Standards & Specifications

Danforth Campus  Prepared on 06/23/2017
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Overview of Technology-Infrastructure Practices

Introduction

The purpose of the document is to describe how Washington University Information Technology (WashU IT) works with the Danforth Campus partners on design and installation of the technology infrastructure supporting staff/administration, teaching, learning, and research at the University. Depending on the project, these partners include, but not limited to, the directors of IT and Facilities for each of the Danforth Schools, Facilities Planning and Management, the Classroom Monitoring Committee (CMC), and the Teaching Center. Other partners will be involved as required by the specific project.

As we begin the process of understanding the construction requirements for all new renovations and capital projects, we also need to include all aspects of technology. For example, wireless networking, cellular phone services and DAS (Distributed Antenna Systems), and wired network connectivity are becoming standard utility services for every building. As faculty, students, staff, and visitors are bringing multiple devices to campus; they expect ubiquitous connectivity in offices, gathering spaces and classrooms. The increased need to use technology throughout the Danforth Campus for a wide variety of purposes drives the need for requirements such as,

- Availability of network resources around-the-clock and for emergency response, including during power outages.
- Reliable wireless connections throughout all interior spaces, including basements for maintenance operations, security and emergency response.
- Support for interactive video presentations, video conferencing and remote class sessions, requiring reliable, high-speed network connections throughout buildings.
- A secure and reliable network to support building control systems, alarms, closed circuit cameras and internet based telephones.
- The number of devices any one individual brings to campus continues to rise and with it an expectation of ubiquitous connectivity.

Process

From the beginning of a building or renovation design project, WashU IT works closely with the relevant campus partners to ensure that the technology infrastructure is designed to meet the requirements and to cohere with the University’s standards. In the case of projects that include University managed classrooms, WashU IT works with the Teaching Center staff to ensure that the technology infrastructure will support the installation and use of technology according to The Teaching Center’s classrooms standards. In other cases, WashU IT will work with the directors of IT and Facilities of the relevant school on their projects.

WashU IT will assign a project liaison to communicate with the campus partners on specific technology needs throughout the project. This project liaison will also communicate with the zone manager, and The Teaching Center where appropriate, when and where projects are to be done, and ensure that the projects are completed per standards.

The preferred approach for documenting technology requirements for projects is to provide drawings dedicated to WashU IT. Upon submission of DD and 50% CAD drawings, WashU IT will then produce wireless (WLAN) and distributed antenna system (DAS) design to be overlaid on the construction drawings.

Any variance from minimal design requirements will be reviewed by WashU IT and the space owner(s). Discussions will include why variances are requested and how this might impact the University’s commitment to having “ubiquitous connectivity” on campus. This request for variance will then be presented to the following for approval; the Associate Vice Chancellor for Facilities Planning and Management, the Vice Chancellor and Chief Information Officer, the highest level executive responsible for the building/space in question, i.e. the deans of the schools (for school owned buildings and spaces), or the Executive Director of The Teaching Center (for University managed classrooms). Final escalation is to the Provost and the Executive Vice Chancellor for Administration. Any and all decisions will be documented in writing.
General Guidelines/Standards

WashU IT is responsible for overseeing installation, maintenance and administration of all campus telecommunications, wireless, DAS, and network critical physical infrastructure. This responsibility includes working with the end users to ensure that the infrastructure fits the technology, and the design of the technology, needed by end users. It also includes ensuring that each building’s infrastructure is planned to support adequate telecommunications rooms, cabling and wiring within the buildings, and cabling between buildings to support the University’s diverse requirements for voice, data, wireless, and DAS.

Adherence to standards and codes is employed to increase the value of the investment in the infrastructure, reduce the labor expense of maintaining the system, decrease the expense of installation at a later time, extend the useful economic life of the system, and provide effective service to users. Adherence to standards and codes also makes it possible to administer the critical infrastructure necessary for daily information technology and to support the mission and vision for growth at the University.

General Planning Guidance

This section is intended to convey the most current information technology infrastructure guidelines for the work areas typically found at the University. These are the minimum initial planning requirements to design and build the appropriate infrastructure to support the foreseeable use of the intended facility. For each type of work area listed in this section, the end user shall consult with WashU IT to help determine the specific configuration necessary to meet work area requirements.

Types of Work Area

- Classrooms/Lecture Halls/Auditoriums – a minimum of two communications outlets, one typical and one non-typical (see below for outlet description).
- Conference Rooms – a minimum of one typical communications outlet in each room. Rooms more than 500 sq. ft. should have two typical communications outlets.
- Faculty and Staff Offices – a minimum of one typical communication outlets for offices of 100 sq. ft. or less. Offices greater than 100 sq. ft. may require an additional communications outlet.
- Residential Rooms - a minimum of one typical residential communications outlet per bed.

Philosophy of Wi-Fi and DAS Placement

- Wireless (Wi-Fi) – all spaces within buildings will be designed for ubiquitous wireless coverage, based on forecasted capacity.
- DAS (Distributed Antenna System) - all spaces within buildings will be designed for ubiquitous cellular coverage, based on forecasted capacity.

Outlet Description

- Typical Communications Outlet (Per University Standards) – two network cables
- Non-Typical Communications Outlet (Per University Standards) – two network, one CATV, one two strand SM fiber, one two strand 50 um MM fiber cables
- Typical Residential Communications Outlet – one network, and one CATV

Technology Categories

- WashU IT Wired Network
- WashU IT Wireless Network
- WashU IT Cellular Phone Service – Distributed Antenna Systems (DAS)
- WashU IT Media Services Room Audio/Visual Standards

Note – All future considerations and recommendations to the standards will be shared and discussed with the Medical School CIT.
Technology: WashU IT Wired Network

This encompasses the cabling, in-room connections, network equipment, wiring closets and back-up power required to support the university’s multiple data networks. All cabling infrastructure guidelines and specifications are provided by WashU IT to ensure the installation meets the needs of the University. Specification standards can be found at http://nss.wustl.edu/infrastructure/Pages/default.aspx

Design Considerations:

The wired data network continues to be a critical technology component and is the backbone for connecting all forms of technology, including wireless networks. Functions dependent on wired network infrastructure include,

- Internet Access
- CCTV
- Building control systems
- Alarm systems
- Alertus emergency notification
- Door access systems
- Access to university and school systems
- Video and voice communications
- Classroom technology
- Wireless network access points and controllers
- Internet television services

Several elements will impact building design and construction.

- Allocation of Telecom Rooms for network equipment and related infrastructure
- Specification for the number of fiber and copper cables based on current utilization and anticipated network growth and technology changes
- Placement of cabling and network connections, to include pathways for future cabling
- Back-up power requirements including UPS and generators

WashU IT has responsibility for providing budgetary cost estimates, building design requirements for space and placement, specifications for contractors, deployment supervision, and acceptance of the completed installation for building projects on the Danforth, West, North and Residential campuses. This is essential to ensure a consistent and secure environment for network connectivity at the University.

Related Documents: http://nss.wustl.edu/infrastructure/Pages/default.aspx

WashU IT Contact: WashU IT Network Engineering
314-747-0814 (Lee Rouse)
Technology: WashU IT Wireless Network (WLAN or WiFi)

Wireless networking includes support for use of unlicensed radio frequency technology using 802.11 protocols to transmit data (commonly referred to as WiFi). This technology provides connections to mobile devices in close proximity to network transmitters and receivers or network access points (AP). The APs in turn require connection to the university wired network. This technology is most appropriate for extending the university network to mobile devices in defined spaces.

Design Considerations:

Deployment of any wireless infrastructure needs to be carefully planned and engineered. The design and deployment of a wireless network for a particular location is influenced primarily by interference and capacity planning factors. Each design must include careful and exhaustive signal strength measurements, which take into account the three-dimensional nature of wireless network devices, interference caused by other devices utilizing the same unlicensed spectrum and obstacles such as concrete walls, metal supports, and low E or lead lined glass.

The design must also take into account the potential load on the wireless network. A large number of wireless users in one area such as a large classroom or lecture hall, for example, may require the use of two or more wireless access points configured to balance load. A less dense but more spread out coverage area, such as a lawn between two buildings may require a "coverage-orientation" as opposed to a "capacity-orientation" design with a different set of configuration options. In addition, it is important to note that the bandwidth provided by the wired network far exceeds that provided by wireless LANs. Users attempting to substitute wireless LANs for wired LANs can expect degradation of performance and speed as well as potential loss of signal from time to time.

Several elements will impact building design and construction.

- Specification for the number and type of access points
- Placement of cabling and network connections
- Back-up power requirements including uninterruptible power supplies (UPS) and generators

Planning should begin with the WashU IT liaison, consulting with the owner and end user of the space to ascertain the intended use of the space. This discussion should happen prior to the design. In the case of University-managed classrooms, The Teaching Center is the space owner, and should be the point of contact for room requirement. The wireless needs of the end user may also influence the design.

WashU IT has responsibility for providing budgetary cost estimates, building design requirements for space and placement, specifications for contractors, deployment supervision, and acceptance of the completed installation for building projects on the Danforth, West, North and Residential campuses. This is essential to ensure a consistent and secure environment for network connectivity at the University.

Related Documents: http://nss.wustl.edu/infrastructure/Pages/default.aspx

WashU IT Contact: WashU IT Network Engineering
314-747-0814 (Lee Rouse)
Technology: WashU IT Cellular Phone Service – Distributed Antenna Systems (DAS)

Cellular phone services are controlled by third party providers and require the use of licensed radio frequencies. Each provider has their own, slightly unique technology for sending and receiving signals. Extending cellular signals onto campus and into buildings requires the cooperation and investment of the cellular service providers.

The cellular technology is generally designed to transmit and receive radio signals over large outdoor areas. Physical structures can block signal transmission resulting in poor phone reception. DAS provide a strategy for capturing and re-broadcasting cellular signals in areas of poor coverage, including inside buildings. WashU IT has deployed multiple configurations of DAS to provide cost effective options for partnering with the third party owners of the cellular RF licenses and services.

Design Considerations:

Similar to WLAN, DAS implementations have the same design guidelines, with one difference. Designs must accommodate capacity and coverage for the four major cellular carriers (Sprint, T-Mobile, AT&T, and Verizon).

Deployment of any DAS needs to be carefully planned and engineered. The design and deployment of a DAS for a particular location is influenced primarily by interference and capacity planning factors. Each design must include careful and exhaustive signal strength measurements, which take into account interference caused by other cellular transmitters and obstacles such as concrete walls, metal supports, and low E or lead lined windows.

The design must also take into account the potential load on the DAS. A large number of smartphones in one area such as a large classroom or lecture hall, for example, may require the use of two or more antennas configured to balance load. A less dense but more spread out coverage area, such as a lawn between two buildings may require a “coverage-orientation” as opposed to a "capacity-orientation” design with a different set of configuration options.

Several elements will impact building design and construction.

- Specification for the number and type of antenna’s
- Placement of cabling, and signal distribution equipment in buildings
- Placement of carriers’ equipment for connections to the DAS or the “Head End”
- Capacity of the university’s fiber network to connect Head End and distribution equipment across campus
- Back-up power requirements including UPS and generators

WashU IT has responsibility in providing budgetary costs and engaging a DAS engineer for design, deployment, and management of the DAS for the Danforth campus. This is essential to ensure a consistent environment for cellular coverage at the University.

Related Documents: http://nss.wustl.edu/infrastructure/Pages/default.aspx

WashU IT Contact: WashU IT Network Engineering
314-747-0814 (Lee Rouse)
Technology: WashU IT Media Services - Room Audio/Visual Standards

This document describes the current standard designs, set by WashU IT Media Services, for audio-visual (A/V) and multi-media technologies in conference rooms, non-University-managed classrooms, and meeting rooms across campus. These rooms can be used for multiple purposes, classrooms can become meeting or conference rooms outside of class time and vice versa, so flexibility in design has been taken into consideration. Technology/equipment configurations are provided by WashU IT - Media Services to ensure the installation meets the needs of the University.

