Western Michigan University – Office of Information Technology & Campus Planning, Design & Construction

Design Guidelines for Facilities Construction:

DESIGN GUIDELINE DG17-0 General Systems Guidelines

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1. INTRODUCTION

The information presented herein is for the Communications Division of the University Standards and represents the standard practices and level of quality required for all University projects. Deviations from these standards required written approval from the University's Campus Planning Department/Office of Information Technology.

In some cases in these standards, items of equipment or design practices are not specified in detail, only guidance is being given. In other cases where specific brands and models are given, these are University standard equipment and deviation from these standards requires approval in writing from the University's Campus Planning Department/Office of Information Technology.

2. COMMUNICATIONS SYSTEM OVERVIEW

A. Preface

Communication technologies are a critical element in virtually all new-construction buildings and renovations. It is important that teams of professionals experienced in the design and construction of communications systems be involved throughout such projects.

Well-designed communications infrastructures, including a structured cabling plant are key in enabling a quality information system for WMU. In order to maximize network functionality and minimize labor and materials cost over the life of the system, a common set of network standards must be adhered to. Such standards must be based on a combination of current technological developments and established procedures and equipment already in use at WMU. This document collects the standards and specifications which the WMU Office of Information Technology (OIT) feels are necessary to assure that WMU buildings are equipped with a high-quality, safe, long-life, full-function communications system compatible with other University facilities practices, and needs.

Construction of communications systems is complicated by the fact that in most cases the pathways (conduit, cable tray, etc.) are installed by the electrical contractor and the communications cable, jacks, racks, etc., are installed by a communications contractor. Provisions need to be made assure the entire system is cleanly integrated and meets all applicable specifications.

B. Communications Philosophy at WMU

1. Single system

All new inter-building and most intra-building communications systems for the University are the responsibility of the Office of Information Technology (OIT). One of OIT's missions is to provide communications facilities for all aspects of university operations. The ultimate goal in doing this is to provide these services with a single standards-based infrastructure able to support all needs.

Ultimately, the University expects the universal communications structure to consist of a TCP/IP over Ethernet based primary system with compatible subsystems or attachments if required. To that end, the University is migrating to Voice over IP (VOIP) telephone service and using the University-wide Ethernet backbone, known as WMUnet, to support building management, security, and other functions wherever possible. Mechanisms to support video over IP are being explored, but are not yet been standardized. Other systems do not yet fit into the desired model. Where special system communications needs are not yet compatible with Ethernet, the OIT cabling system is used for connectivity whenever possible.

Since communications technology has existed for some time in many forms and is still evolving towards the integrated ideal, it is not possible to immediately mandate that all campus systems fit into the universal mold. Most older buildings use the more traditional arrangement of different technologies, with varying amounts of separate cabling systems for telephone, data network, and the EDUcable campus-wide CATV system. Several other systems use OIT cabling or non-OIT cabling to carry special signals.

2. New Project Design Goals

In order to support the philosophy described above, including support for legacy systems, OIT currently uses the following top-level principles for new projects:

a. New buildings or significant renovations will use VOIP phone service.

b. In-building communications will use a single integrated structured wiring system as espoused in current EIA/TIA, BICSI, and other standards.

c. Inter-building connections will use single-mode fiber optics.

d. Wireless Ethernet access will be provided for the entire building/project area and outside areas around it. The wireless system is intended to support user mobility and portable equipment only. Wireless connectivity is and is expected to remain relatively insecure and much slower than wired connectivity and is not intended to replace it.
e. Legacy systems will be supported when required with minimal deviation from the ideal system.

For practical purposes, these goals are expanded into the following practical high-level guidelines, which are defined in more detail in the other WMU DG-17 documents.

Inter-building connections.

> In addition to the primary single mode fiber connections, a minimal number of copper twisted pair telephone-style circuits will be provided from the current phone cable plant to support current loop systems as required. Pair count will be appropriate to the magnitude of the project (minimum 25).

Building structure

The building must be equipped with a system of communications rooms servicing horizontal user connections and interconnected by a riser system to provide a structured cabling environment.

The riser system will use primarily fiber optic cables, but will also have a limited number of copper Category 5e pairs.

UTP Cable system

All locations where the need for voice or data communications could be reasonably expected should be provided with UTP outlets to minimize the need of adding outlets after completion of the project.

All UTP user connections will exceed Category 6 specifications and will be identical except for jack colors (as specified elsewhere) with no discrimination by use (voice, data).

All new WMU buildings use a completely jacked UTP copper system. In addition to user jacks, all UTP copper cables are terminated on jack panels in racks and the outside entry cable is cross connected to similar panels. No traditional punch blocks or cross-connecting facilities are used.

A trunk cable pathway for horizontal user cables should be incorporated into the building to provide a neat-well organized system and relatively easy maintenance over the life of the facility. All user cabling will use organized pathways/supports over the full length.

