.
- L. ANSI/TIA/EIA 606-A – Administration Standard for Commercial Telecommunications Infrastructures, June 21, 2002
- M. International Standards Organization/International Electro-technical Commission (ISO/IEC) DIS 11801, January 6, 1994.
- N. Underwriters Laboratories (UL®) Cable Certification and Follow Up Program.
- O. National Electrical Manufacturers Association (NEMA).
- P. American Society for Testing Materials (ASTM).
- Q. National Electric Code (NEC®), Latest Issue
- R. Institute of Electrical and Electronic Engineers (IEEE).
- S. UL Testing Bulletin.
- T. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps.
- U. SYSTIMAX® Structured Connectivity Solutions (SCS), Performance Specifications, (Addendum) Latest Issue.
- V. SYSTIMAX® SCS, Components Guide, Latest Issue.
- W. SYSTIMAX® SCS Generic Specifications: Fiber Optic Outside Plant Cable, Latest Issue.
- X. SYSTIMAX® SCS Solutions Design & Installation Guidelines, Latest Issue.

1.05 QUALITY ASSURANCE

- A. Contractor shall install work in accordance with the BISCII Telecommunications Distributions Methods Manual.
- B. Contractor shall install work in accordance with the SYSTIMAX® SCS Guidelines.

1.06 SUBMITTALS

- A. Before the installation of any wire or equipment, Contractor shall submit shop drawings and product data under provisions of, "Shop Drawings, Product Data and Samples" for University approval.
- B. Contractor shall indicate installation details, cable routing, system configuration, and outlet numbering on all shop drawings.
- C. Contractor shall submit all appropriate product data for each component.
- D. Contractor shall submit manufacturer's installation instructions.

1.07 PROJECT RECORD DOCUMENTS

Contractor shall submit record documents.

Contractor shall accurately record location of service entrance conduit, termination backboards, outlet boxes, messenger cable raceways and cable trays, pull boxes, and equipment boxes on CD or 3.5-inch floppy diskettes using AutoCAD 14 or latest version.

Contractor shall document the cable plant and associated equipment installation in accordance with Parts 3.19, 3.20, and 3.21 in this Section.

1.08 QUALIFICATIONS

- A. Installation of all wire, equipment, terminations and associated services shall be performed by a company that is currently a Authorized SYSTIMAX[®] SCS Value Added Reseller (VAR) in good standing with SYSTIMAX Solutions[™]; and has a minimum of (5) years of experience on similar SYSTIMAX[®] SCS systems. Prior to the final selection of the telecommunications sub-contractor, the main contractor shall submit its choice for telecommunications sub-contractor for the University's approval.
- B. The company specializing in supplying the products specified in this Section shall have a minimum of three (3) years experience distributing such supplies, and shall be duly authorized by the product manufacturer.

1.09 MAINTENANCE SERVICE

Contractor shall furnish warranty of SYSTIMAX[®] SCS products, applications, and workmanship for no less than 20 years from the date of acceptance by the University. All other non-SYSTIMAX products and workmanship shall carry warranties equal to or greater than the SYSTIMAX warranty from date of acceptance by the University

1.10 DEFINITION—STRUCTURED CABLING SYSTEM

Structured Cabling Systems, Henceforth referred to as "SCS," wiring is defined as all required equipment and cabling including hardware, termination blocks, cross connect wiring, patch panels, telecommunications outlets, UTP and fiber light guide cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/ switch designated as the service point of the local area network.

PART 2 - PRODUCTS

2.01 TELEPHONE TERMINATION BACKBOARDS

- A. The Contractor shall install 3/4-inch fire resistant plywood with Class A surface in all communications rooms (BDF and ER/TR). Equipment Room (ER) and Telecommunications Room (TR)
- B. Termination backboards shall cover entirely, to a height of 8 feet, one wall within a communications room, to be determined by closet design and equipment installation.
- C. Minimum backboard size shall be 4' X 8' unless otherwise approved by the University

2.02 STATION COPPER CABLE

- A. All UTP station copper cable supporting voice and data communications requirements shall be SYSTIMAX® XX91E (where XX is either 10 or 20 depending on insulation type), and shall meet the following technical specifications:

Specifications:

The SYSTIMAX® GigaSPEED® X10D Guaranteed Performance Specifications for 4-Connection GigaSPEED X10D Channels:

Electrical Parameters	Guaranteed Channel Margins to ISO/IEC 11801 : 2002 "Class E" (1 - 250 MHz)	Guaranteed Channel Margins to Draft ISO/IEC 11801 Edition 2.1 "New Class E" (1 - 500 ¹ MHz)
Insertion Loss	5%	2%
NEXT	6 dB	1 dB
PSNEXT	7.5 dB	2.5 dB
ELFEXT	6 dB	6 dB
PSELFEXT	8 dB	8 dB
Return Loss	3 dB	0 dB
PSANEXT	N/A	0 dB
PSAFLEXT	N/A	0 dB

Guaranteed Channel Performance Specifications for 4-Connection GigaSPEED X10D Solution²

Freq (MHz)	Insertion Loss		Pr-pr		PS		PS		Pr-pr		Return		Delay (ns)
	Loss (dB)	ANEXT (dB)	NEXT (dB)	ACR (dB)	NEXT (dB)	ACR (dB)	ELFEXT (dB)	ELFEXT (dB)	Loss (dB)	Delay (ns)	Skew (ns)		
1.0	2.1	75.0	71.0	68.9	69.5	67.4	69.3	68.3	22.0	580	40		
4.0	4.0	74.0	69.0	65.0	68.0	64.0	57.2	56.2	22.0	562	40		
8.0	5.6	71.0	64.2	58.5	63.1	57.5	51.2	50.2	22.0	557	40		
10.0	6.3	70.0	62.6	56.3	61.5	55.2	49.3	48.3	22.0	555	40		
16.0	7.9	68.0	59.2	51.3	58.1	50.2	45.2	44.2	21.0	553	40		
20.0	8.9	67.0	57.6	48.7	56.5	47.6	43.2	42.2	20.5	552	40		
25.0	10.0	66.0	56.0	46.1	54.8	44.9	41.3	40.3	20.0	551	40		
31.3	11.2	65.1	54.4	43.3	53.2	42.1	39.4	38.4	19.5	550	40		
62.5	15.9	62.0	49.4	33.4	48.1	32.2	33.3	32.3	17.0	549	40		
100.0	20.4	60.0	45.9	25.6	44.6	24.2	29.3	28.3	15.0	548	40		
200.0	29.4	55.5	40.8	11.4	39.4	10.0	23.2	22.2	12.0	547	40		
250.0	33.1	54.0	39.1	6.0	37.7	4.5	21.3	20.3	11.0	546	40		
300.0	36.5	52.8	32.7	-3.8	31.3	-5.3	19.7	18.7	8.0	546	40		
400.0	42.7	51.0	30.6	-12.2	29.1	-13.7	17.2	16.2	8.0	546	40		
500.0	48.3	49.5	28.9	-19.4	27.3	-21.0	15.3	14.3	8.0	546	40		

Note: The table provides reference values only. All parameters comply with the governing equations given above over the entire frequency range. All values and equations apply to worst-case channels utilizing four-pair 91A series cables with full cross-connects, consolidation points and work area outlets (4 connectors in a channel) for the length up to 100 meters.