These standards are applicable for departments / schools where there are no current standards and do not override existing standards. All University-managed classrooms under the auspices of the Classroom Monitoring Committee (CMC) and the Teaching Center (http://teachingcenter.wustl.edu) have their own set of standards that apply. Please contact The Teaching Center directly when working with a University-managed pooled classroom.

Design Considerations:

Deployment of any room audio-visual equipment needs to be carefully planned and engineered. The needs of a room should be discussed with the room owners early in the process. Common variables used to create the equipment packages below are the size of the room and the most likely use case. Each combination presents a different equipment package with various options that can be used for renovations or new construction. These equipment packages should be used as a starting-point in the decision-making process.

<table>
<thead>
<tr>
<th>ROOM SIZE</th>
<th>ROOM USE CASE</th>
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<tbody>
<tr>
<td>Small, 3-5 occupants</td>
<td>Infrequent need for A/V</td>
</tr>
<tr>
<td>Medium, 6-20 occupants</td>
<td>Frequent A/V, single input for BYO (bring your own) computer</td>
</tr>
<tr>
<td>Large, 21-50 occupants</td>
<td>Frequent A/V, Multiple inputs, room based computer</td>
</tr>
<tr>
<td>Stadium Seating, 51-120 occupants</td>
<td>Classroom / Stadium Seating</td>
</tr>
<tr>
<td>Auditorium</td>
<td>Presentation or Performance</td>
</tr>
</tbody>
</table>

Interactivity options: Video camera(s) and microphones can be added to any package
Control System: AMX w/ Resource Management Suite (RMS)

Basic design schematic for each equipment package provided by WashU IT Media Services
Basic programming for AMX control systems provided by WashU IT Media Services

WashU IT – Network Engineering has an approved set of network standards that are fully applicable towards any A/V installations. School/departmental requirements that could cause variance to these standards and are subject to review and approval prior to design phase.

WashU IT has responsibility for providing budgetary cost estimates, building design requirements for space and placement, specifications for contractors, deployment supervision, and acceptance of the completed installation for building projects on the Danforth, West, North and Residential campuses. This is essential to ensure a consistent environment for audio-visual / multi-media technologies at the University and to provide better budgeting baselines for directors of IT and Facilities for each of the Danforth Schools, Facilities Planning and Management at the Medical School and other partners as required for specific projects.

Security of A/V equipment is the responsibility of the room owners and should be considered ahead of installation. WashU IT provides live security loops tied into the university card access system upon request.

Related Documents:
WashU IT Contact: WashU IT Media Services
314-935-4900
WashU IT Media Services Audio/Visual Media Room Standards

Common variables for audio-visual (A/V) and multi-media equipment that will go into WUSTL conference rooms, meeting rooms or non-University-managed (pooled) classrooms are based upon a combination of use-case and room size. For this purpose, we list five room sizes and five basic ‘use cases’. Each combination presents a different equipment package with a variety of options. This approach provides recommended setup and usage, but allows for movement up or down the optimal setup matrix based upon input by the room ‘owner’. Recognition is also made that these non-University-managed (pooled) classrooms can become meeting or conference rooms outside of class time and vice-versa.

Administrative buildings (CFU and Med School Admin), room/building ‘owners’ will work with facilities and WashU IT - Media Services to understand the best multi-media configuration fit. Each school will include its IT leadership in working with facilities and Media Services to find the best multi-media configuration for classrooms, conference and meeting rooms.

It is important to note that all of the configurations listed are sufficient for lecture capture. A part of that philosophy requires controllable zone lighting to be sure that during any capture session, both the speaker and presentation can be seen locally and via the capture. In addition, it is important that controllable zoned audio is included in rooms of sufficient size. Lecture capture does require additional software and possibly additional hardware as well. There is no university standard for lecture capture at this time.

These standards are applicable for departments / schools where there are no current standards and do not override existing specs/standards/guidelines. All University-Managed classrooms under the auspices of the Classroom Monitoring Committee (CMC) and The Teaching Center (http://teachingcenter.wustl.edu) have their own set of standards that apply. Please contact The Teaching Center directly when working with a University-Managed pooled classroom.

**Room Size, Usage Narrative and Equipment Configurations**

1. **Small Room, 3-5 Occupants**
   a. Usage Narrative: Infrequent need for A/V
      i. Flat screen installed
      ii. Additional technology (laptop, speakerphone, camera) will be brought in
   b. Equipment Configuration - E1
      i. Flat screen w/ back box and power conditioner
         1. Professional grade w/ television tuner*
            a. Usually 42” – 55” LCD/LED
         2. Mount – Chief LTMU or RLTU Series Mount
         3. Back box – Chief PAC 526 or equivalent
         4. Option – CATV cable run
         5. Option – Ethernet cable run (x2)
         6. Option – Audio Sound Bar (additional speakers may be required)
         7. Option - Active Digital Signal Transmitter and Receiver (AMX)
      ii. Interactivity Option - Portable:
         1. Logitech HD C-series webcam or equivalent
         2. Jabra 510 speakerphone or equivalent
         3. Joby GuerillaPod Tripod or equivalent
         4. USB 25 foot extender cable
      iii. Wall Plate or Table Plate w/ connectors from Flat screen
         1. VGA / 3.5mm Audio connector, HDMI, Ethernet RJ45

* Professional Rated displays are warrantied for use in conference rooms and installed systems. The use of a consumer display in a professional environment could void the manufacturer’s warranty.

2. **Medium Room, 6-20 Occupants**

Washington University Information Technology
a. Usage Narrative: Frequent A/V w/ single input
   i. Flat screen or Projector w/ BYO computer, Extron cable cubby
   ii. Option: Resource Management System (RMS)
   iii. Option: Controllable Zone Lighting and Audio

b. Equipment Configuration - E2
   i. Video
      1. Option A: Flat screen HD LED 46” – 64” w/ Chief mount
         a. Professional Rated display* (size based on requirements)
         b. Chief LTMU or RTLQ Series Mount
      2. Option B: Projector, based upon room environment
         a. Projector (3500-4500 lumen, XGA or better resolution)** w/ Chief mount (RPMA series)
         b. Screen – Da-Lite or Draper equivalent, non-tensioned screen (standard)
            i. Motorized doors are not acceptable
            ii. Tensioned upon request/discussion
   ii. Audio - Ceiling Mounted Speakers
   iii. Room Control System w/ wall-mounted touch pad - AMX
      1. Occupancy Sensor: Dual technology, ceiling mounted – Lutron
      2. Active Digital Signal Transmitter and Receiver
      3. Master Controller
   iv. Ceiling box equipment housing / equipment rack
   v. Option: Resource Management Suite (RMS) connection
   vi. Option: Controllable Zone Lighting and Audio
   vii. Option: Interactive Audio/Video
      1. Portable:
         a. USB speakerphone - Jabra Speak 510 or equivalent
         b. USB camera /w tripod - Logitech C920/930 and Joby GorillaPod or equivalent
      2. Installed V1:
         a. USB Camera and USB Microphones
         i. Alternative Option: Audio sound bar w/ built-in camera
      3. Installed V2:
         a. USB PTZ Camera
         b. USB Ceiling Microphones
         c. In-Room Audio Processor w/ Noise Cancellation
   viii. Standard Network Install for Room (see #7 below)

* Professional Rated displays are warranted for use in conference rooms and installed systems. The use of a consumer display in a professional environment could void the manufacturer’s warranty.
** Panasonic, NEC, Digital Projection and Christie projectors have all been tested and conform to the standards

3. Large Room, 21-50 Occupants
   a. Usage Narrative: Frequent A/V w/ multiple inputs
      i. Projector w/ installed computer, cubby box, control/touch panel (AMX), room switching
      ii. Resource Monitoring System (RMS)
      iii. Option: Controllable Zone Lighting and Audio

b. Equipment Configuration – E3
   i. Video
      1. Projector (5000 – 7000 lumen, XGA or better resolution)** based upon room environment w/ Chief mount (RPMA series)
      2. Screen – Da-Lite or Draper equivalent, non-tensioned screen (standard)
         a. Motorized doors are not acceptable
         b. Tensioned upon request/discussion
   ii. Audio – Ceiling Mounted Speakers
iii. Computer w/ monitor – full size w/ multiple USB ports
   1. Wireless or wired keyboard and mouse
   2. Integrated DVD player

iv. Equipment rack, wall-mounted
   1. Should comply with WashU IT – Network Engineering low voltage standards for rack, mounting, wiring and power – including UPS.

v. Room Control System - AMX
   1. Occupancy Sensor: Dual technology, ceiling mounted – Lutron
   2. Active Digital Signal Transmitter and Receiver
   3. Resource Monitoring Software (RMS) connection
   4. Master Controller
   5. Control/Touch Panel w/ remote access application for tablet

vi. Option: Controllable Zone Lighting and Audio

vii. Option: Interactive Audio/Video
   1. Installed V1:
      a. USB Camera and USB Microphones
         i. Alternative Option: Audio sound bar w/ built-in camera
   2. Installed V2:
      a. USB PTZ Camera
      b. USB Ceiling Microphones
      c. In-Room Audio Processor w/ Noise Cancellation

viii. Standard Network Install for Room (see #7 below)

** Panasonic, NEC, Digital Projection and Christie projectors have all been tested and conform to the standards

4. **Stadium Seating, 51-150 Students**

a. Usage Narrative: Classroom / Stadium Seating
   i. Room Control System w/ connectivity to Resource Management Suite (RMS)
   ii. High Definition Web/Video Conferencing Technologies
   iii. Controllable Zone Lighting and Audio*
      1. Wireless Mic System
      2. Listening Assist Devices
   iv. Confidence Monitor / Projection
   v. Document Camera

b. Equipment Configuration – E4
   i. Video
      1. Projector (6000 + lumen, XGA or better resolution)** based upon room environment
   ii. Audio – Ceiling mounted speakers
   iii. Computer w/ monitor – full size w/ multiple USB ports
      1. Wireless or wired keyboard and mouse
      2. Integrated DVD player
   iv. Equipment rack, wall-mounted or closet suggested
      1. Should comply with WashU IT – Network Engineering low voltage standards for rack, mounting, wiring and power – including UPS.
   v. Room Control System - AMX
      1. Occupancy Sensor – Dual technology, ceiling mounted – Lutron
      2. Active Digital Signal Transmitter and Receiver
      3. Resource Monitoring Software (RMS)
      4. Master Controller
      5. Active Signal Transmission for Video/Audio
      6. Audio Bridge/Processing Unit – Echo Cancelation
      7. Control/Touch Panel w/ remote access application for tablet
   vi. Controllable Zone Lighting and Audio
vii. Confident Monitor / Projection on aisles
viii. Document Camera w/ White Board Base
ix. Option: Interactive Audio/Video, Installed V2:
   1. USB PTZ Camera
   2. USB Ceiling Microphones
   3. In-Room Audio Processor w/ Noise Cancellation
x. Standard Network Install for Room (see #7 below)

** Panasonic, NEC, Digital Projection and Christie projectors have all been tested and conform to the standards

5. Auditorium
   a. Start with Large or Stadium Seating equipment package, but there should be a discussion that includes primary usage of the space (performance or presentation/teaching). These discussions should include WashU IT - Media Services, room owner/School IT support and supporting facilities department.