The user connection environment should be designed to eliminate or minimize the use of floor-based access or outlets due to the high probability of damage.

Fiber Cable System

All new inter-building cables will be single mode.

Risers within buildings may be either multimode or single mode, depending on length. The current length limitation for multimode is driven by the emerging 10 Gbps Ethernet standards.

All backbone fibers (outside and riser) are terminated with ST connectors except for the top 6 of each cable, which are terminated with FC/APC to allow support for broadband analog (video) signals.

CATV system

Broadband video (EDUcable) will continue to be distributed to users as required over a CATV structure separate from the Ethernet system.

Inter-building connections will use single mode optical fiber in the main communications cable unless the use of conventional coax is much less costly.

CATV signals will be distributed throughout the building as needed using a combination of optical fiber and coaxial cable suitable for the size of the area being served.

Wireless system

A system of wireless access points will be deployed throughout the area to allow acceptable access from all areas used by students or staff. Currently available technology will be used- at the writing, both IEEE 802.11a and 802.11g are supported for all new projects.

Outside antennas should be provided to service nearby areas, which may have a need for access.

OIT should be consulted for possible uses of wireless backup links to other campus buildings.

C. System Summary

This is a very short overview summary of the salient points of the building communications system. It is not to be interpreted as simplifying any other included specifications.

All closets will be equipped with floor mounted telecommunications-style 19" racks with cable management to hold cable terminations and distribution electronics.

The exterior copper building telephone entrance will be terminated at a wall-mounted protection block. There will be a cross-connect system between punch blocks near the protected entrance and RJ-45 jacks in racks to allow jumper connections to the RJ-based riser system.

The riser cable system will consist of Category 5e UTP cables, single mode and multimode fiber optic cables, and video cables installed between the BEF and TCs.

Copper UTP riser cables will be terminated on RJ-45 jacks in panels mounted in communications racks, 2 pairs per jack. Horizontal cable management will be placed between 48-jack panels.

Fiber optic riser cables will be terminated with ST connectors in rack-mounted cabinets.

Horizontal user outlet distribution UTP cabling will be a Category 6 level system.

All horizontal UTP drops will use 4-pair category 6 Superior Essex cable with color-coded Panduit Category 6 Mini-Com jacks at each end. There is no physical differentiation between voice and data jacks.

Components specified above both exceed Category specifications. Panduit and Superior Essex have a component compatibility agreement. As a result it is expected that the horizontal system will have a demonstrable margin of headroom over Category 6 specifications.

Horizontal UTP cables will be terminated in TCs with panel-mounted jacks in floor mounted 19" racks.

A limited number of horizontal fiber connections may be required, depending on the project.

Terminations and equipment will be arranged in racks to minimize required jumper lengths: generally with alternating horizontal cable panels and electronic distribution equipment (switches, etc.) or with terminations and electronics in a side-by-side arrangement.

The default video system will use single mode fiber to bring the University EDUcable system to the building and distribute it with a combination of single mode fiber and coax cables and passives.

Horizontal coaxial video connections will be installed from taps in the source TC to outlets installed in Panduit faceplates as specified.

D. OIT Involvement

OIT must be involved in consultations with the proposed building occupants in defining communications outlet requirements. Placement of such outlets significantly affects building usability. Knowledge of total outlet and jack count is necessary to prepare system designs and cost estimates for University-supplied equipment.

OIT must be involved in preparation and review of the communications system construction final design to oversee detailed design of communication rooms, communications support equipment, and the labeling, etc. of components in accordance with these specifications.

OIT should be involved to assist in addressing questions during the actual communications construction phase.

Final installation and activation of communications equipment must be under the direct supervision of OIT in order to ensure an orderly integration into the existing systems.

3. GENERAL REQUIREMENTS

A. Design

The designers for the project communications systems should be qualified in that field. They should have RCDD certification and be very familiar with communications standards and guidelines from EIA/TIA, BICSI, and similar organizations in addition to the NEC, local codes, and other governing regulations. Within the total project design, personnel qualified in telecommunications/IT systems should provide appropriate input to those preparing overall design and especially the electrical, climate control, and other aspects that directly impact the communications/IT system.

The entire system will be designed and installed with the intent of being adequate to support high-speed digital and analog signals meeting current and future standards. Systems used may include, but are not limited to:

1. 10Base-F, 100base-FX Ethernet.
2. Gigabit and multi-gigabit Ethernet, both SX and TX.
3. 10 Base-T, 100 Base-T, and gigabit on copper Ethernet.
4. Video signals of various types including broadband CATV.
5. Conventional single line telephones, 2-wire or 4-wire, analog and digital.
6. T1, DS1, PRI circuits.
7. ISDN
8. ATM
9. FDDI
10. SONET

B. QUALITY OF WORKMANSHIP & MATERIALS

1. General

The expected life of the communications system infrastructure covered by these guidelines is 15-25 years. All specifications and requirements should be defined with the objective of obtaining a high quality system capable of a long useful service life.