- B. All copper cable and jumpers shall conform to the REA color guide meet NEC article 125-38, 3 (B) 1, 2 and 3.

2.03

RISER COPPER CABLE

All UTP riser copper cable supporting voice communications requirements shall be standard 24 gauge, paired dual, semi-rigid PVC skin over foamed PE, Superior Essex Cable - XXX (where XXX is the number of pairs), and shall meet the following technical specifications:

COPPER VERTICAL RISER CABLES (NOTE: SYSTIMAX WILL EXTEND IT'S WARRANTY AND APPLICATION ASSURANCE TO COVER THE USE OF SUPERIOR ESSEX AEMM CABLE AS PART OF A TOTAL SYSTIMAX SCS)

The 24 AWG multi-pair copper cables shall be used as the vertical riser cables. The cable shall support voice service applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation and the multi-pair copper cables shall be in nonplenum form and placed in conduit as required.

The SUPERIOR ESSEX ARMM cables are a nonplenum cable and shall consist of solid copper conductors insulated with expanded polyethylene covered by a PVC skin, be conformance tested to meet EIA/TIA 568B for Category 3 cables, be UL and c(UL) listed as CMR. The core shall be overlaid with a corrugated aluminum sheath, which is adhesively bonded to an outer jacket of PVC plastic to form an ALVYN sheath.

2.04 UNDERGROUND COPPER CABLE

The underground copper cable supporting voice and data communications requirements shall be 24 gauge, paired, dual-insulated with foam skin and plastic, flooded by FLEXGEL filling compound, Superior Essex ANMW, and shall meet the following technical specifications:

OUTSIDE PLANT COPPER CABLES

All voice grade wire and cable placed in the outside environment shall be solid, twisted pair, and multi-conductor. The copper twisted pairs shall have a mutual capacitance at 1kHz of 15.7 nF/1,000 ft. The cable shall be resistant to mechanical damage, lightning or damage from wildlife.

The buried or underground cable shall have an aluminum steel polyethylene (ASP) sheath and a core of solid-copper conductors, dual insulated with foam skin and plastic, surrounded by FLEXGEL III® filling compound.

2.05 CABLE PROTECTORS FOR COPPER CABLE

- A. For all pairs, Contractor shall install three-element gas protector modules, SYSTIMAX® 4B1-EW, containing silicon avalanche on both ends.
- B. Contractor shall supply and install SYSTIMAX® 195A1-type, multi-pair protector panels in BDF and MDF.

2.06 FIBER OPTIC CABLE

For single mode fiber, SYSTIMAX® TeraSPEED™ 5201 (24 – 72 strands (HFC) 5301)-0XXA-WPYL (indoor applications, plenum rated) where XXX is strand count, or SYSTIMAX® TeraSPEED™ 5022-0XXA-ZXBK dielectric (outdoor applications) cable, and shall meet the following technical specifications:

Optical Specifications:

Mode Field Diameter	9.2 (±0.3) μm @1310 nm; 10.4 (nominal) @1
Group Index of Refraction	1.466 @1310 nm and 1383 (±3) nm, 1.467 @

Attenuation	Tight Buffered: 0.70 dB/km @1310 nm 0.70 dB/km @1550 nm
	Loose: 0.35 dB/km @1310 nm 0.24 dB/km @1550 nm
Maximum Dispersion	2.8 ps/nm-km 1285 to 1330 nm
Zero-Dispersion Wavelength	1300-1322 nm
Zero-Dispersion Slope	0.092 ps/((nm) ² km)
Polarization Mode Disp. LDV	0.08 ps/(km) ^{1/2}

Physical Specifications:

Core Diameter	8.3 μm nominal
Cladding Diameter	125.0 (±0.7) μm
Core/Clad Offset	<=0.5 μm
Cladding Non-Circularity	<=1%
Coated Fiber Diameter	245 (±10) μm
Cladding/Coating Offset	<=12 μm
Colored Fiber Diameter	254 (±7) μm
Proof Test	0.7 Gpa
Fiber Curl	>4 m
Dynamic Fatigue Parameter	>=18
Macrobend 100turns, 50mm Mndrl	0.10 dB @1310 nm, 0.10dB @1550 nm
Macrobend 1 turn, 32mm Mandrel	0.50 dB @1310 nm and @1550 nm

SYSTIMAX® TeraSPEED™ Loose Tube Dielectric Enhanced Singlemode Cable 5024 xxxA WXBK, Black (4 – 288 fibers) approved

C. All optical fiber cable used shall have the following physical characteristics:

Cable Core:

Building interior:	Air core
Building exterior:	Filled core stable from -40F to +140F

Cable Composition:

Building Interior:		
station:	(plenum)	OFNP Fluoropolymer jacket
	(non-plenum)	OFNR PVC jacket
riser:		OFNR PVC jacket

Building exterior:	Non-metallic dielectric
Cable Strength:	Maximum pulling tension-600 lb.
Minimum Bend Radii:	(<30% max. pull tension) 10 times cable diameter (>30% max. pull tension) 20 times cable diameter
Fiber Identification:	Color coding system adequate to unambiguously identify each fiber. See paragraph 3.16 in this Section. The words "Fiber Optic Cables" shall be imprinted on cable no more than one meter apart.

2.07 OPTICAL FIBER TERMINATIONS

All single mode optical fiber cable installed shall be terminated utilizing a split-ferrule alignment sleeve and a precision ceramic tip. All single mode connectors shall meet the following technical specifications:

Connector Type:	LC
Fiber Outside Diameter	125 Microns
Loss Repeat:	< 0.2 dB per 1000 reconnects
Axial Load, min.	30 pounds
Temperature Stability:	-40 C to 85 C

2.08 OPTICAL FIBER PATCH CORDS

The University will provide optical fiber patch cords as it relates to the University's voice and data systems.

2.09 CONNECTING BLOCKS

- A. All UTP riser copper cable shall be terminated on high-density, modular SYSTIMAX® 110AW2-XXX, where XXX indicates pair capacity, connecting blocks.
- B. All UTP station copper cable shall be terminated on SYSTIMAX® GigaSPEED® X10D Universal Modular Patch (UMP) panel (s). The UMP panel accepts up to 24 GigaSPEED X10D MGS500 information outlets that must be ordered separately. A SYSTIMAX equivalent patch panel may be substituted with approval by the Office of Information Technology
- C. All optical fiber cable in Building Distribution Frame (BDF) rooms and Intermediate Distribution Frame (IDF) rooms shall be terminated in SYSTIMAX® 600G2-1U-MOD-SD (760028324) Fiber Optic Terminating Unit, with MODG2-12LC-SM (760032193) adapters, and associated equipment.