6. Design Schematics
   a. Each meeting room equipment configuration has a corresponding design schematic that will be adapted for each instance. Below is an example:

![Design Schematic Example]

7. Network Considerations for A/V Installations:
   a. Washington University has an approved set of network standards that are applicable towards A/V installations. All network drops, switches, etc. must conform to these standards.
   - I.E., is no longer acceptable for A/V vendors to supply or install any network hub, switch, router or wireless access points outside a WashU IT telecommunications room.
b. Approval for any exceptions must be coordinated with Media Services and Network Engineering during the design phase.

c. Wireless networking devices are also included in the approved network standards. All wireless devices must conform to these standards and must be approved during the design phase.

d. Any wired or wireless network, equipment etc. required for A/V installations must be designed by WashU IT – Network Engineering.

e. For a copy of the approved network standards, please contact Lee Rouse, Manager - WashU IT – Construction Management, Network Engineering, rousel@wustl.edu, 314-747-0814

<table>
<thead>
<tr>
<th>A/V Standards</th>
<th>small</th>
<th>medium</th>
<th>large</th>
<th>stadium seating</th>
<th>auditorium</th>
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<td>3 - 5 occupants</td>
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<td>5 - 20 occupants</td>
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<td>20 - 50 occupants</td>
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<td>50 - 150 occupants</td>
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<tr>
<td>equipment</td>
<td>E1</td>
<td>E2</td>
<td>E3</td>
<td>E4</td>
<td>E5</td>
</tr>
</tbody>
</table>

- **E1**: flat screen with BYO computer
- **E2**: flat screen or projector with BYO computer
- **E3**: projector with installed computer
- **E4**: projector with installed computer
- **E5**: custom

- **E1** plus consultant and design fees

- **E2**: wall plate / direct connections
- **E3**: wall plate / direct connections
- **E4**: wall plate / direct connections
- **E5**: wall plate / direct connections

- **E1**: interactivity option - portable
- **E2**: interactivity option - portable
- **E3**: interactivity option - portable
- **E4**: interactivity option - portable
- **E5**: interactivity option - portable

- **E1**: ceiling or rack equipment
- **E2**: ceiling or rack equipment
- **E3**: ceiling or rack equipment
- **E4**: ceiling or rack equipment
- **E5**: ceiling or rack equipment

- **E1**: installed VT or V2
- **E2**: installed VT or V2
- **E3**: installed VT or V2
- **E4**: installed VT or V2
- **E5**: installed VT or V2
Specifications for Communication Cabling Distribution Systems

General Overview

Listed below are the separate sub-systems of Washington University’s structured cabling system standard. The sub-systems are each summarized and then described in detail as separate sections in this document. All telecommunications wiring systems must adhere fully to all applicable ANSI/TIA Telecommunications Building Wiring Standards. The requirements for Washington University (WU) communications cabling sub-systems provide for:

1. **Service Entrance and Termination Room (Entrance Facility – EF)**
   This is the main telecommunications building service entrance. It is the area where the demarcation between inter and intra building cable is located. At WU this room is typically the Telecommunications Room on the lowest level of the building.

2. **Equipment Room (ER)**
   This area contains the electronic equipment that transitions between the core campus data, voice and video backbones and the building backbone. This securable room is to be dedicated to this purpose with no other building services sharing the space. This space may be co-located with the Service Entrance and Termination Room provided the room is sized for both functions. At Washington University, all Telecommunication Rooms and house active network equipment are treated as ERs.

3. **Telecommunications Room (TR)**
   This room provides for demarcation between horizontal cabling serving work areas and the building video, data and voice backbone cabling. Additionally, this room may contain electronic equipment that transitions between the data, voice and video building backbone and the end user telecommunications equipment. This securable room is to be dedicated to this purpose with no other building services sharing the space. This space may be co-located with the Service Entrance and Termination Room and/or ER provided the room is sized for both functions. At Washington University all TRs and house active network equipment are treated as ERs.

4. **Communications Conduits (CC)**
   Communication conduit requirements depart from those used for “normal” electrical power distribution. Communications conduit sizing does not follow NEC in terms of the maximum number of conductors allowed per unit volume. Due to the need for facilitating frequent adds, moves and changes, communications conduits are generously sized. Conduits entering the building are usually 4 inches with inner duct partitioning. Conduits between a buildings stacked TRs are four STI EZPath Series 44 (part # EZD44) sleeves. Conduits servicing end user spaces are usually 1” diameter and are also usually “stubbed” above the ceiling and thence to the nearest corridor/hallway telecommunications horizontal pathway entering the TR.

5. **Communications Pathways (CP)**
   Communications pathways are the single most critical component of the structured cable system. WashU IT does not, in general, require a separate “home-runned” 1” conduit from the end user information outlet to the TR. In general, WashU IT prefers to utilize wiring hangers, sometimes known as J-Hooks, or cable trays. A key feature of the j-hook/cable tray arrangement is its flexibility in ongoing moves, adds and changes to the cabling system over the lifetime of the building. Cable trays are required through all hallways and corridors and will terminate in the TR.

6. **Telecommunications Wiring**
   WashU IT’s specifies the latest standard in twisted pair wiring. This cable carries the bulk of data and voice services. In general, WashU IT does not require fiber or coaxial cable to the desktop though limited instances of this may be required, and will be specified during the design process. All cable is plenum rated.
7. **Building Riser**

The building backbone riser system connects TRs to each other, to the main service entrance room, and to the ER. WashU IT specifications call for installing several separate cable systems in order to provide the building occupants’ data, video and voice needs. Riser rated twisted pair copper “bulk” cables, coax, and both single mode and multimode fiber along with their termination requirements are specified.

8. **Grounding and Bonding**

All cabling systems and electronics distribution equipment must be grounded for both safety and electromagnetic interference reasons. Specifications for how this will be installed are found in this section.

9. **Electrical Power**

Provisioning the electrical power for communications systems requires special attention. Electrical interference as well as power quality must be managed in order to minimize long-term maintenance costs and end user disruptions.

**SERVICE ENTRANCE AND TERMINATION ROOM (EF)**

This room is the required service entrance for Telecommunications service (voice, data, video, FASS, BACS). The minimum size and number of conduits to a building are four, 4” conduits with two of the four having three 1¼” inner ducts installed for fiber optic cabling. If the building has a tunnel attached, inter-building conduits are not required.

The EF shall be within 50’ of the point where electrical facilities enter the building.

Never run more than 50’ of exposed non-fire-rated entrance cable within a building. If more than 50’ of cable is necessary between the entry point and the termination point, use rigid metallic conduit to enclose the cable. Installing a transition splice from outside plant cable to the indoor rated cable is acceptable. All conduit must be grounded.

The EF room is dedicated to Washington University’s Information Technology’s (WashU IT) use only.

The basic requirements for WashU IT’s EF are the same as a TR.

Approved manufacturers of fiber optic cable are Mohawk and Corning. All outside plant cable in non-protected or protected pathways (tunnels, direct bury, and overhead) shall be loose-tube, armored, and include a trace wire.

*The fiber and copper entrance facility cabling counts will be provided on a per project basis based on building size, function, and number of users.*

**EQUIPMENT ROOMS (ER)**

Equipment Rooms provide space and maintain a suitable operating environment for communications equipment. ERs are generally considered to serve a building, where TRs serve one floor or a section of a floor. In most cases at WU, each TR will house active equipment and will meet all ER specifications.

The room should be located so it has access to the intra and inter backbone pathway, is physically accessible for the delivery of equipment, away from potential EMI sources, from machinery that causes vibration, and from steam pipes, drains, and clean-outs.

If the ER is on a different floor than the Service and Termination Room, it must be stacked above the Service Entrance and Termination Room.

*The room shall be dedicated to Washington University’s voice, network, CATV, & DAS requirements and will be maintained by Washington University Information and Technology (WashU IT).*
1. The basic requirements for an ER are:

<table>
<thead>
<tr>
<th>Minimum Size for Small Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving area of &lt;1,000 sq.ft., 3’ X 4’</td>
</tr>
<tr>
<td>Serving area of &lt;5,000 sq.ft., 6’ X 6’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Size for Large Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving area of &lt;8,000 sq.ft., 6’ X 10’</td>
</tr>
<tr>
<td>Serving area of &lt;10,000 sq.ft., 8’ X 10’</td>
</tr>
<tr>
<td>Serving area of &lt;20,000 sq.ft., 10’ X 15’</td>
</tr>
<tr>
<td>Serving area of &lt;30,000 sq.ft., 15’ X 15’</td>
</tr>
<tr>
<td>Serving area of &lt;40,000 sq.ft., 17’ X 17’</td>
</tr>
<tr>
<td>Serving area of &lt;50,000 sq.ft., 19’ X 19’</td>
</tr>
</tbody>
</table>

2. Minimum ceiling height is 9’ 6”, with the exposed slab as the ceiling as long as walls are sealed to deck.

3. Location, number, and size of conduits, and sleeves between the Service Entrance and Termination Room, ERs, and TRs will be specified during the project’s design phase.

4. Rooms shall have outward swinging, fully opening, and lockable doors that are at least 36 inches in width and 80 inches in height. The door will be outfitted with the University’s standard standalone card reader. If door cannot be outfitted with card reader, then it must be keyed to match the “MD-81” lock.

5. To avoid dust all exposed concrete, brick, and gypsum board shall be painted or sealed. Carpet is not allowed.

6. Rooms shall have a dedicated HVAC system that maintains positive air pressure to control temperature and humidity. The heat dissipation will be specific to each building, but should be in the range of 750 to 5,000 Btu per equipment rack. Relative humidity should be controlled at 30% to 50%. Temperature should be controlled at 64 to 75 degrees. Condensing units will not be located in the ER/TR.

7. ERs cannot have any water pipes in the room, above the room, or in the floor below the room. If sprinklers are required in an ER or TR, install wire cages or other protection to prevent them from being accidentally set off. Sprinkler heads should not be installed directly over active equipment.

8. Provide a building ground wire, with bus bar, to the room. Locate the bus bar at the lower left corner of the plywood backboard. WashU IT will indicate on which backboard to place the bus bar. See Grounding section.

9. Provide a minimum lighting to be equivalent of 540 lux (50 foot-candles) measured 3 feet AFF.

10. Each wall shall have 3/4” X 4’ X 8’ sheets of A-C fire retardant plywood installed. The plywood shall reach from corner to corner. Install the plywood vertically at 6” AFF and fastened securely with a minimum of five (5) equally spaced fasteners along each vertical edge and one column of five (5) equally spaced fasteners centered on each sheet of plywood. Paint the plywood with two coats of fire retardant low-gloss, light-colored paint. When plywood is painted, the “Fire Rating Stencil and Underwriters Laboratory seal” on the plywood should be taped over and the tape removed after painting, as to clearly display the rating and seal on the plywood.

11. On each wall, except the wall containing the door, install two A/C 20-amp electrical fourplex outlets at 12” AFF. In the larger rooms, 10’ X 15’ and larger, install three A/C 20 amp electrical fourplex outlets evenly spaced along each wall. See Power section. Install a dedicated 208 volt 30-amp circuit to support a rack mountable UPS with one L6-30 and one L14-30 Receptacles. See page 30, #13.

12. Minimum floor loading should be 4.8 kPA (100 lb./ft²).

13. Install a minimum of three 7’ racks with vertical wire managers to support network termination devices and network electronics. The amount of services required to support the building may require more racks to be
installed. Fasten the rack(s) to the floor and bond them to the ground bus. Number and location of the racks will be supplied during the design phase of the project.

14. Install ladder rack from the racks(s) to the plywood backboard. Bond the ladder rack(s) to the ground bus. Ladder Rack posts are required every 12” to 16” to support cable bundles. The exact amount is determined by the total length of tray installed in each room.

15. When the ER is also used as a Service and TR and/or a TR, WashU IT will size the room based upon the type and amount of services required to support the building. WashU IT will also take into consideration the intended use of the building when determining the size of the ER.

16. Install one uninterruptible power supply (UPS) in each ER.

TELECOMMUNICATIONS ROOM (TR)

A per floor centrally located TR shall be provided for in the design of the building. If a horizontal distance of 90m between TR and work area outlet cannot be attained a second TR might be required per floor. These rooms will not be shared with other physical plant systems. In most cases, each TR will house active equipment and will meet all ER specifications.

A TR provides the connection point between the building backbone and horizontal distribution pathways.

The TRs must be stacked above each other on each floor. If rooms are not stacked, the TR shall have a means to access the TR's on the floor above and below via metal conduits or sleeves.

The location shall be as close as possible to the center of the floor it is intended to serve. This is to minimize the horizontal cable lengths and the requirement to install additional electronic equipment.