The selection, design, and specification of the materials and workmanship to be incorporated into the communications systems of the project should respond to the demanding environment of a major educational institution providing reliable, durable, low-maintenance, long-life usage, while recognizing the budget constraints for the project.

All material will be new, current production and will be undamaged when installed.

All materials will be handled, stored, and installed in accordance with manufacturers specifications or recommendations.

In the Professional's specifications the contractor(s) shall be required to obtain and pay for all permits identified and required by the State of Michigan.

2. Codes & Standards

Codes shall be used as minimum requirements, and where these guidelines call for an installation that exceeds and does not violate the code requirements, these guidelines shall be followed.

All designs and work shall conform to the PSC identified edition of the National Electrical Code, Life Safety Code, IBC and State of Michigan requirements. In addition the design and installation shall comply with all the requirements of MIOSHA and OSHA.

All materials used shall conform to the standards of the Underwriter's laboratories in every case where such standards have been established for the particular type of material and/or application in question. All materials shall be labeled as UL listed.

Many standards or regulations of the organizations below apply specifically to the communications systems for the project. These will be adhered to and called out specifically as appropriate.

a. BICSI
b. Electronics Industries Association (EIA)
c. Telecommunications Industries Association (TIA)
d. Institute of Electrical and Electronics Engineers (IEEE)
e. Federal Communications Commission (FCC)

Where conflicts occur between codes and standards or between codes and standards and Specifications and Plans, the one establishing the more stringent requirements shall be used.

3. Warranties

The system is expected to have a life of 10-20 years or more. WMU will assume maintenance duties of the system soon after cutover. Expecting a contractor to warrant the full system for long periods while the owner works on it is unreasonable.

Contractor will provide Panduit *Certification Plus* 15-year system warranty on Category 6 system and components.

Contractor will supply Corning *LANscape Extended Warranty Protection (EWP)* 25-year system warranty for fiber cable system.

All manufacturer warranties for components provided by contractor will be passed to owner. Contractor will take first responsibility to see that manufacturer warranty is honored during its life in case of failures of components.

On remaining system components, for a period of three years from the date of executed contract, contractor will provide the following services, available between 8 a.m. and 5 p.m. weekdays except holidays:

Telephone based engineering support to assist owner personnel with configuration and design matters.

On-site maintenance to repair any malfunctioning supplied component. Owner must approve any component replacement.

All manufacturer technical journal and release note distribution/subscriptions for contractor-supplied equipment.

4. Installer's Qualifications for work

Firm shall have at least seven (7) years of successful installation experience with projects utilizing telecommunications/special media systems and equipment similar to that required for this project.

The company shall have a fully staffed office with technical installation support personnel within 75 miles of the project.

Installer will be certified under the Graybar VIP-2000 Program for the Panduit hardware– Superior Essex cable UTP combination.

Installer shall use personnel currently certified by Panduit for Category 6-level UTP installations

Installer will use personnel currently certified by Corning for fiber optic installations.

All requested certifications will be current and will be made available for owner review on request throughout the work period.

5. Workmanship

All work will be directly supervised by one or more RCDDs and BICSI registered Installers employed by the contractor.

Fully qualified communications crafts persons working under fully qualified and experienced supervisors will do all work.

All communications work will be carried out under the direct supervision of one or more qualified RCDDs or designers with equivalent knowledge and experience acceptable to owner.

At least 10% of the personnel involved on the project will be BICSI registered cable installers.

At least 25% of the supervisors on the project will be BICSI registered Technicians.

6. Inspections

The University's representatives will conduct periodic inspections in which the contractors must comply. During project closeout, the University's representatives will perform an inspection for final acceptance.

4. BASIC DESIGN, MATERIALS & METHODS

A. Design

This standard group (17) covers the project information communications system used primarily to connect building occupants and systems to outside communications resources. It includes but is not limited to telecommunications ("phones"), data communications ("network") and broadband video ("CATV") systems. It currently does not directly cover, but may optionally be applied to, similar communications facilities for security, building management, or other systems.

Communications designs in building projects shall include, but not be limited to, outside cable systems, riser cable systems, horizontal distribution systems, and wireless systems.

B. Arrangement

All communications equipment shall be located in communications rooms separated from the rest of the uses of the buildings. The door of communications rooms shall open off of a public space in the building.

Communications spaces may not contain non-communications equipment or facilities not required for operation of the rooms. Communications rooms shall be separate rooms from the electrical spaces. With approval of the University's Campus Planning Department/Office of Information Technology, security equipment or appropriate instructional technology equipment may share a communications room, provided adequate space is available.