2.10 EQUIPMENT RACKS

All equipment racks will be Ortronics "Mighty Mo 6" racks with the following accessories:

<u>Item</u>	<u>Ortronics Part #</u>
10.5" channel X 7' high rack	OR-MM6710
Vertical cable mgmt 10" x 13" x 7'	OR-MM6VMD710
Vertical cable mgmt 6" x 8" x 7'	OR-MM6VMD706
10.5 channel dust cover	OR-MM6BDC10

2.11 INTRABUILDING COAXIAL CABLE

All intrabuilding coaxial cable in the new facility supporting video communications requirements shall be RG-11/U Belden 89292, and shall meet the following technical specifications:

Gauge:	14 AWG solid bare copper covered, .064 in
Outside Diameter:	0.348 in (8.84 mm)
Shields:	Duofoil + 61% tinned copper braid
Insulation:	Black tint Teflon jacket
Nominal DC Resistance:	2.5 Ohms/1000 ft
Nominal Mutual Capacitance:	16.5 pF/ft @ 1 kHz
Attenuation:	.15 dB/100 ft @ 1 MHz
Characteristic Impedance:	75 Ohms @ 1 MHz

2.12 INTERBUILDING COAXIAL CABLE

All interbuilding coaxial cable in the new facility supporting video communications requirements shall be P-3-75-500JCASS, and shall meet the following technical specifications:

Gauge:	0.111 in. (2.82 mm) nom.
Outside Diameter:	0.560 in. (14.22 mm) nom. Outer jacket of medium density polyethylene, solid aluminum sheath and Migra-Heal compound between jacket and sheath
Nominal DC Resistance:	0.37 Ohms/1000 ft
Attenuation:	0.66 dB/100 ft @ 83 MHz
Characteristic Impedance:	75 Ohms @ 1 MHz

2.13 VIDEO SYSTEM PARTS AND ACCESSORIES

Coaxial cable equipment: The following equipment of University approved equivalent shall be used:

Fiber Optic Transmitter (BNI Solutions):	ENI TR2100-7715
Fiber Optic Receiver (BNI Solutions):	ENI TR2200-750(38)-N17
Line extender:	CCOR LAN-100-2rv
Pads (attenuators) for CCOR LAN-100-2rx:	
PB-0	PB-12
PB-3	PB-15
PB-6	PB-18
PB-9	PB-21

Pads for Line Extender:

<u>Forward</u>	<u>dbmv of cable @ 450 MHz</u>
Eq-450-3	2.5
Eq-450-5	6.2
Eq-450-8	9.9
Eq-450-11	13.8
Eq-450-13	17.3
Eq-450-15	20.9

Splitters and Directional Couplers:

<u>Type</u>	<u>Tap Value</u>	<u>Insertion Loss</u> <u>@ 450 MHz</u>
Jerrold SSP-3	4.4	
Jerrold SSP-6367.9,	7.9	4.4
Jerrold SSP-7	7.8	2.5

Jerrold SSP-9	10.0	1.8
Jerrold SSP-12	12.8	1.5
Jerrold SSP-16	16.3	1.2

Full Feature Taps:

<u>Type</u>	<u>Tap Value</u>	<u>Insertion Loss @ 450 MHz</u>
Jerrold FFT8-14	14.2	4.3
Jerrold FFT8-17	17.8	1.8
Jerrold FFT8-20	20.0	1.2
Jerrold FFT8-23	22.5	1.0
Jerrold FFT8-26	26.1	0.8
Jerrold FFT8-29	29.2	0.6

Connectors and Other Accessories:

Gilbert Parts:	
Pin Connector:	GRS-500-CH-DU-03
Power Blocking Ks-F:	GF-625-CH-DCB
Chassis-Chassis Connector:	G-KS-KS-M
Right Angle Connector:	GP-90-S
Splice Connector:	GRS-500-SP-DU-03
Teflon RG-11 Connector:	GF-11-300p-388
F-type terminators:	GTR-59-s

D-Rings for Mounting Equipment:

<u>Type</u>	<u>Inside Dimension</u>	<u>Outside Dimension</u>
Graybar GB 13a	1-7/8"	4-7/8"
Graybar GB 13b	3-1/8"	6-1/8"

Crimping Tool:

Teflon RG-11 Crimper:	HCT-775
-----------------------	---------

Testing Equipment:

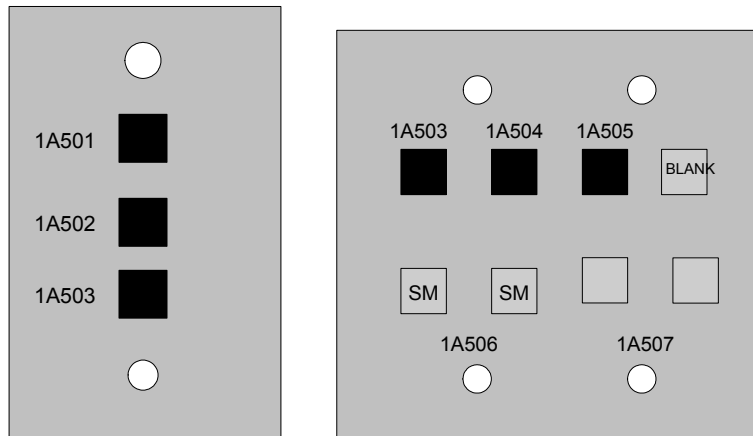
RF Signal Strength Meter:	Wavetek SAM III or approved equal must be used for testing.
---------------------------	---

2.14 OUTLET BOXES

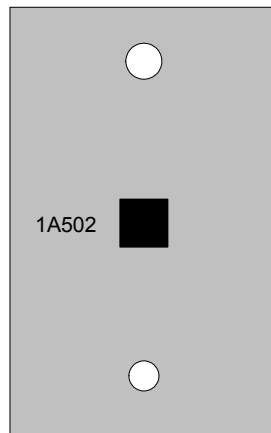
- A. All outlet boxes supporting voice/data communications requirements shall be double-gang, four (4) inch square, by two and one half (2.5) inch deep minimum galvanized steel boxes.
- B. All outlet boxes supporting video communications requirements shall be single gang; two and one half (2.5) inch deep minimum galvanized steel boxes.

2.15 VOICE/DATA OUTLETS AND COVER PLATES

- A. All outlet plates shall be (SYSTIMAX® M13L-246) faceplates for voice/data applications and (Systemax M28A-246) faceplates for voice/data/fiber applications, with M20AP-246 modular covers filling unused portals.



- B, The outlet assembly to support voice only or data only communications requirements shall be one (1) eight (8) position, eight (8) wire SYSTIMAX® MGS500-003.(BLACK) modular RJ45 outlet, wired per the 568B wiring standard The faceplate will be (SYSTIMAX® M10L-246).

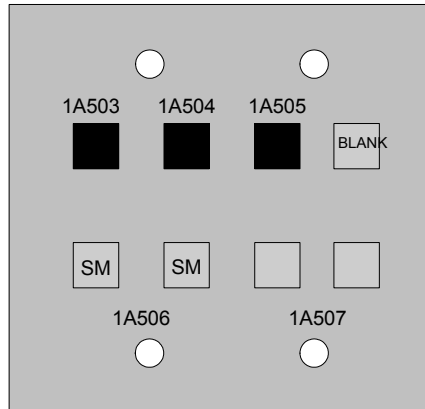


- C. The outlet assembly supporting voice/data communications requirements herein referred to as a “standard” outlet shall be three (3) eight (8) position, eight (8) wire modular RJ45 outlets, **wired per the 568B wiring standard**. The RJ45 receptacle (SYSTIMAX® M13L-246) shall consist of three (3) RJ45 outlets. The standard outlet is to be mounted in a vertical position with three (3) SYSTIMAX® MGS500-003 (BLACK) modular RJ45 outlets.