The basic requirements for a TR are:

1. Maximum distance between the TR and a telecommunications outlet is 295 ft. as per the cable pathway.

2. There shall be at least one TR per floor.

3. The basic requirements for an TR are:

<table>
<thead>
<tr>
<th>Minimum Size for Small Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving area of &lt;1,000 sq.ft, wall enclosure</td>
</tr>
<tr>
<td>Serving area of &lt;5,000 sq.ft, 4.5’ X 4.5’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Size for Large Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving area of &lt;5,000 sq.ft, 10’ X 7’</td>
</tr>
<tr>
<td>Serving area of &lt;8,000 sq.ft, 10’ X 9’</td>
</tr>
<tr>
<td>Serving area of &lt;10,000 sq.ft, 10’ X 11’</td>
</tr>
</tbody>
</table>

4. The typical WashU IT ER/TR size is 10’ X 11’ per each floor.

5. Minimum ceiling height is 9’ 6”, with the exposed slab as the ceiling.

6. Provide and install four STI EZPath Series 44 (part # EZD44) sleeves between TRs located on different floors. One 4” conduit shall be installed between TRs located on the same floor. Location of conduits, cable trays, and sleeves shall be coordinated with WashU IT.

7. Rooms shall have outward swinging, fully opening, and lockable doors that are at least 36 inches in width and 80 inches in height. The door shall be outfitted with the University standard standalone card reader. If the door cannot be outfitted with a card reader, then it must be keyed to match the “MD-81” lock.

8. To avoid dust all exposed concrete, brick, and gypsum board shall be painted or sealed. Carpet is not allowed.
9. Rooms shall have a dedicated HVAC system in order to maintain a positive air pressure to control temperature and humidity. The heat dissipation will be specific to each building, but should be in the range of 750 to 5,000 Btu per equipment rack. Relative humidity should be controlled at 30% to 50%. Temperature should be controlled at 64 to 75 degrees. Condensing units will not be located in the ER/TR.

10. TRs cannot have any water pipes in the room, above the room, or in the floor below the room. If sprinklers are required in ER or TR, install wire cages or other protection to prevent them from being accidentally set off. Sprinkler heads should not be installed directly over active equipment.

11. Provide a building ground wire, with bus bar, to the room. Locate the bus bar at the lower left corner of the plywood backboard. WashU IT will indicate on which backboard to place the bus bar. See Grounding section.

12. Provide a minimum lighting to be equivalent of 540 lux (50 foot-candles) measured 3 feet AFF.

13. Each wall shall have 3/4" X 4' X 8' sheets of A-C fire retardant plywood installed. The plywood shall reach from corner to corner. Install the plywood vertically at 6" AFF and fastened securely with a minimum of five (5) equally spaced fasteners along each vertical edge and one column of five (5) equally spaced fasteners centered on each sheet of plywood. Paint the plywood with two coats of fire retardant low-gloss, light-colored paint. When plywood is painted, the “Fire Rating Stencil and Underwriters Laboratory seal” on the plywood should be taped over and the tape removed after painting, as to clearly display the rating and seal on the plywood.

14. On each wall, except the wall containing the door, install two A/C 20-amp electrical fourplex outlets at 12" AFF. In the larger rooms, 10' X 15' and larger, install three A/C 20 amp electrical fourplex outlets evenly spaced along each wall. See Power section. Install a dedicated 208 volt 30-amp circuit to support a rack mountable UPS with one L6-30 and one L14-30 receptacle. See page 29, #15.

15. Minimum floor loading should be 2.4 kPA (50 lb. /ft²).

16. Install a minimum of three 7' racks with vertical wire managers to support network termination devices and network electronics. The amount of services required to support the building may require more racks to be installed. Fasten the rack(s) to the floor and bond them to the ground bus. Number and location of the racks will be supplied during the project’s design phase.

17. Install ladder rack from the rack(s) to the plywood backboard. Bond the ladder rack(s) to the ground bus. Ladder Rack posts are required every 12” to 16” to support cable bundles. The exact amount is determined by the total length of tray installed in each room. The manufacturer and location will be provided during the design phase of the project.

18. When the TR is also used as a Service and Termination Room and/or an ER, WashU IT will size the room based on the type and amount of services required to support the building. WashU IT will also take into consideration the building’s intended use when determining the size of the TR.

19. Each TR shall contain a smoke/fire sensor as part of the overall building fire alarm system.

20. The Ethernet cables will be terminated in the data rack in patch panels with cable management. CATV will be mounted on a wall mounted swing rack. The specific part numbers of the patch panels, racks, and cable management devices are provided in this document.

21. The room shall be dedicated to Washington University’s voice, network, CATV, & DAS requirements and maintained by Washington University Information and Technology (WashU IT).

22. Install one uninterruptible power supply (UPS) in each TR.

See attached document labeled “Typical Washington University Telecommunications Room Layout”. Pg. 34
COMMUNICATIONS CONDUITS AND INFORMATION OUTLETS

The minimum conduit and outlet specifications for WashU IT’s communication cabling system is as follows:

1. The communication entrance conduit shall consist of at least four (4), four (4) inch conduits run from the nearest existing maintenance hole, hand hole, or tunnel to the Service Entrance and Termination Room of the new facility. At least two 4” conduits will contain (3) 1 ¼” inner ducts. These conduits shall not contain more than two 90-degree bends and will be installed with a minimum of 1/4 inch slope per foot to allow proper water drainage from the ducts. No run of conduit shall exceed 500 feet between hand holes/maintenance holes. New manholes shall contain permanent ladders, pull rings, a grounding system, a sump pit, and a floor drainage system to drain water. New hand holes shall contain, pull rings, grounding system, a sump pit, and a floor drainage system to drain water.

2. Conduit run outdoors for other communication purposes shall be a minimum of one-inch diameter, and be placed with a minimum of 1/4 inch slope per foot to allow proper water drainage from the ducts. No run of conduit shall exceed 500 feet between pull points and contain no more than two 90-degree bends. If pull boxes are installed the conduits shall enter the pull box one foot above the bottom and the pull box shall have a means to drain water from them.

3. The conduits entering from outside of the building shall terminate within 4” after they penetrate the outside wall. Cable tray shall be installed or conduit extended to the TR from the penetration point. A ground wire with a bus bar shall be installed at the location the cable enters the building.

4. A one-inch conduit shall connect the work area outlet to the nearest cable tray or J-hook run. The conduit shall terminate within 4’ of the nearest cable tray or J-hook. The minimum size conduit run from the Telecommunications outlet to the nearest cable tray of J-hook shall be a one-inch EMT conduit.

5. The total length of conduit runs shall not exceed 150 feet in length, with the distance between pull boxes not to exceed 100 feet. Provide pull boxes in readily accessible locations. The installation of pull boxes in the conduit run shall be placed in line with the conduit run such that wire or fiber optic cable can be pulled through the pull box without incurring damage to the cable. No turns or bends of the conduit run are allowed within pull boxes.

6. Conduit installed for payphones, emergency phones and elevator phones shall be ¼” EMT conduit home-runned back to the TR with a pull box after every 180 degree change in direction, elevation change, or every 150 feet. Conduit runs shall not exceed 295 ft. in length. Provide pull boxes in readily accessible locations. The installation of pull boxes in the conduit run shall be placed in line with the conduit run such that wire or fiber optic cable can be pulled through the pull box without incurring damage to the cable. No turns or bends of the conduit run are allowed with pull boxes.

7. No LB type fittings of any size are to be used for communication conduit.

8. No PVC conduit or PVC sleeves are to be used for communication conduit within the confines of a building.

9. Minimum radii for bends shall be 9-1/2 inches for 3/4-inch conduit, 10-1/2 inches for one inch conduit and the equivalent of long radius factory bends for larger sizes. The short radius bends of larger diameter conduit normally installed for electrical installations is not sufficient for communication cabling. Four (4) inch conduits installed for communication cabling will have a minimum of a four-foot radius bend.

10. Label all pull and junction boxes.

11. Provide a nylon pull cord in each empty conduit and run that has a minimum of a 200 LB pulling tension.

12. Conduit installation for communication purposes shall be installed with the probability of fiber optic cable being installed. Pulling tension and minimum bend radius are critical factors for installing usable fiber optic cable as well as category 6 cable.
13. All pathways and cable penetrations are required to use the approved STI fire stopping methodology.

COMMUNICATIONS PATHWAYS SPECIFICATIONS

The standards adopted by Washington University provide for a clear and accessible pathway for telecommunications horizontal cabling. These pathways are located between the TRs and the rooms containing the telecommunications outlets. The Architect and the Mechanical/Electrical/Plumbing consultants shall prepare drawings and specifications that insure a clear and accessible pathway for telecommunications wiring. Any pathway that is not accessible and/or does not provide a clear and workable pathway will be removed and reinstalled.

There are several methods available for providing a pathway that supports telecommunications cables. The architectural design of each building is unique and requires an analysis of which method(s) are best suited for that building. At WU, J-Hooks and cable trays are the preferred pathway method. All pathways and spaces must adhere to current ANSI/TIA-569-B. Both pathway types are listed below.

1. Cable Trays - The cable tray shall be installed in accordance with the applicable electrical code. The cable tray is for the dedicated use by WashU IT. No other cabling shall share the cable tray. Cable Tray must be installed with 12” of vertical space above the tray and with a minimum of 3” between the tray and finished ceiling.

2. J-Hooks - The model to use will be determined by the number of cables in that pathway. No other cabling is to share the J-Hooks with WashU IT cabling. J-Hooks must be located on 4’ to 5’ centers to adequately support and distribute the cables weight.

PER FLOOR TELECOMMUNICATIONS WIRING SYSTEMS

Proper installation and the physical protection of the telecommunications cable is a very critical element necessary to the cable’s ability to deliver its rated bandwidth. A "kink", "pinch", a bend radius less than 1.25 inches in diameter, or stretching of the cable by exceeding the 25 pound maximum pulling tension during installation will damage the cable to the point that it will not meet rated specifications and have to be replaced. Telecommunications cable termination standards requires that no more than the minimum amount of the common sheath be removed then is required for the termination, and no more than 1/2 inch of untwisted conductors. Installation personnel shall be BICSI certified installers or equivalent and able to provide proof of certification.

At WashU IT the minimum wiring system specification varies by building function and type. An addendum to the “Per Floor Telecommunications Wiring Systems” section will be attached separately.

All telecommunications wiring systems must adhere fully to the latest applicable to the current ANSI/TIA Telecommunications Building Wiring Standards (ANSI/TIA-568B.1, B.2, B.3-1, and 569B):

1. The cable run from the TR to the work area outlet will not exceed 90m and will contain no splices.

2. All fiber optic cable will be installed in inner duct or armored rated cable.

3. At the user end of the cables, above the ceiling, there shall be 24” of slack after termination to facilitate future re-terminations.

4. Each cable will be labeled on each end with a Telecommunications outlet number. The Telecom room patch panel will contain the floor number and the cable’s sequence number (start with 1 and number sequentially). The User end outlet will follow the labeling standards found on pg. 28. Each voice and network cable itself will be labeled with the four digit ID.
5. The installation of the data and voice cables shall conform to the following clearances:
   a. At least 127 millimeters (5 inches) from power lines carrying 2KVA or less
   b. At least 305 millimeters (12 inches) from power lines carrying from 2 to 5KVA
   c. At least 915 millimeters (36 inches) from power lines carrying more than 5KVA
   d. At least 127 millimeters (5 inches) from all fluorescent lights and other sources of electromagnetic interference such as electric motors, HVAC equipment, arc welders, intercoms, etc.

BUILDING RISER SPECIFICATIONS

Twisted pair riser cables, fiber optic riser, and CATV Coax broadband riser cable, shall be installed from the EF to individual floor TRs.

The minimum specifications for this riser system is as follows:

1. Install two (2) 25-pair category 5 plenum rated cables totaling 50 pair to be terminated on Siemens 66-blocks and on Homaco frames at the EF and at each individual floor’s TR.

2. Install one armored composite cable with 12-pair (24 strand) 50/125 (OM4) micron multimode fiber and 12-pair (24 strands) single mode fibers terminated with LC type connectors in a rack mounted box.