C. Identification

All components, equipment, wire, wire ways, boxes, and panels shall have identification permanently attached to it in accordance with the specific requirements in DG16 sections and/or the sections to follow.

Specifications shall require the contractor to provide communications system diagrams (as built version) mounted with protective, transparent covers on walls of appropriate communications rooms in each building.

D. Drawing Standards

Communications systems are considered electrical in nature and shown on Electrical sheets. Communications outlets, wireless access points, etc., will be shown on separate drawings including only other relevant items/systems. Most equipment using communications outlets require power and power outlets are

considered relevant and should be included on floor plans with communications outlets.

Where appropriate, communication system design information will be the subject of completely separate drawings. For example, the communications riser cable system should be detailed in a separate drawing.

Where it may be necessary to show communications outlets or facilities that are only indicated on drawings other than Electrical series communication system drawings, references to these drawings will be clearly made on an appropriate communications drawing.

All communications component symbols that appear in the drawings will have full definitions, including specific jack requirements, etc., included in the drawing set or clearly called out.

Additional drawing provisions from DG 16 apply.

E. Connections to Existing Systems and Equipment

Communications systems for the project will be required to interconnect and interoperate, or support equipment that will interoperate with existing University communications systems.

Standards that the new system will be required to interoperate or interconnect with may include, but are not limited to:

1. Physical
    a. Corning single mode optical fibers
    b. Corning multimode 62.5/125 optical fibers
    c. Current-loop and digital telephone systems
2. Functional
    a. High-speed Ethernet over fiber optics (100Mbps, Gigabit/sec, 10 Gigabit/sec.)
    b. IEEE 802.11ag and other power over Ethernet equipment.
    c. IEEE 802.11a, 802.11b, 802.11g wireless Ethernet equipment.
    d. Cisco and other Voice over IP systems.
    e. Special purpose low voltage/current signaling systems (fire alarm circuits, etc.).

For situations that require contractors to actually connect to, modify, or otherwise access existing communications systems must be carried out in coordination with

and under supervision of the WMU Office of Information Technology or other owner/operator of the existing system.

F. Shop Drawing Standards

Provide permanent operational data for each item of equipment; indicating manufacturer, product name, model number, serial number capacity, operating and power characteristics, labels of tested compliances, and similar essential data.

5. SUBMITTALS REQUIRED

A. Design Descriptions

During the Schematic Design Phase prior to the drafting of the specifications, the designer shall provide a design description of the communications systems in the project. The design description shall give a description of each system, its location, components, applicable to each system, system purpose, how it functions.

B. Communications Requirement Calculations

The designer shall furnish estimated communications equipment requirements prior to the completion of bidding of the project. Electronic versions of these shall be furnished in “as built” versions at the close of the project.

Communications demand requirements will include the projections for the following for each communications room:

1. Number of individual jacks.
2. Number of communications racks.
3. Power requirements.
4. Heat loads.
5. Number of wireless network access points.
6. Vertical (riser) and horizontal cable requirements.

C. As Built Drawings

The designer shall provide one complete set of “as built” cad files of the construction and design drawings in AutoCAD format. This shall include a complete set of the communications specifications in Microsoft Word format.

The drawings should include the following information:

1. The location of all outlets, fixtures, pulls boxes, etc., as installed.

2. Complete riser diagrams for the communications systems.

3. Fixture schedules with catalog numbers and manufacturers, as installed.

4. Each floor should have separate drawings for communications and related components.

D. Operating and Maintenance Manuals

When the construction is substantially completed, before the University is expected to operate and maintain it, the Consultant shall provide a complete set of Operation and Maintenance Manuals (O&M's) and System Operation Descriptions for any communications items where this may be relevant.

E. Spare Parts and Equipment

Spare parts or components may be required in related DGs.

F. WARRANTIES

Assemble the warranties specified in Division 17, into a separated set of vinyl covered, three ringed binders, tabulated and indexed for easy reference. Provide complete warranty information for each item, product or equipment. Warranty information shall include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

6. EARLY OR TEMPORARY COMMUNICATIONS SERVICE

Project needs for University communications systems before substantial completion of project. Projected needs should be determined and incorporated into project schedule or otherwise defined for WMU OIT. Functional connections for new or existing systems or equipment shall be requested in advance and shall be made at the convenience of the University.

Such needs may include elevator emergency phones, building management, alarm, or security systems.

7. CLEANING / TURNOVER

The designer shall require in their communications specifications a requirement that communications rooms and spaces and equipment will be cleaned prior to turnover. Communications rooms must be cleaned, including removal of all dust and dust-producing materials.

Cables and other facilities required for activation of early or temporary communications connections will be essentially complete before the University will install communications equipment to support such connections. Any communications rooms, which must be used, will be painted, secure, and completely dust-free and clean before equipment will be installed.

END OF SECTION