- D. Video outlets shall be one (1) M81C-B coupler kit, video F81 coaxial video module, mounted in a separate single-gang box.

- E. All fiber outlets, herein referred to as a “standard with fiber, shall be one LC connector P1101A-Z-125 (700011372), LC adapter C1101A-1 (700002215) and M81LC-029-Collar (760010090) per pair of fiber. Fiber outlets will be mounted in conjunction with other voice or data applications, using the (SYSTIMAX® M28A-246) faceplate.



- F. The “pin-out” wiring assignment for the 4-pair UTP copper cable for both voice and data shall be consistent with the TIA/EIA T568B Commercial Building Telecommunications Wiring Standard.

2.16 HORIZONTAL DISTRIBUTION CABLE MANAGEMENT SYSTEM

A. Cable Tray Pathways

1. Cable tray is required in all areas where horizontal cabling bundle quantity (copper, optical fiber and coax) exceeds 40 wires.
- B. Cable tray for telecom applications shall be Cablofil Incorporated EZTray or an approved equivalent, and shall adhere to the following dimensional guidelines:

<u>Dimension</u>	<u>EZTray Part#</u>	<u>Bundle Quantity</u>
4”D X 12” W	CF 105/300EZ	Less than 300
4”D X 18” W	CF 105/450EZ	300- 450
4”D X 24” W	CF 105/600EZ	In excess of 450

3. Cable tray shall be installed to the specifications of the manufacturer.

B. J-Hook Pathways

1. J-hooks shall be utilized in all areas where bundle quantity is between 10 and 40 cables
2. All j-hook pathways shall be provided with a center hung, triple tiered, six-hook cable support system with a maximum spacing specified as not greater than four (4) feet. Contractor shall submit samples and cut sheets on proposed solutions.

2.17 DUCTBANK INNERLINERS

Innerliners are required. Contractor shall furnish Pi-Mar PVC conduit manufactured by Pyramid Industries Inc. Contractor will install four (4) one (1) inch innerliners in a duct. If OSP is to be installed, contractor will fill duct with OSP and inner liner as space allows.

2.18 CABLE LUBRICANT

Cable pulling lubricant, Ideal Yellow 77 or a University approved equal, shall be utilized when pulling all cable.

2.19 CASES AND SPLICES

- A. All outside plant (OSP) Cable Splice Cases shall be Preformed Line Products Stainless Steel with Filling Flange and must be filled with a University Approved re-enterable encapsulant.
- B. All entrance cases in the Patuxent Building; Building 010 shall be SYSTIMAX® Cable Rearrangement Facilities.

2.20 FIRESTOPPING

- A. Contractor shall provide firestopping protection that shall meet NFPA Life Safety Code #101, 6-2.3.6, "Penetrations and Miscellaneous Openings and Fire Barriers" and the NEC 300.21 "Fire Stopping" regulations and standards.
- B. All vertical penetrations consisting of conduit, sleeves, or chases shall be firestopped at the bottom of the penetration.
- C. All horizontal penetrations consisting of conduit, sleeves of chases shall be firestopped on both sides of the penetration.
- D. Individual cable penetrations in plenum air return areas not enclosed in conduit shall be firestopped.
- E. Openings made in concrete floors shall be firestopped using a tested system. Thickness or depth of firestop materials shall be as recommended by the material manufacturer and backed by formal ASTM E-814 tests.
- F. Plenum air return ceiling penetrations for conduit and cables shall be sealed with a system appropriate for the substrate and level of protection required.
- G. All metal conduits designed for communications with or without wire/cable inside shall be firestopped to restrict transfer of smoke.

2.21 ELEVATOR PHONE

In the event of a new elevator installation that does not come equipped with a phone or during a retrofit, the following equipment will be installed:

<u>Manufacturer</u>	<u>Description</u>	<u>Stock No.</u>
Talk-A-Phone Co. 5013 North Kedzie Ave. Chicago, IL 60625 312-539-1100	Hands-free Phone programmed to use campus circuit assurance equipment	EPT-100E

2.22 OUTDOOR EMERGENCY PHONE

The Contractor shall coordinate with the General Contractor to install the following campus approved Emergency Phone:

<u>Manufacturer</u>	<u>Description</u>	<u>Stock No.</u>
Talk-A-Phone Company 5013 North Kedzie Ave. Chicago, Ill. 60625 (773) 539-1100	Vandal resistant security unit with speakerphone, keypad, blue light, strobe, and camera arm.	ETP MTR OPT4 UMCP with ETP-400K Phone

**** Wall Mount for Garages and other locations as specified by the University.

ETP WM UMCP with ETP-400K Phone

All outdoor emergency phones will be wired with a 6 pair OSP cable terminated in the building on a protector in the nearest BDF/TR. The University will terminate the OSP at the phone unless contractor is otherwise instructed.

Additional cabling is required by the Department of Public Safety for camera placement. Please consult the DCFS of Department of Public Safety for that information.

PART 3 – EXECUTION

3.01 SYSTEM DESIGN

- A. The cabling system to support voice, data, and video requirements has been designed in accordance with BICSI, EIA/TIA, NFPA, NEC, SYSTIMAX® SCS, IEEE, and FCC communications.
- B. The proposed cabling system has been designed and shall be installed in a manner that provides mechanical integrity and symmetry for the cabling media and any associated frames and racks and which also furnishes ease of access and suitability for future rearrangements and changes.
- C. The transmission media shall be installed through a network of cable trays, conduit, sleeves, and chases and interconnect the various rooms and floors of the building.
- D. All telecommunications closets require two sources of power, including normal building power and emergency power. In each MDF, IDF or BDF the contractor will install one (1) normal power outlet and one (1) emergency power outlet per rack, to be mounted on that rack. The outlets shall be dedicated 30 amp circuits, with an L6-30R connector for each. The contractor will also install normal power, courtesy outlets within the room, per NEC requirements.
- E. Telecommunications Closet Design Requirements (BDF's and TR's)
 - 1. BDF
 - a. BDF shall be located on lowest level of building.
 - b. BDF shall be at least 200 square feet.
 - c. BDF shall have neither width nor depth less than 12 feet.
 - d. BDF shall have two sources of power; normal building power and UPS power (see 3.01d for UPS power distribution).
 - e. BDF shall have card access through the Department of Public Safety Lenel System.
 - f. BDF shall be cooled through the building HVAC system (to be determined by design) including dust filtering of all pathways, penetrations, venting and doorways.
 - 2. TR(s)
 - a. Each floor with telecommunications outlets must include at least one (1) TR.
 - b. TR(s) must be placed such that the longest station run is less than 90 meters from outlet termination point to the cross connect.
 - c. TR(s) shall be sized as follows:

<u># of Stations</u>	<u>Minimum Closet Size</u>	<u>Minimum Width/ Depth</u>
0-100	100 square feet	8 feet
Over 100	120 square feet	10 feet
 - d. TR(s) shall be "stacked" one above the other.