3. Install a minimum of four (4) RG-6 Quad Shield coaxial cables from the EF to individual floor TRs.

GROUNDING AND LIGHTNING PROTECTION

Each EF, ER and the TR shall have a bus bar installed and bonded to ground as per the requirements of Telecommunications Industry Association standard ANSI-J-STD-607-A Grounding and Bonding Standard as follows:

1. An insulated copper ground wire shall be run from the building main electrical ground bus to the EF bus bar with no splices or connections other than the designated end points or conduit bonds if run in metal conduit.

2. An insulated copper ground wire shall be run from the EF bus bar to the ER bus bar and the ground bus bar in each TR. This ground wire shall be sized based on the cable size of the main electrical feed and the cable should be one continuous cable containing no splices. In the intermediate closets, the ground bus shall be connected to this cable with "H tap" connection.

3. If there is more than one closet riser in a building, each closet riser shall have the same ground system installed as stated in the previous paragraph. In addition, an insulated ground equalizer copper equipment ground shall be run to connect together the ground buses of each top floor closet and every third floor closet in between.

4. The routing path of this ground should be as direct as possible.

5. The minimum conductor size for this ground shall be a number 3 AWG insulated.

6. All racks and building entrance terminals shall be bonded to ground.

7. If this ground conductor passes through metal conduit or metal enclosures greater than three feet in length, each end of the conduit or enclosure shall be bonded to the ground conductor by approved means.

8. Each grounding plan shall be tested using a Two-Point Test Method, and the ohmic value shall be less than 0.1 ohm to be considered to have an adequate bonding between the two reference points.
LIFE SAFETY AND BUILDING AUTOMATION SYSTEMS

The Life Safety and Building Automation Systems typically consist of fire alarm, security and access control, heating, ventilating, and air conditioning, as well as energy management systems. The following outlines the installation of the services applicable to Washington University. It would also include the installation of the USN Network, which is comprised of specified network equipment.

1. Fire Alarm - Install one category 6 cable from fire alarm panel to a Siemon 66-block in the closest TR.

2. Security and Access Control - Install one category 6 cable from security panel to network patch panel in the closest TR.

3. Security loops - Install one category 6 cable from the security panel to the device that needs to be secured, such as AV equipment if requested. Multiple devices within the room can be daisy chained to this homerun cable.

4. Indoor or Entrance Emergency Phones - Install one category 6 cable from phone to a Siemon 66-block in the closest TR.

5. Outdoor Emergency Phones - Install one 3-pair category 3 outside plant cable (with lightning protection) from phone to Siemon 66-block in the closest TR.

6. Elevator Phones - Install one category 6 cable from each elevator controller to a Siemon 66-block in the closest TR.

7. Laundry Controllers and Vending Machines - Install one category 6 cable from device location to network patch panel in the closest TR.

ACCEPTANCE TESTING

<table>
<thead>
<tr>
<th>Fiber Optics</th>
<th>Backbone and Horizontal Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fiber backbone cables shall be 100% tested for insertion loss and length</td>
</tr>
<tr>
<td>2</td>
<td>Length shall be tested using an OTDR, optical length test measurement device or sequential cable measurement markings</td>
</tr>
<tr>
<td>3</td>
<td>Insertion loss shall be tested at 850 nm and 1300 nm for 62.5/125 μm and 50/125 μm multimode and 1300 nm or 1550 nm for the appropriate single mode cable in at least one direction using the 1-jumper method</td>
</tr>
<tr>
<td>4</td>
<td>Insertion loss shall be tested at 850 nm and 1300 nm for 62.5/125 μm and 50/125 μm multimode and 1300 nm or 1550 nm for the appropriate single mode cable in at least one direction using the 1-jumper method</td>
</tr>
<tr>
<td>5</td>
<td>All testing must adhere fully to current ANSI/TIA-568-A-4 Annex H, ANSI/TIA-526-14-A, and TSB 140 which requires an OTDR trace for each fiber</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CATV Cabling</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Test all cables with a coaxial cable TDR</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Copper Cabling</th>
<th>Outside Plant and Riser</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Test all cable pairs from the MC/IC to TR or from TR to TR</td>
</tr>
<tr>
<td>2</td>
<td>The system shall be tested for shorts, opens, grounds, crosses, and transpositions</td>
</tr>
</tbody>
</table>
Cable pair defects must be repaired and retested

All repair and/or replacement of defective material and labor shall be done at no cost to Washington University.

All testing must adhere fully to current ANSI/TIA-568.

<table>
<thead>
<tr>
<th>Copper Cabling</th>
<th>Horizontal Cabling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Horizontal cabling lengths must not exceed 90m for the permanent link and 100m for the channel and 100 percent will be tested to current ANSI/TIA-568 using a level III tester with Belden approved test adapters</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Copper Cabling</th>
<th>Security Loops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All cables shall be tested for shorts, opens, grounds, crosses, and transpositions</td>
</tr>
<tr>
<td>2</td>
<td>Complete security loop installation shall consist of a continuity test using white/blue, blue/white at the security panel</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**DELIVERABLES - DOCUMENTS**

1. Cable installation and termination personnel shall be specialists in the Telecommunications systems installation field with at least 5 years’ experience, and must be a Belden or equivalent certified installer.

2. The contractor shall furnish and install all material required, for the installation of communication cable, communication outlets, and terminations of all cable in the EF, ERs, and TRs.

3. The contractor shall test and certify all cables and provide documented test results. The documented test results can be supplied in ASCII format electronically. All Telecommunications cable shall be certified to perform at the speeds referenced in the standard for that cable. If any cable tests defective, the contractor shall repair/replace the defective cable. A Belden warranty shall be included on all cable and hardware installed by the contractor.

4. Contractor to provide “Red Line” drawings at the earliest opportunity. Red Line drawing are drawings marked up in “red” showing line ID locations.

5. Contractor shall provide two copies of “as-built” drawings and an AutoCAD version of the completed project showing cable runs and location numbers assigned to rooms. This shall be provided to WashU IT and Washington University Facilities upon completion. All manufacturer warranties will be transferred at this time. An as-built copy must be left behind in each Telecommunications Room referencing the connections that feed from that particular room.

Note: All outside plant specification are designed on a project to project basis. Please contact WashU IT Network Engineering for further information.
Communication Cabling Specification: Research

Voice/Network/Typical

1. Furnish and install faceplate and modular jacks at each single gang outlet as described below:
   a. One Belden single gang Mediaflex faceplate, sloped with 2 labels and 2 blanks (part # AX106567).
   b. Two Belden Cat 6 jacks, blue, to be designated as stations Network (part # RV6MJKUBL-S1). Each jack is an eight position, eight conductor RJ-45 type.
   c. Provide (part # AX102262) blanks to be in installed in the unused opening.
   d. Note: All boxes are 4" square and a minimum of 2.5" depth (when using single gang faceplate, use a single-gang raised cover on all dual-gang outlet boxes).

2. Furnish, install and terminate the following cables for each outlet as described below:
   a. Two Four-pair category 6, 24 gauge MPP/CMP plenum rated UTP cables to be designated as station network to be wired at wall outlet and TR on (part # RV6MJKUBL-S1) modules using T568B wiring scheme. Terminate at wall outlet per manufactures specification and at the TR end on patch panels (part # AX103115). These cables shall be designated following labeling standards found on Page 28.

Voice/Network/Coax/Fiber/Non-Typical

1. Furnish and install faceplate and modular jacks at each double gang outlet as described below:
   a. One Belden double-gang Mediaflex faceplate, (part # AX106643).
   b. Two Belden Cat 6 jacks, blue, to be designated as stations Network (part # RV6MJKUBL-S1). Each jack is an eight position, eight conductor RJ-45 type.
   c. One Belden F-Type bulkhead modular insert to be designated as stations CATV (part # AX102907). Each module is an Angled module with 1 F-type adapter.
   d. One Belden Duplex fiber optic type LC module to be designated as stations Fiber (part # AX105641-AL). This module is an Angled Duplex OHM4 LC adaptor (2 ports).
   e. One Belden Duplex fiber optic type LC module to be designated as stations Fiber (part # AX102419). This module is an Angled Duplex SM LC adaptor (2 ports).
   f. Provide (part # AX102262) blanks to be in installed in the unused opening.

2. Furnish, install and terminate the following cables for each outlet as described below:
   a. Two Four-pair category 6, 24 gauge MPP/CMP plenum rated UTP cables to be designated as station network to be wired at wall outlet and TR on (part # RV6MJKUBL-S1) modules using T568B wiring scheme. Terminate at wall outlet per manufactures specification and at the TR end on patch panels (part # AX103115). These cables shall be designated following labeling standards found on Page 28.
b. One RG-6 CATV quad-shield plenum rated coaxial cables to be designated as station CATV and
installed onto (part # AX102907) using F-type terminations at wall outlet and inserted into faceplate.
At closet end provide and install (part # AX102907) F-type Flat module inserted into a (part #
AX103115) which will be mounted in a CPI Swing-EZ wall mount rack (part # 11791-725). Any unused
spaces in panel shall have (part # AX102262) blanks installed. Use Belden part # SNS-1P6U CATV
connectors.

c. One 50/125 (OM4) micron two strand plenum rated multi-mode fiber cable to be designated as
station fiber and installed onto (part # AX105641-AL), each strand to be terminated with LC connector
and inserted into module at wall outlet. At the closet end terminate with LC connector and insert
into a Corning (part # CCH-CP06-E4) and insert into a Corning, Fiber Rack Interconnect Center (part #
CCH-03U, size determined by the amount of fiber cables) which will be mounted in 19” rack.

d. One 9 micron two strand plenum rated single-mode fiber cable to be designated as station fiber
and installed onto (part # AX102419), each strand to be terminated with LC connector and inserted into
module at wall outlet. At the closet end terminate with LC connector and insert into a Corning (part #
CCH-CP06-A9) and insert into a Corning, Fiber Rack Interconnect Center (part # CCH-03U, size
determined by the amount of fiber cables) which will be mounted in 19” rack.

Note: Adequate amount of panels shall be provided and installed depending on the amount of Coax station
required in specifications.

Network\Voice

1. Furnish and install faceplate and modular jacks at each single gang outlet as described below:

   a. One Belden single gang Mediaflex faceplate, sloped with 2 labels and 2 blanks (part # AX106567).

   e. Two Belden Cat 6 jacks, blue, to be designated as stations Network (part # RV6MJKUBL-S1).
      Each jack is an eight position, eight conductor RJ-45 type.

2. Furnish, install and terminate the following cables for each outlet as described below.

   a. Two Four-pair category 6, 24 gauge MPP/CMP plenum rated UTP cables to be designated as station
      network to be wired at wall outlet and TR on (part # RV6MJKUBL-S1) modules using T568B wiring scheme.
      Terminate at wall outlet per manufactures specification and at the TR end on patch panels (part # AX103115).
      These cables shall be designated following labeling standards found on Page 28.

Pooled Classroom/Teaching Center/Podium

1. Furnish and install faceplate and modular jacks at each double gang outlet as described below:

   a. One Belden double-gang Mediaflex faceplate, sloped with 2 labels and 2 blanks (part #AX106643).

   b. Four Belden Cat 6 jacks, blue, to be designated as stations Network (part # RV6MJKUBL-S1).
      Each jack is an eight position, eight conductor RJ-45 type.
c. One Belden F-Type bulkhead modular insert to be designated as stations CATV (part # AX102907). Each module is an Angled module with 1 F-type adapter.

d. Two Belden modular jacks, green, to be designated as stations Security Loop (part # AX104192).