- e. 4" conduits (or sleeves where appropriate) shall be installed to accommodate current needs plus 100% growth.
Office grade HVAC shall be provided.
TR(s) shall have two sources of power; normal building power and UPS power (see 3.01d for UPS power distribution).
TR(s) shall have card access through the Department of Public Safety Lanel System.
TR(s) shall be cooled through the building HVAC system (to be determined by design) including dust filtering of all pathways, penetration, venting and doorways.

F Determination of station quantities—quantity and placement of outlets, as well as outlet labeling assignments, shall be shown on the floor plans.

G Determination of minimum station quantities:

<u>General Office</u> -	(1) standard outlet every 70 sq/ft
<u>Conference Rooms</u> -	(2) standard outlets with CCTV coax connections at opposing ends of the room, and (1) standard every 70 square feet.
<u>Computer Labs/Server Rooms</u> -	(1) standard outlet with 4 strands of sm fiber (location to be determined by design), and one standard outlet every 70 sq/ft. Internal wiring to seating to be determined by design.
<u>Classrooms</u> -	(2) standard outlets with CCTV coax connections, both in the front of the room.
<u>Wireless Coverage</u> -	(1) single wire jack to be located every 2000 sq/ft. Location to be determined by design.

(sm = singlemode)

3.02 FORBIDDEN WORK

- A. Other than the entrance splice, no cable splices shall be allowed within buildings.
- B. Aerial cable construction shall not be permitted.

3.03 EXAMINATION

- A. Contractor shall verify that surfaces are ready to receive work.
- B. Contractor shall verify that field measurements are as shown on the CDT's Construction Drawings approved by the University.

3.04 INSTALLATION OF BACKBOARDS

- A. All backboards shall be supported as specified under provisions of "Wiring Materials and Methods."
- B. All backboards shall be marked with the legend "COMM" under the provisions of Section 16915.

3.05 CABLE PULLING

Contractor shall utilize cable-pulling lubricant for all pulls in conduit ducts or innerliners. Not less than three (3) gallons per kilometer shall be used.

3.06 COORDINATE WITH OTHER TRADES

- A. Cable routing shall be designed and installed so that cabling and associated equipment does not interfere with the operation or maintenance of any other equipment. No wiring shall be hung, tied to, or supported from anything other than telecommunications raceway or the building structure.
- B. All cable in accessible spaces shall be designed and installed for easy access. Cable paths above suspended ceilings, mechanical rooms, closets, etc. shall not be blocked or covered in any way that would impede the addition of cable in the future.

3.07 CONDUIT INSTALLATION

- A. To support voice and data communications requirements, Contractor shall install one (1) inch conduit from the outlet box stubbed into the accessible ceiling for a maximum of three Category 6A cables. If additional cabling is required to an outlet, conduit must be sized accordingly to meet product specifications. Contractor shall conform to the Conduit Installation Schedule in Section 16100 for selection of appropriate conduit type. All telecommunications wiring shall be concealed in conduit or in the ceiling.
- B. Conduit sleeves shall be four (4) inch trade size minimum. Sleeves shall be Rigid Galvanized Steel for penetrations of concrete slabs, concrete walls, and CMU walls. Sleeves for penetrations of stud walls shall be EMT. All sleeves shall be rigidly installed using appropriate fittings and all masonry penetrations shall be grouted. Sleeves shall project a minimum of six (6) inches beyond wall or floor surface. All penetrations of fire rated construction shall be firestopped with fire-stopping as specified in Part 2.16 of this Section to equal or exceed fire rating of the penetrated material. Sleeves for penetration of walls and floors shall have one hundred percent (100%) spare capacity, and shall be firestopped as per code.
- C. Any section of conduit containing two (2) 90-degree bends, a reverse bend, of having length greater than one hundred (100) feet shall have an accessible pullbox. All conduits with less than a 50% fill ratio shall have a 3/32-inch polyethylene pull cord approximately secured at each end.
- D. No oval or square conduit fittings shall be permitted. No screw type fittings shall be permitted.
- E. All metallic conduit and raceways shall be appropriately grounded as specified in the National Electric Code.
- F. Supports and fasteners shall be used to hold all cables, conduits, and trays firmly in place. Supports and fasteners shall be used such that they provide an adequate safety factor. All conduit/cable trays shall be supported from the building structure and not from any other ductwork, pipes, ceiling tiles, or equipment.
- G. Where cable trays or conduit are not provided (especially between the stubbed out conduit and the nearest cable tray). Kindorf lay-in pipe hangers, or a University approved equal shall be installed. The lay-in pipe hanger shall be attachable to a floor slab through the use of a pre-threaded lead insert, which is suitable for installation of a 3/8-inch "all-thread" rod in a predrilled 1/2-inch hole. The threads of the closure bolt on the pipe hanger shall be covered by 3/8-inch copper or aluminum tubing to protect the cabling sheaths.
- H. Cables placed in hangers in the plenum ceiling area shall be routed high and away from all other electrical and mechanical systems so as to avoid contact with light fixtures, ventilation ducts, sprinkler systems or plumbing piping, motors, or any other electrical devices. The cable shall not be run in

parallel with any high voltage electrical wiring. The maximum separation between support points for all cabling shall be eight (8) feet. Lay-in pipe hangers shall be installed so as to accommodate these maximum distance spacing. Hangers shall be installed at directional bend points so as to provide a maximum bend angle of 45 degrees for the supported cabling.

- I. Contractor shall install 3/16-inch polyethylene pulling string in each empty conduit, and appropriately secured at each end.

3.08 COMMUNICATIONS EQUIPMENT ROOMS

- A. The communications equipment rooms supporting voice, data, and video requirements are identified on the construction documents.
- B. Prior to the installation of any equipment in any of the communications rooms, the Contractor shall provide room layouts, for University approval, for each of the rooms listed above showing the proposed locations of all backboards, termination blocks, distribution panels, security boxes, control boxes, power supplies, etc. required for all communications systems, which is part of this specification.
- C. Cable must be installed such that station wire runs from the outlet to the cross connect do not exceed 90 meters.
- D. Grounding shall be #6 AWG wire provided to each communications equipment room in accordance with ANSI/NFPA 780.
- E. All walls, ceilings and floors must be made non-porous with paint or sealant to minimize dust.
- F. Sleeves or conduits from outlets shall penetrate closet walls at a height above the plywood panels and extend only far enough to install bushings.
- G. Hardware shall be installed plumb and level on the wall backboards. Appropriate wire management shall be installed so that jumper, cross connects, and patch cord wires can be installed in a neat and orderly fashion.
- H. Equipment racks shall be installed level, to manufacturer specifications, and shall be so that jumpers and patch cords can be installed in a neat and orderly fashion. Contractor will install (1) one equipment rack installation of network infrastructure hardware. Contractor will install fiber termination shelves at the top of the rack, unless otherwise instructed. Contractor shall appropriately ground all equipment racks in accordance with the National Electric Code (NEC).