2. Furnish, install and terminate the following cables for each outlet as described below:

a. Four Four-pair category 6, 24 gauge MPP/CMP plenum rated UTP cables to be designated as station network to be wired at wall outlet and TR on (part # RV6MJKUBL-S1) modules using T568B wiring scheme. Terminate at wall outlet per manufactures specification and at the TR end on patch panels (part # AX103115). These cables shall be designated following labeling standards found on Page 28.

b. One RG-6 CATV quad-shield plenum rated coaxial cables to be designated as station CATV and installed onto (part # AX102907) using F-type terminations at wall outlet and inserted into faceplate. At closet end, provide and install (part # AX102907) F-type Flat module inserted into a (part # AX103115) which will be mounted in CPI Swing-EZ wall mount rack (part # 11791-725). Any unused spaces in panel shall have (part # AX102262) blanks installed. Use Belden part # SNS-1P6U CATV connectors.

c. One Four-pair category 6, 24 gauge MPP/CMP plenum rated UTP cable to be designated as security loop to be wired at wall outlet on two (part # AX104192). Terminate the White/Blue wire on the first module and the Blue/White wire on the second module, which will terminate on the White/Blue position on each module. Spare the White/Orange, White/Green, & White/Brown pairs around cable. Install cable to the nearest card access panel located within building and leave un-terminated at the panel location. These cables shall be designated following labeling standards found on Page 28.

Note: Adequate amount of panels shall be provided and installed depending on the amount of Coax station required in specifications.

Digital Signage

1. Furnish and install faceplate and modular jacks at each double gang outlet as described below:

a. One Belden double-gang Mediaflex faceplate, (part # AX106643).

b. Two Belden Cat 6 jacks, blue, to be designated as stations Network (part # RV6MJKUBL-S1). Each jack is an eight position, eight conductor RJ-45 type.

c. One Belden F-Type bulkhead modular insert to be designated as stations CATV (part # AX102907). Each module is an Angled module with 1 F-type adapter.

 d. Two Belden modular jacks, green, to be designated as stations Security Loop (part # AX104192).

 e. Provide (part # AX102262) blanks to be in installed in the unused opening.

2. Furnish, install and terminate the following cables for each outlet as described below:

a. Two Four-pair category 6, 24 gauge MPP/CMP plenum rated UTP cables to be designated as station network to be wired at wall outlet and TR on (part # RV6MJKUBL-S1) modules using T568B wiring scheme. Terminate at wall outlet per manufactures specification and at the TR end on patch panels (part # AX103115). These cables shall be designated following labeling standards found on Page 28.

b. One RG-6 CATV quad-shield plenum rated coaxial cables to be designated as station CATV and installed onto (part # AX102907) using F-type terminations at wall outlet and inserted into faceplate. At closet end
provide and install (part # AX102907) F-type Flat module inserted into a (part # AX103115) which will be mounted in CPI Swing-EZ wall mount rack (part # 11791-725). Any unused spaces in panel shall have (part # AX102262) blanks installed. Use Belden part # SNS-1P6U CATV connectors.

c. One Four-pair category 6 24 gauge MPP/CMP plenum rated UTP cable to be designated as security loop to be wired at wall outlet on two (part # AX104192). Terminate the White\Blue wire on the first module and the Blue/White wire on the second module, which will terminate on the White/Blue position on each module. Spare the White/ Orange, White/Green, & White/Brown pairs around cable. Install cable to the nearest card access panel located within building and leave un-terminated at the panel location. These cables shall be designated following labeling standards found on Page 28.

Note: Adequate amount of panels shall be provided and installed depending on the amount of Coax station required in specifications.

3. Furnish and install Siemon # CC-2025-TB-DC and Siemon # SOB-CC frame standoff brackets with Siemon terminal blocks on designated wall in Telecommunications Room for termination of voice riser cables. Furnish and install 19" racks, patch panels, horizontal and vertical management for termination of network cables and fiber. Furnish and install wall mount Swing-EZ rack for all CATV cables in Telecommunication Room.

a. Provide Siemon (part # S66M1-50) category 5E split type terminal block for all telephone terminations. Provide Belden (part # AX103115) category 6 patch panels for network terminations.

b. Provide Belden (part # AX103115) keystone type patch panel for CATV terminations.

c. Provide and install a minimum of three 7'x19" CPI (part # 66353-703) equipment racks and adequate amount of CPI (part # 30130-719) horizontal wire management for patching to Switches and Patch Panels on equipment racks. Provide and Install CPI Vertical Wire Managers on both sides of each rack (part # 40096-703) (one on each end and one between each rack). Provide and install a minimum one Geist (part # RCXRN102-102D20ST5-D) and one Geist (part # 2XPRCN062-103-L30TL6) 19" rack mount power strips with surge suppression for power to the electronic equipment.

d. Provide CPI (part # 11791-725) Swing-EZ wall mount rack for CATV terminations.

e. Provide 3/4"UL Classified grade A/C fire-retardant plywood on designated walls for installation of frames. Note: A side out C side to wall.

Note: All cables routed from Telecommunications Room out to wall outlets shall be routed within Telecommunication Room to equipment racks on ladder racking or cable runway, this shall be furnished and installed in a Black Finish. “Waterfalls” shall be used for cables leaving ladder racking into floor mounted racks. The equipment racks have a 12” ladder channel on top to accept runway.
1. Cables at typical and non-typical wall outlets and the terminations in the telecommunication rooms shall be identified and labeled as follows:

<table>
<thead>
<tr>
<th>TYPE</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Typical</td>
<td>2 data drops</td>
</tr>
<tr>
<td>2 Non Typical</td>
<td>2 data drops, 1 CATV coax, 1 fiber (50/125), or single mode</td>
</tr>
<tr>
<td>3 Digital Signage</td>
<td>2 data drops, 1 CATV, 1 security loop</td>
</tr>
<tr>
<td>4 Pooled Classroom</td>
<td>4 data drops, 1 CATV coax, 1 security loop</td>
</tr>
</tbody>
</table>

**Examples**

Two data cables for drops located in Athletic Complex 2nd floor TR in the 32nd and 33rd patch panel locations are labeled as follows:

**ATH-208B-2032**

- ATH= Building code
- 208B= TR room number
- 2032= 32nd data line run on 2nd floor
- 2033= 33rd line run

A single data outlet is labeled as follows:

**ATH-208B-2032**

CATV shall be labeled as follows:

**ATH-208B-2007**

- ATH= Building code
- 208B= TR room number
- 2007= 7th coax cable run to cable TV rack in TR

Security loop cabling shall be labeled as follows:

**ATH-212-203**

- ATH= Building code
- 212= room number where the IStar panel is located
- 203= actual room number where Security Loop is connected

**NOTE:**

*All labeling including fiber will be agreed upon before actual labeling begins.*

2. Patch panels shall be labeled with a corresponding 4 digit cable number.

3. The first location shall end with the number (1) and continue sequentially, labels at wall outlet shall be TIA/EIA-606 compliant.

4. All work shall be ANSI/TIA/EIA-568B.1, B.2, B.3-1 & 569B and NEC and NFP codes compliant and follow local jurisdiction having authority guidelines.

5. All communication TR voice and network terminations shall be on patch panels installed in 19” racks that are permanently mounted to the TR floor.

6. All station cables shall not exceed 90 meters from termination in closet to wall outlet.

7. Voice, network, & security loop cable shall be Belden cat 6 unbonded UTP data cable, blue (part # 4813) Plenum, no substitutions. Coax cable shall be Belden (part# 1189AP 8771000) Plenum, no substitutions.

8. Fiber shall utilize Corning glass, cut sheets will be provided for verification.
9. All of the above mentioned equipment and scope of work shall be properly grounded and bonded per ANSI-J-STD-607-A.

10. Provide Belden (part # C6011090xx), size to be determined upon equipment location and Belden (part #C601109010) Modular patch Cords for use in telecommunications room and at the network wall outlet. The sum of patch cables is determined by the total number of network drops. (one to one relationship)

11. All installed cabling shall be bundled using a black Velcro strap solution throughout the cable run (no tystraps), and shall be supported by either a J-hook, cable hook or cable hanger system solution, no bridle rings). Note: All cable shall be supported and contained using Category 6 Standard mounting devices.

12. In areas where a courtesy wall phone, pay-phone, elevator car modem lines will be installed, only one each category 6 cable per unit will be installed. Terminations at the telecommunication room at outlet shall be terminated on patch panels.

13. Cable trays will be installed in hallways and corridors, and must be a Wash IT approved manufacturer’s cable tray. Route cable tray into room via conduit stubbed out to cable tray or use J-hooks. Routes used must be easily accessible for future use. Within telecommunications rooms, use black finish Hoffman (part # LSS12BLK) ladder rack 12’ wide, black finish with Hoffman retaining post kit (part # LRPB) and elevated using CPI 6” elevation kit (part # 10506-706). Retaining post shall be placed every 16” to 20” along ladder rack.

14. All entrance facility copper, fiber and coax shall be specified separately based upon project size.

15. Provide and install one Liebert Rack-Mount UPS to include the follow in each Telecommunication Room:

<table>
<thead>
<tr>
<th>QTY</th>
<th>PART</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Liebert UPS</td>
<td>GXT4-6000RT208</td>
</tr>
<tr>
<td>1</td>
<td>Liebert Battery Pack</td>
<td>GXT4-144VBATT</td>
</tr>
<tr>
<td>1</td>
<td>Liebert Power Distribution Strip</td>
<td>PD2-003</td>
</tr>
<tr>
<td>1</td>
<td>Liebert Rack Shelf</td>
<td>RS500</td>
</tr>
<tr>
<td>1</td>
<td>Geist PDU</td>
<td>RCXR102-102D20ST5-D</td>
</tr>
<tr>
<td>2 ea.</td>
<td>American Power Conversion (APC)</td>
<td>AP7811</td>
</tr>
</tbody>
</table>

NOTES
The Liebert UPS unit requires one 208 volt 30 amp circuit, with a L14-30 receptacle.
The APC PDU unit requires one 208 volt 30 amp circuit, with a L6-30 receptacle.

16. Contractor shall provide the following CATV equipment list below:

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>QFRF ORR100048/SA</td>
<td>Fiber Receiver</td>
<td>1</td>
</tr>
<tr>
<td>TCE48300310</td>
<td>Single Mode Jumper (SC/APC)</td>
<td>2</td>
</tr>
<tr>
<td>BTL61103040</td>
<td>8 way coax splitter</td>
<td>1</td>
</tr>
<tr>
<td>OEM18100050</td>
<td>24 port splitter</td>
<td>Quantity determined by number of drops</td>
</tr>
<tr>
<td>TFC45400150</td>
<td>3 ft. RG6 patch cord</td>
<td>Quantity determined by number of drops</td>
</tr>
</tbody>
</table>

Buildings with two IDF’s or over 96 connections
| BTL41600285 | Rack Amp | 1 |
| BTL61103040 | 8 way coax splitter | 1 |
Communication Cabling Specification: Residential

Voice/Network/Coax/Typical

1. Furnish and install faceplate and modular jacks at each single gang outlet as described below:
   a. One Belden single gang Mediaflex faceplate, sloped with 2 labels and 2 blanks (part # AX106567).
   b. One Belden Cat 6 jacks, blue, to be designated as stations Network (part# RV6MJKUBL-S1). Each jack is an eight position eight conductor RJ-45 type.
   c. One Belden F-Type bulkhead modular inserts to be designated as stations CATV (part # AX102907). Each module is an Angled module with 1 F-type adapter.
   d. Provide (part # AX102262) blank to be installed in the unused openings.

Note: All boxes are 4” square and a minimum of 2.5” depth (when using single gang faceplate, use a single-gang raised cover on all dual-gang outlet boxes).

1. Furnish, install and terminate the following cables for each outlet as described below:
   a. One Four-pair category 6 24 gauge MPP/CMP plenum rated UTP cables to be designated as station network to be wired at wall outlet on (Part # RV6MJKUBL-S1) modules using T568B wiring scheme. Terminate at wall outlet per manufactures specification and at the TR end on patch panels (Part # AX103115). These cables shall be designated following labeling standards found on Page 28.
   b. One RG-6 CATV quad-shield plenum rated coaxial cables to be designated as station CATV and installed onto (part # AX102907) using F-type terminations at wall outlet and inserted into faceplate. At closet end provide and install (part # AX102907) F-type Flat module inserted into a (part # AX103115) which will be mounted in CPI Swing-EZ wall mount rack (part # 11791-725). Any unused spaces in panel shall have (part # AX102262) blanks installed. Use Belden part # SNS-1P6U CATV connectors.