3.09 STATION CABLING AND INSTALLATION

- A. All voice, data, fiber, and video outlets shall be installed in the locations that are conspicuously marked in the building floor plans. If there is a question as to the location of any outlet it shall be brought to the attention of the University prior to installation.
- B. Prior to installing any cabling, drawings indicating all jack numbering shall be submitted by contractor for approval.
- C. All outlets supporting voice and data communications requirements shall be wired with three (3) (SYSTIMAX® XX91) 4 pair UTP copper cables as specified in Part 2.02 of this section.
- D. Data jack for wireless access: All wireless access points will be located above an accessible ceiling in areas designated by the University. (See 3.01F, Minimum Station Requirements) If areas designated for wireless access do not have accessible ceilings, jack location is at the discretion of the University.

- E. Fiber jack: The station fiber pairs for singlemode fiber will be terminated at the outlet and in fiber termination shelves mounted at the top of the equipment racks.
- F. The terminations in the BDF and TR's of all UTP riser copper cable shall be on 110 termination fields.
- G. The terminations in the BDF and TR's of all UTP station copper cable shall be on patch panels.
- H. All wiring supporting voice and data communications shall conform to IEEE 802.3 100BASE-T, and 100 Base-t and 1000 Base-t wiring standards.
- I. All wiring shall meet Category 6A standards.

3.10

RISER CABLING AND INSTALLATION

- A. In the BDF and all TR's, connecting blocks shall be modular, high-density, SYSTIMAX® 110-type or a University approved equal, with clear protective covers. All telecommunication rooms shall be grounded by means of a #6 AWG insulated copper ground wire connected to the building ground system. The BDF shall also have gas element surge protection with sneak fuses adequate for protecting all circuits entering the building.

NOTE: All closet layouts shall be approved by the University before installation of any equipment or termination of any wiring.

- B. Contractor shall install 200 pair UTP vertical copper cabling between the BDF and each TR to support voice communications requirements. Each riser cable shall be homerun from the BDF to each TR in the conduit and sleeves provided. In both the BDF and TR, the cable pairs shall be terminated on SYSTIMAX® 110 connecting blocks and appropriately cross-connected to the UTP horizontal copper cabling (in the TR) and the UTP backbone copper cabling (in the BDF).
- C. Riser Optical Fiber Cabling: All optical fiber riser will be terminated on shelves mounted at the top of the equipment rack. Each TR will have twelve (12) tested single mode optical fibers installed and terminated from the BDF fiber shelves to each of those TR's (**see additional riser requirements below**). All optical fiber, terminations, and connections shall conform to the IEEE 802.3 100BASE-F specifications.

Additional Riser Requirements:

In addition to the existing fiber riser, the contractor will add two (2) multimode and/or two (2) single mode fibers to each of the TR riser counts, for each two strands installed to an outlet being serviced by that TR.

- D. Riser Coaxial Cabling: A single RG-11 coaxial cable extending from the BDF to the top floor TR's shall be installed and used as the riser for each TR stack.
- E. "Kellums"- type basket hangers, or a University approved equal, shall be installed on all riser cables to provide independent support of cables passing through conduit sleeves installed in floor slabs. Hangers shall have a maximum separation of twelve (12) inches.

3.11

UNDERGROUND CABLING AND INSTALLATION

- A. Contractor shall install UTP underground copper cabling between the BDF and the ER (Main Distribution Frame located in Patuxent Building, Building 010) to support voice and data communications requirements (as specified in Part 2.04 of this Section). The underground cable shall run in the appropriate ductbank and manholes. The contractor shall terminate the underground cable in the cable vault of Building 010 in a SYSTIMAX® Cable Rearrangement Facility (vertical splice case). The pairs shall then be run into the frame room of building 010 and terminated on Contractor provided 195A type protector panels, and extend tails to 110 fields, as directed by the University. The Contractor shall make terminations in the BDF, utilizing SYSTIMAX® 195A type, multi-pair protector

panels and extend tails to 110 fields. The Contractor shall also provide new frame racks to support the protector units. The size of the copper underground cable shall be XXXX pairs. The Contractor shall use the largest size of cable applicable.

- B. Contractor shall install single mode optical fiber backbone cabling between the BDF and the ER to support data communication requirements (as specified in Part 2.06 of this Section). The underground single mode optical fiber shall run in innerliner (as specified in Part 2.17 of this Section) in the appropriate ductbank and manholes. The single mode optical fiber shall be terminated on both ends utilizing Contractor provided SYSTIMAX® 600G2-1U-MOD-SD (760028324) Fiber Optic Terminating Unit, with MODG2-12LC-SM (760032193) adapters. The size of the backbone single mode optical fiber cable shall be XX strands.
- C. Whenever termination points for single and multi mode fiber are the same, a hybrid cable shall be utilized, when available.
- D. Contractor shall install coaxial backbone cabling between the BDF and the nearest available tap, as designated by the University, to support video communications requirements (as specified in Part 2.12 of this Section). The underground coaxial cable shall run in innerliner (as specified in Part 2.16 of this Section) in the appropriate ductbank and manholes. Cable in the manhole shall be secured to the manhole at least two (2) feet from the connection point and every four (4) feet thereafter. The connector shall be covered with a one (1) foot section of shrink tube except where the connector is located inside the building. Upon completion, the cable now shows no sign of stretches, kinks, or compressions. If damage is apparent, the contractor will pull new coaxial cable.

3.12 OUTLET BOX INSTALLATION

Unless otherwise noted on the drawings, outlets shall be securely and neatly installed at the height specified in the following table:

Standard Telephone Outlets:	1ft 6 inches above Finished Floor (AFF)
Wall Mounted Telephone Outlets: Wall Mounted for Head On	4ft 6 inches AFF
Wheelchair Access:	4ft 0 inches AFF
Service Counter Areas:	0ft 8 inches above counter work surface

3.13 DUCTBANK DESIGN, CONSTRUCTION, AND UTILIZATION

- A. Contractor shall install XXXX pairs (specified and approved by the University) of multipair, UTP copper cable between the BDF and the Patuxent Building (Building 010). Prior to the termination of this cable in the Patuxent Building, Contractor shall verify its termination location with the University.
- B. Contractor shall install a XX strand (specified and approved by the University) single mode optical fiber cable (as specified in Part 2.06 of this Section), between the BDF and the ER located in the Patuxent Building. Prior to termination of this cable in the Patuxent Building, Contractor shall verify its termination location with the University.
- C. Contractor shall install one (1) coaxial cable (as specified in Part 2.12 of this Section) between the BDF and the nearest available tap. Prior to termination of this cable Contractor shall verify its termination location with the University.
- D. Contractor shall install new concrete encased ductbank and manholes and/or install new concrete encased ductbank between existing manholes to accommodate the outside plant needs of the facility as directed by the University. The contractor shall submit proposed pathway for University approval.
- E. Any duct supporting optical fiber, copper or coax will require the installation of four (4) one inch innerducts. In the event of a larger cable being installed, the remaining duct space will be filled with

inner duct. Optical fiber, copper and coaxial cable in the specified amounts above shall be run in separate innerducts. Ductbank shall be engineered to accommodate the required twisted pair, fiber optic, and coaxial cable needs plus one hundred percent (100%) spare capacity.