Voice/Network/Coax/Fiber/Non-Typical

1. Furnish and install faceplate and modular jacks at each double gang outlet as described below:
   a. One Belden double-gang Mediaflex faceplate, (part # AX106643).
   b. One Belden Cat 6 jacks, blue, to be designated as stations Network (part # RV6MJKUBL-S1).
      Each jack is an eight position, eight conductor RJ-45 type.
   c. One Belden F-Type bulkhead modular insert to be designated as stations CATV (part # AX102907).
      Each module is an Angled module with 1 F-type adapter.
   d. One Belden Duplex fiber optic type LC module to be designated as stations Fiber (part # AX105641-AL).
      This module is an Angled Duplex OHM4 LC adaptor (2 ports).
   e. One Belden Duplex fiber optic type LC module to be designated as stations Fiber (part # AX102419).
      This module is an Angled Duplex SM LC adaptor (2 ports).
   f. Provide (part # AX102262) blank to be installed in the unused opening.
2. Furnish, install and terminate the following cables for each outlet as described below:

   a. One RG-6 CATV quad-shield plenum rated coaxial cables to be designated as station CATV and installed onto (part # AX102907) using F-type terminations at wall outlet and inserted into faceplate. At closet end provide and install (part # AX102907) F-type Flat module inserted into a (part # AX103115) which will be mounted in a CPI Swing-EZ wall mount rack (part # 11791-725). Any unused spaces in panel shall have (part # AX102262) blanks installed. Use Belden part # SNS-1P6U CATV connectors.

   b. One 50/125 (OM4) micron two strand plenum rated multi-mode fiber cable to be designated as station fiber and installed onto (part # AX105641-AL), each strand to be terminated with LC connector and inserted into module at wall outlet. At the closet end terminate with LC connector and insert into a Corning (part # CCH-CP06-E4) and insert into a Corning, Fiber Rack Interconnect Center (part # CCH-03U, size determined by the amount of fiber cables) which will be mounted in 19” rack.

   c. One 9 micron two strand plenum rated single-mode fiber cable to be designated as station fiber and installed onto (part # AX102419), each strand to be terminated with LC connector and inserted into module at wall outlet. At the closet end terminate with LC connector and insert into a Corning (part # CCH-CP06-A9) and insert into a Corning, Fiber Rack Interconnect Center (part # CCH-03U, size determined by the amount of fiber cables) which will be mounted in 19” rack.

Note: Adequate amount of panels shall be provided and installed depending on the amount of Coax station required in specifications.

**Network/Voice**

1. Furnish and install faceplate and modular jacks at each single gang outlet as described below:

   a. One Belden single gang Mediaflex faceplate, sloped with 2 labels and 2 blanks (part # AX106567).

   b. Two Belden Cat 6 jacks, blue, to be designated as stations Network (part # RV6MJKUBL-S1). Each jack is an eight position eight conductor RJ-45 type.

   c. Provide (part # AX102262) blank to be in installed in the unused openings.

2. Furnish, install and terminate the following cables for each outlet as described below:

   a. Two Four-pair category 6, 24 gauge MPP/CMP plenum rated UTP cables to be designated as station network to be wired at wall outlet on (part # RV6MJKUBL-S1) modules using T568B wiring scheme. Terminate at wall outlet per manufactures specification and at the TR end on patch panels (part # AX103115). These cables shall be designated following labeling standards found on Page 28.

**Pooled Classroom/Teaching Center/Podium**

1. Furnish and install faceplate and modular jacks at each double gang outlet as described below:

   a. One Belden double gang Max Modular faceplate, (part # AX106643).
b. Four Belden Cat 6 jacks, blue, to be designated as stations Network (part # RV6MJKUBL-S1). Each jack is an eight position eight conductor RJ-45 type.

c. One Belden F-Type bulkhead modular inserts to be designated as stations CATV (part # AX102907). Each module is an Angled module with 1 F-type adapter.

d. Two Belden modular jacks, green, to be designated as stations Security Loop (part # AX104193).

2. Furnish, install and terminate the following cables for each outlet as described below:

a. Four Four-pair category 6, 24 gauge MPP/CMP plenum rated UTP cables to be designated as station network to be wired at wall outlet on (Part # RV6MJKUBL-S1) modules using T568B wiring scheme. Terminate at wall outlet per manufactures specification and at the TR end on patch panels (Part # AX103115). These cables shall be designated following labeling standards found on Page 28.

b. One RG-6 CATV quad-shield plenum rated coaxial cables to be designated as station CATV and installed onto (part # AX102907) using F-type terminations at wall outlet and inserted into faceplate. At closet end provide and install (part # AX102907) F-type Flat module inserted into a (part # AX103115) which will be mounted in CPI Swing-EZ wall mount rack (part # 11791-725). Any unused spaces in panel shall have (part # AX102262) blanks installed. Use Belden part # SNS-1P6U CATV connectors.

c. One Four-pair category 6 24 gauge MPP/CMP plenum rated UTP cable to be designated as security loop wired at wall outlet on two (Part # AX104192). Terminate the White/Blue wire on the first module and the Blue/White wire on the second module, which will terminate on the White/Blue position on each module. Spare the White/ Orange, White/Green, & White/Brown pairs around cable. Install cable to the nearest card access panel located within building and leave un-terminated at the panel location. These cables shall be designated following labeling standards found on Page 28.

Note: Adequate amount of panels shall be provided and installed depending on the amount of Coax station required in specifications.

Digital Signage

1. Furnish and install faceplate and modular jacks at each double gang outlet as described below:

a. One Belden double-gang Mediaflex faceplate, (part # AX106643).

b. Two Belden Cat 6 jacks, blue, to be designated as stations Network (part # RV6MJKUBL-S1). Each jack is an eight position, eight conductor RJ-45 type.

c. One Belden F-Type bulkhead modular insert to be designated as stations CATV (part # AX102907). Each module is an Angled module with 1 F-type adapter.

d. Two Belden modular jacks, green, to be designated as stations Security Loop (part # AX104192).

e. Provide (part # AX102262) blanks to be in installed in the unused opening.

2. Furnish, install and terminate the following cables for each outlet as described below:

a. Two Four-pair category 6, 24 gauge MPP/CMP plenum rated UTP cables to be designated as station network to be wired at wall outlet and TR on (part # RV6MJKUBL-S1) modules using T568B wiring scheme. Terminate at wall outlet per manufactures specification and at the TR end on patch panels (part # AX103115). These cables shall be designated following labeling standards found on Page 28.
b. One RG-6 CATV quad-shield plenum rated coaxial cables to be designated as station CATV and installed onto (part # AX102907) using F-type terminations at wall outlet and inserted into faceplate. At closet end provide and install (part # AX102907) F-type Flat module inserted into a (part # AX103115) which will be mounted in CPI Swing-EZ wall mount rack (part # 11791-725). Any unused spaces in panel shall have (part # AX102262) blanks installed. Use Belden part # SNS-1P6U CATV connectors.

c. One Four-pair category 6 24 gauge MPP/CMP plenum rated UTP cable to be designated as security loop to be wired at wall outlet on two (part # AX104192). Terminate the White/Blue wire on the first module and the Blue/White wire on the second module, which will terminate on the White/Blue position on each module. Spare the White/Orange, White/Green, & White/Brown pairs around cable. Install cable to the nearest card access panel located within building and leave un-terminated at the panel location. These cables shall be designated following labeling standards found on Page 28.

Note: Adequate amount of panels shall be provided and installed depending on the amount of Coax station required in specifications.

3. Furnish and install Siemon # CC-2025-TB-DC and Siemon # SOB-CC frame standoff brackets with Siemon terminal blocks on designated wall in Telecommunications Room for termination of voice riser cables. Furnish and install 19" racks, patch panels, horizontal and vertical management for termination of network cables and fiber. Furnish and install wall mount Swing-EZ rack for all CATV cables in Telecommunication Room.

   a. Provide Siemon (part # S66M1-50) category 5E split type terminal block for all telephone terminations. Provide Belden (part #AX103115) category 6 patch panels for network terminations.

   b. Provide Belden (part #AX103115) keystone type patch panel for CATV terminations.

   c. Provide and install a minimum of three 7'x19" CPI (part # 66353-703) equipment racks and adequate amount of CPI (part # 30130-719) horizontal wire management for patching to Switches and Patch Panels on equipment racks. Provide and Install CPI Vertical Wire Managers on both sides of each rack (part # 40096-703) (one on each end and one between each rack). Provide and install a minimum one Geist (part # RCXRN102-102D20ST5-D) and one Geist (part # 2XPRCN062-103-L30TL6) 19" rack mount power strips with surge suppression for power to the electronic equipment.

   d. Provide CPI (part # 11791-725) Swing-EZ wall mount rack for CATV terminations.

   e. Provide 3/4"UL Classified grade A/C fire-retardant plywood on designated walls for installation of frames. Note: A side out C side to wall.

Note: All cables routed from Telecommunications Room out to wall outlets shall be routed within Telecommunication Room to equipment racks on ladder racking or cable runway, this shall be furnished and installed in a Black Finish. “Waterfalls” shall be used for cables leaving ladder racking into floor mounted racks. The equipment racks have a 12” ladder channel on top to accept runway.
Telecommunication Room Layout
Emergency Phone Specification

Location of Blue Light Phones will be determined by Washington University Campus Police.

Blue Light Phones located outside the building:
- Install a three pair buried outdoor cable (PE 89) from telephone to nearest Telecommunications Room.
- If the distance from the point of entry to the nearest Telecommunications Room is more than 50ft., transition to indoor rated cable.

Blue Light Phones located on or within a building:
- Install a cat 6 voice cable from phone to nearest Telecommunications Room and terminated on 66 blocks.

Install lightning protection within building and surge suppression at phone.

Telephone cable and electric must be run in two separate one inch conduits.

Ramtel PLC-8 Stanchion (midnight blue) is to be used at all locations that are that NOT attached to buildings.
Note: This replaces the 4” galvanized pole.

Part # for Ramtel Phones

RR733 (One button emergency phone with enclosure, no door).
800-1018 (Surge suppression at blue light)
Two palm button

RR734 (One bottom emergency phone with keypad and enclosure, no door)
(Building Entrance Phones)
800-1018 (Surge suppression at blue light)
Two palm button

Contact for purchase of phones:
Ramtel Corporation
115 Railroad Av.
Johnston, RI. 02919
Tel. # 401-231-3340

All phones must have the Washington University silk screening, two inch palm button, and surge suppression.
**NO** substitutions of manufacturers or part numbers.
Ramtel Phone Examples

Ramtel Single Button Phone – RR733
Stanchion – PLC-8

Building Entrance Phones
Ramtel Single Button with Key Pad Phone – RR734
## Washington University List of Qualified Communications Contractors

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Contact</th>
<th>Phone</th>
<th>Fax</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sachs Systems</td>
<td>Kris Huels</td>
<td>636-532-2000</td>
<td>636-532-0065</td>
<td><a href="mailto:khuels@sachsco.com">khuels@sachsco.com</a></td>
</tr>
<tr>
<td>Geco Systems</td>
<td>Gary Julius</td>
<td>314-773-1111</td>
<td>314-771-2688</td>
<td><a href="mailto:gary.julius@Geco.com">gary.julius@Geco.com</a></td>
</tr>
<tr>
<td>TSI (Telecom Services Installations, Inc.)</td>
<td>Joe Straatmann</td>
<td>636-949-8889</td>
<td>636-925-2111</td>
<td><a href="mailto:jstraatmann@tsi-global.com">jstraatmann@tsi-global.com</a></td>
</tr>
<tr>
<td>PayneCrest</td>
<td>Mark Kettler</td>
<td>314-952-8611</td>
<td>314-996-0463</td>
<td><a href="mailto:MKettler@paynecrest.com">MKettler@paynecrest.com</a></td>
</tr>
<tr>
<td>Bell Communications</td>
<td>Chad Colvin</td>
<td>314-447-9046</td>
<td>314-739-0717</td>
<td><a href="mailto:chad.colvin@bellelectrical.com">chad.colvin@bellelectrical.com</a></td>
</tr>
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**Communications Projects Under $25,000 add the following Contractors:**