- F. All ductbank shall conform to the provisions of "Outside Power Transmission and Distribution", and shall be arranged in a rectangular fashion. Only four (4) inch PVC "type B" conduit shall be used for communication ducts. No section of ductbank shall have more than a sum of 180 degrees of bends without the installation of a manhole.
- G. Ductbanks shall have a minimum of (30) thirty inches cover over encasement. There shall be twenty-four (24) inch minimum clearance between communications ductbank encasement and any other utilities.

Note: NO EXCEPTIONS WILL BE MADE WITHOUT PRIOR APPROVAL OF THE UNIVERSITY

- H. Concrete encased, galvanized intermediate weight rigid steel conduit shall be used instead of PVC or polypropylene wherever ductbanks cross roads, parking lots, or buried steam lines. Steel ducts shall extend ten (10) feet on either side of the crossing. At steam line crossings, encasement shall be covered with an aluminum reflector.
- I. All spare ducts or those with less than twenty-five percent (25%) fill shall have a one-quarter (1/4) inch polypropylene pull wire appropriately secured at each end. All vacant innerducts or those with less than twenty-five percent (25%) fill shall have a 3/16- inch polypropylene pull wire appropriately secured at each end.
- J. All ducts shall be pneumatically rodded using a University approved slug of one-quarter (1/4) inch diameter less than the duct inner diameter.
- K. All ducts, including spares, shall be sealed watertight with expandable urethane foam at both ends.

3.14 MANHOLES

- A. Manholes shall have inside dimensions 6 feet Wide x 12 feet 1 inch deep x 7 feet High (6'-0"W x 12'-1"D x 7'0"H) minimum.
- B. Manholes shall conform to the provisions of "Outside Power Transmission and Distribution". All steel equipment shall be hot dipped galvanized. All manholes shall have at least one (1) 7/8-inch diameter steel-pulling eye in the wall opposite each duct entrance. Pulling eyes shall be welded to the reinforcing rods at the time of manhole fabrication. Each manhole shall be equipped with at minimum four (4) cable racks, two (2) per long side, that have adjustable hooks adequately sized to support the hardware. Manhole covers shall have the designation ""COMM"" cast on the cover.
- C. New ductbank shall be appropriately doweled to existing manholes.

3.15 CONNECTION TO EXISTING SYSTEM

- A. Splicing shall only be allowed in manholes or at building entrance locations. No splices shall be allowed in any other location in the new facility or in any ducts or innerliner. Splice cases in manholes shall be securely supported by support hooks on the cable racks not more than two (2) feet away from the splice case. Before closure, all splices shall be offered for inspection by the University and certification of workmanship by SYSTIMAX Solution™.
- B. Contractor shall make all cross-connections in each TR to connect the first pair of each voice UTP horizontal copper cable to the facility copper riser system.
- C. Contractor shall connect to University video network at the University's direction.

3.16 RE-ROUTING OF EXISTING UNDERGROUND CABLES

- A. Contractor shall re-route any voice, data, and video cables that are currently located in the space where the new facility is to be constructed to new or existing manholes. The re-routing and manhole locations are conspicuously identified on the site plan of the drawings.
- B. Contractor shall notify the University at least two (2) weeks in advance prior to any outage, re-routing any existing voice, data, and video cables; and the outage shall be scheduled at the convenience of the University.
- C. Any cable that is re-routed must be re-terminated and tested according to the termination and testing requirements as described in Part 3.19 of this Section.

3.17 VIDEO SYSTEM INSTALLATION - BUILDING INTERIOR

- A. Install a BNI TR2100-7715 (Multichannel RF Fiber Optic AM Transmitter in the BDF of building 147, location to be determined by OIT/NTS. The University will make the final fiber connection to the transmitter.
- B. Install a BNI TR2200-750(38)-N17 (Multichannel RF Fiber Optic AM Receiver) in the BDF of the new building. The University will make the final fiber connection to the receiver.
- C. The contractor shall provide video system design with loss calculation for University approval before the beginning of installation of any video system cable or equipment.
- D. Line extenders shall be mounted horizontally five (5) feet above finished floor using two (2) GB13b D-rings secured with eight (8) 1-3/16" screws. At least one (1) line extender must be provided for each TR stack. Appropriate pads and equalizers shall be installed in the forward line extender section. Return line extenders pads and equalizers may be omitted.
- E. The first line extender in each TR stack shall be located in the first floor TR's. Depending on sign level requirements and the size of the building, additional line extenders in the higher floor TR's may be required.
- F. All active and/ or passive devices in an individual BDF or TR shall be attached together using chassis to chassis or right angle connectors.
- G. Multiport taps shall be mounted vertically to one (1) GB13a D-ring, with a hex bolt (1/4" wide x 3/4" long) and secured to plywood with four (4) 1-3/16" screws. This does not apply to multiports attached to line extenders.
- H. The multiport tap, excluding those attached to line extenders shall face either left or right, but not outward into the BDF/TR. All unused ports shall be terminated.
- I. An FFT8-29 multiport shall be the first device attached to the output side of the line extender and is to be used to read the signal levels and measure forward tilt. F-Type right angle connectors may be used for multiport wiring.
- J. Directional couplers and splitters shall only be used to connect the first amplifiers in the BDF/TR stacks.
- K. All BDF/TR's shall have at least one (1) multiport tap connected to the riser regardless if that IDF/BDF, services any outlets. At every TR/BDF, a minimum of three (3) spare ports is required.
- L. In each TR, the RG-11 coaxial station cable shall be secured to the existing plywood every two (2) feet with screw-type cable tie connectors. Station cable ends in the TR/BDF shall clearly indicate the outlet and room number of the station end in indelible ink written on plastic cable tags.

- M. Connectors shall be chosen and installed so they can withstand (30) thirty pounds of pulling force without separating from the cable.

3.18 VIDEO SYSTEM ADJUSTING

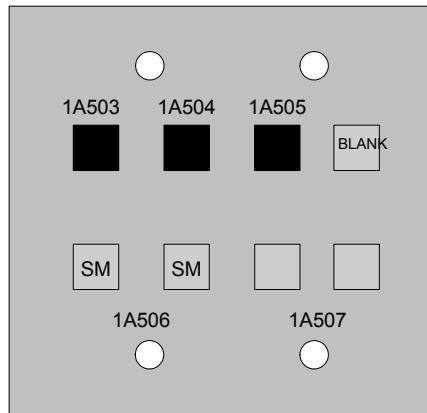
Contractor shall adjust amplifier gain and make other system adjustments to achieve specified output levels at each outlet.

3.19 CABLE PLANT LABELING

- A. All labeling shall be clear, securely affixed, and consistent on both ends of each installed cable. The University shall approve all labeling in advance.
- B. The labeling of outlets and TR hardware shall be permanently engraved in the field by the Contractor according to the following numbering system:
 - 1. Each outlet identification code shall consist of five (5) characters.
 - 2. The first character shall indicate the floor of the building where the communications room serving the outlet is located. The number 0 (zero) shall be used for the ground floor, 1 (one) for the first floor, etc. The letter B shall be used for basements, S for sub-basements, and M, N, and P for mezzanines.
 - 3. The second character shall be used for the communications room identifier. The letters A through Z (except I and O) shall be used and the University will specify the character to be used for each communications room.
 - 4. The last three (3) characters shall denote the number of the outlet. **All outlet numbering will begin at 001.**

Example: An outlet labeled 1A006 means first floor, TR "A", outlet number 006.
 - 5. Outlets containing fiber shall be labeled with a separate 5-digit number. These numbers do not have to correspond to the UTP numbers that share the faceplate. **All outlet numbering for fiber will begin at 001.**

The following is an example of a three UTP cable outlet with sm fiber:



- C. The (5)-five character code for each outlet shall be permanently marked on the outlet, as well as on the corresponding IDF blocks. In addition, each outlet shall be labeled in advance on all telecommunications drawings.
- D. All coaxial cable shall be labeled with an outlet number consistent with the closest communications outlet.
- E. All UTP copper riser and underground cable termination blocks shall be labeled with white 110 label strips and shall indicate pair count and destination closet. Voice riser shall be labeled separately.
- F. Underground cable protector units shall be labeled with green 110 label strips reflecting cable pair count and cable number. Underground cable in manholes shall be labeled with engraved brass tag showing cable number where entering and exiting manhole.
- G. All optical fiber riser and underground cable termination panels shall be labeled with fiber strand count, destination closet, and "SMOF, or "HYB" to indicate cable type. The underground frame shall be labeled with the fiber strand count, fiber number, and fiber optic hub building number. Underground cable in manholes shall be labeled with engraved brass tag showing cable number where entering and exiting manhole.
- H. All underground coaxial cable shall be labeled on each end with brass tag marked with the building number and designated as a coaxial feed cable.

3.20 TESTING AND ACCEPTANCE

- A. Prior to acceptance, all "As-Built" and technical documentation shall be received and approved by the University. As-built documentation shall include the completed and notarized original copy of the Avaya SYSTIMAX® Structured Cabling System Registration Document. All intrabuilding and interbuilding wiring and equipment, and all site restoration shall be installed and completed in accordance with University and industry standards. All wiring and equipment provided and/or installed under this Contract shall be tested as described under the terms of this Contract and shall be fully operational. After all work is complete, the Contractor shall also provide the University with SYSTIMAX® SCS Certification for all communications work completed on the project and Avaya Distribution Technologies certification for all outside plant splices.
- B. All copper cable plant testing shall diagnose, at a minimum, the presence of all open-loop conductors, noisy lines and distortion, low-loop current, high-loop current, ringer failures, grounded, shorted or crossed conductors, dB loss, and split connections. Contractor shall perform a continuity test on all pairs installed in the cable plant, both inside and outside the new facility. The testing shall cover end-to-end, from the outlet to the TR and the BDF to the Patuxent Building (Building 010). In addition, all tests described above shall be performed on a randomly selected pair per twenty-five (25) pair binder group of the copper riser cable. If this random selection is bad, additional testing shall be done to

ensure that ninety-nine percent (99%) good pairs exist. The Contractor shall supply complete testing and correction reports to the university for review prior to acceptance of the system. For copper pairs used for any voice/data outlets, the Contractor shall perform such additional testing as required to verify that pairs meet the transmission parameters required for 100BASE-T and Category 6 wiring specifications. The University shall have final approval on the format used for recording and reporting of test results prior to the start of testing activities.

- C. Optical fiber cable testing shall, at a minimum, quantify the attenuation range, optical loss, bandwidth, and misalignment. The cable completion tests shall be performed after all optical fiber cable has been placed and all splicing completed. All optical fibers shall be tested at both 850nm and 1300nm. For outside plant fiber, testing shall include two-way testing using an Optical Time Domain Reflector (OTDR), and one-way testing using a Multimode Optical Loss Test Set (MOLTS). For optical fiber installation between the BDF and an TR, the contractor shall provide two-way loss testing through the use of MOLTS. Two-way MOLTS testing shall also be performed on station fiber terminated for testing purposes. All traces and results shall be provided to the University for approval. Protective covers shall be in place on all connectors when they are not in use to protect against contamination by dirt or dust. Any fiber found to be defective a result of installation, physical inspection, or operational test shall be replaced at the Contractor's expense.
- D. Coaxial cable and video signal testing shall be performed in the following manner to verify correct installation of coaxial cable and video system electronics:

<u>Input Signal @ 450 MHz (after pad & equalizer)</u>	<u>Output @450 MHz</u>	<u>Output@ch. 7 (175.2 MHz)</u>
9 dbmv (\pm 1 dbmv)	43 dbmv	40 dbmv

FFT8s Located in TR's:

15 dbmv at 450 MHz at the output of all eight (8) ports of all FFT8s located in the building.

3.21

AS-BUILT DOCUMENTATION

- A. The contractor shall provide the following outside plant wiring information, prior to acceptance of the building by the University, for each of the specified media:
 1. Cable identification number (Copper, Fiber, Coax).
 2. Cable design makeup (Copper, Fiber, Coax).
 3. Cable lengths between splice points, terminations amplifiers, or line extenders (Copper, Fiber, Coax)
 4. Exact routing of cable (Copper, Fiber Coax).
 5. Splice location and identification (Copper, Fiber, Coax).
 6. Strand count, mode of installed fiber, loss per splice in dB, and total amount of optical fibers installed (Fiber).
 7. Frequency rating, location and identification of amplifiers and splitters (Coax).
 8. Bonding and grounding (Copper, Fiber, Coax).
 9. Location and description of all associated equipment (Copper, Fiber, Coax).
 10. Location and description of all associated structures and obstructions. (Copper, Fiber, and Coax).
 11. Signal level readings at all line extenders, FFT8s, and all video jacks using frequencies 175.2 MHz (CH. 7) and 450 MHz.
- B. The Contractor shall provide the following intrabuilding wiring information for each specified media prior to acceptance of the building by the University:
 1. Cable entrance locations and penetration details (Copper, Fiber, Coax).

2. Location and identification of all distribution closets and of all equipment located inside distribution closets (Copper, Fiber, Coax).
 3. Terminal information, outlet numbering, and pair count information at each distribution frame (Copper).
 4. Schematic drawings of riser (Copper, Fiber, Coax).
 5. Routing of cable and termination information (Copper, Fiber, Coax).
- C. The Contractor shall provide the following MDF wiring information prior to acceptance of the building by the University:
1. Cable pair assignments per connector block.
 2. Identification of cable routing to MDF.
- D. The Contractor shall provide a complete listing of pair assignment records for copper wiring, optical fiber cabling, and coaxial cabling. Copper cable records shall include the status of each copper pair. Optical fiber cable records shall include strand allocation, test results, and identification of media and protocol used.
- E. The Contractor shall provide the University with the operational and maintenance documentation of all telecommunications equipment installed under this contract.
- F. As-Built drawings shall include actual locations of installed ductbank and manholes, including elevations, and shall indicate location, elevation and type of service for all utilities crossed by the new ductbank.
- G. Contractor shall submit all drawings on CD or 3.5-inch floppy diskettes utilizing AutoCAD 14, or (Latest Version).

+ + END OF SECTION + +