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Contact</th>
<th>Phone</th>
<th>Fax</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>TeleWiring, Inc.</td>
<td>Richard Longland</td>
<td>314-426-5005</td>
<td>314-426-5015</td>
<td><a href="mailto:richl@telewiring.com">richl@telewiring.com</a></td>
</tr>
<tr>
<td></td>
<td><strong>Ext. 102</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>TD4 Electrical (MBE)</td>
<td>Tom Endermuhle</td>
<td>314-655-9846</td>
<td>314-772-5813</td>
<td><a href="mailto:tendermuhle@td4llc.com">tendermuhle@td4llc.com</a></td>
</tr>
<tr>
<td>Master Communications, Inc. (WBE)</td>
<td>Dan Enright,</td>
<td>314-215-4110</td>
<td>636-779-1199</td>
<td><a href="mailto:danenright@mastercomminc.com">danenright@mastercomminc.com</a></td>
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</table>
## Siemon\Belden Parts Cross Reference

<table>
<thead>
<tr>
<th>Description</th>
<th>MFG</th>
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<tbody>
<tr>
<td><strong>Copper</strong></td>
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<tr>
<td>UTP Patch Panels</td>
<td>Siemon</td>
</tr>
<tr>
<td>24 port- HD6-24</td>
<td>Belden</td>
</tr>
<tr>
<td>AX103114</td>
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</tr>
<tr>
<td>48 port- HD6-48</td>
<td>AX103115</td>
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<tr>
<td><strong>Modular Cat 6 Patch Cables</strong></td>
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<tr>
<td>2'-MC6-02-02</td>
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<tr>
<td>3'-MC6-03-02</td>
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<td>4 port-MX-FP-S-04-02</td>
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<tr>
<td>4 port- AX106567</td>
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<td>8 port-MX-FP-S-08-02</td>
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<td>CAT6 UTP modules</td>
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<td>MX6-02</td>
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<tr>
<td>RV6MJKUBL-S1</td>
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<tr>
<td>Blank Insert</td>
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<td>M Series S66 Blocks</td>
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Network Infrastructure Components - Danforth Campus
To be used on all new and major renovations.

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<th>MFG</th>
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<th>PART #</th>
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<tr>
<td>COPPER</td>
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<tr>
<td>Belden</td>
<td>MediaFlex KeyConnect Single-Gang Faceplate</td>
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<td>Belden</td>
<td>MediaFlex KeyConnect Double-Gang Faceplate</td>
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<td>Belden</td>
<td>REVConnect CAT6+ UTP Modular Jack</td>
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<td>Belden</td>
<td>CAT6+ Modular Jack, Green</td>
<td>AX104192</td>
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<td>Belden</td>
<td>KeyConnect Blank Insert</td>
<td>AX102262</td>
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<td>Belden</td>
<td>KeyConnect Patch Panel, 48-port, 2U, Black</td>
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<tr>
<td>Belden</td>
<td>CAT6+ Modular Patch Cord- 2’</td>
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<td>Belden</td>
<td>CAT6+ Modular Patch Cord- 3’</td>
<td>C601109003</td>
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<td>CAT6+ Modular Patch Cord- 4’</td>
<td>C601109004</td>
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<td>CAT6+ Modular Patch Cord- 5’</td>
<td>C601109005</td>
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<td>CAT6+ Modular Patch Cord- 6’</td>
<td>C601109006</td>
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<td>CAT6+ Modular Patch Cord- 7’</td>
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<td>CAT6+ Modular Patch Cord- 10’</td>
<td>C601109010</td>
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<td>Belden</td>
<td>Category 6 Non-bonded-Pair Cable</td>
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<td>Belden</td>
<td>KeyConnect LC Duplex Module Multimode</td>
<td>AX10564-AL</td>
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<td>Belden</td>
<td>KeyConnect LC Duplex Module Singlemode</td>
<td>AX102419</td>
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<td>Corning</td>
<td>Closet Connector Housing, 3 RU</td>
<td>CCH-03U</td>
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<tr>
<td>Corning</td>
<td>CCH Panel, LC Duplex, 6 F, Multimode</td>
<td>CCH-CP06-E4</td>
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<td>CCH Panel, LC Duplex, 6 F, Single-mode</td>
<td>CCH-CP06-A9</td>
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<td>Belden</td>
<td>KeyConnect Video F Coax, Surface</td>
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<td>Belden</td>
<td>Snap-N-Seal &quot;F&quot; Series Compression Connector</td>
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<td>Belden</td>
<td>Coax - Broadband CATV Coaxial Cable</td>
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<td>CPI</td>
<td>Swing Gate Wall Rack</td>
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<td>Telecom Room</td>
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<td>CPI</td>
<td>Standard 2 post Rack; 19&quot;W x 7'H x 6&quot;D; Black</td>
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<td>CPI</td>
<td>Cable Manager, Horizontal, Single-Sided, Universal, 2 RU</td>
<td>30130-719</td>
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<tr>
<td>CPI</td>
<td>Cable Manager, w/ Extended Fingers, Double Sided, Black</td>
<td>40096-703</td>
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<tr>
<td>CPI</td>
<td>Cable Runway Rack Elevation Kit, 6” High</td>
<td>10506-706</td>
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<tr>
<td>Hoffman</td>
<td>Ladder Rack Straight Section, 12&quot;W, Black</td>
<td>LSS12BLK</td>
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<tr>
<td>Hoffman</td>
<td>Stringer Radius Drop Kit- &quot;Waterfall&quot;, Black</td>
<td>LSRDBLK</td>
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<tr>
<td>Hoffman</td>
<td>Cable Retaining Post Kit; Black</td>
<td>LRPB</td>
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Network Infrastructure Legacy Components – Danforth Campus
To be used for existing and minor renovations.

<table>
<thead>
<tr>
<th>MFG</th>
<th>DESCRIPTION</th>
<th>PART #</th>
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<tbody>
<tr>
<td>Copper</td>
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</tbody>
</table>
| Siemons | HD 6 UTP Patch Panels | • 16 Port - HD6-16  
• 24 Port - HD6-24  
• 48 Port - HD6-48  
• 96 Port - HD6-96 |
| Siemons | MC 6 UTPO Modular Cat 6 Patch Cables | • 3’ - MC6-03-02  
• 5’ - MC6-05-02  
• 7’ - MC6-07-02  
• 10’ - MC6-10-02  
• 15’ - MC6-10-02  
• 25’ - MC6-25-02 |
| Siemons | MAX Faceplates Single Gang | • 1 Port - MX-FP-S-01-02  
• 2 Port - MX-FP-S-02-02  
• 3 Port - MX-FP-S-03-02  
• 4 Port - MX-FP-S-04-02  
• 6 Port - MX-FP-S-06-02 |
| Siemons | MAX Faceplates Double Gang | • 6 Port - MX-FP-06-02  
• 8 Port - MX-FP-08-02  
• 12 Port - MX-FP-12-02 |
| Siemons | MAX 6 UTP Modules | • Angled – MX6-02  
• Flat – MX6-F02 |
| Telephone | | |
| Siemons | M Series S66 Blocks | • S66M1-50 |
| Siemons | Cross-Connect Frames | • CC-2025-TS-DC |
| Fiber | | |
| Siemons | Fiber Rack Mount Interconnect Center (RIC3) | • RIC3-24-01 (2U)  
• RIC3-24-01 (2U)  
• RIC3-24-01 (3U)  
• RIC3-24-01 (4U) |
| Siemons | Fiber Wall Mount Interconnect Center (SWIC3) | • SWIC3G-AA-01 |
| CATV | | |
| Siemons | Optical Rackmount Receiver | • ORR1000-48-SA-DFB |
Revision History

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
<th>Change and Reason For Changes</th>
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<tbody>
<tr>
<td>Modifications from Media Services</td>
<td>12/01/2015</td>
<td>page 4 - added 50 um fiber to first bullet point – added “No voice line if VOIP”&lt;br&gt;page 5, 6, 7 – Changed “Related documents to add URL and WashU IT contact information updated”&lt;br&gt;page 14, 20, 22 – changed from TIA/EIA to ANSI/TIA&lt;br&gt;page 15 – Added “The room shall be dedicated to Washington University’s voice, network, CATV, &amp; DAS requirements and will be administered by Network Engineering within Washington University Information Technology” and approved fiber manufacturer is now Corning NOT Siecor&lt;br&gt;page 16 - #10 – All walls shall have plywood&lt;br&gt;page 16 - #11 – Referenced UPS Specifications&lt;br&gt;page 16 - #13 – Changed to a minimum of 3 racks&lt;br&gt;page 17 - #8 – Removed tile floors&lt;br&gt;page 18 - #13 – All walls shall have plywood&lt;br&gt;page 18 - #14 – References UPS specifications&lt;br&gt;page 19 - #12 – Changed to category 6 cable and #20 “if voice cables are to be installed instead of VOIP.”&lt;br&gt;page 19 - #3 – Changed the slack from “in the receptacle box” to “above the ceiling”&lt;br&gt;page 22 - #3 – Added “Multiple devices within the room can be daisy chained to this homerun cable&lt;br&gt;page 22 – Added “Copper cabling- Security Loops&lt;br&gt;page 30, 36 - number 13 – change UPS from APC to Liebert and updated grounding standard page 40 – added Payne Crest as a qualified contractor</td>
</tr>
<tr>
<td>Terri Carr</td>
<td>04/01/2016</td>
<td>Page 1 - Added Standard Title Page &amp; Index Sheet&lt;br&gt;Page 8 – 13 Added WashU IT Media Service AV Standards&lt;br&gt;ADJUSTED SPECIFICATIONS FOR VoIP&lt;br&gt;Removed From Categories&lt;br&gt;Telecommunications Room (TR)&lt;br&gt;• #20 – The Voice Cables will be terminated on wall mounted racks (if voice cables are to be installed instead of VoIP)&lt;br&gt;Building Riser Specifications&lt;br&gt;• #1 install 2 (2) 25-pair &amp; 50 pair to be terminated&lt;br&gt;Communication Cabling Specification: Research&lt;br&gt;Communication Cabling Specification: Residential&lt;br&gt;• Deleted&lt;br&gt;• Voice/Network/Typical&lt;br&gt;• Voice/Network/Coax/Fiber/Non-Typical&lt;br&gt;• One Siemon modular jack to be designated as stations Voice (part # MX-U3-02). Each module is an angled two pair-six position jack. Provide the icon and place in designated area on modules (part # CT-ICON-03).&lt;br&gt;• One Four-pair category 6 24 gauge MPP/CMP plenum rated UTP cable to be designated as station voice to be wired at wall outlet on (MX-U3-02) modules using USOC six wire wiring scheme. Terminate the White/Blue &amp; White/Orange pairs at outlet onto modules and spare the White/Green &amp; White/Brown pairs around cable. Terminate all pairs at closet end on Siemon category 5E S66M1-50 blocks. These cables shall be designated as V1 along with the outlet number assigned. Place the red voice icon furnished with mod in the designated area on jack.</td>
</tr>
</tbody>
</table>
Voice Only

- Furnish and install faceplate and modular jacks at each single gang outlet as described below:
  - One Siemon single gang Max Modular Faceplate (part # MX-FP-S-01-02).
  - One Siemon modular jacks to be designated as stations Voice (part # MX-U3-02). Each module is an angled two pair six position jack. Provide the icon and place in designated area on modules (part # CT-ICON-03).

- Furnish, install and terminate the following cables for each outlet as described below:
  - One Four-pair category 6 24 gauge MPP/CMP plenum rated UTP cables to be designated as station voice to be wired at wall outlet on (MX-U3-02) modules using USOC six wire wiring scheme. Terminate the White/Blue & White/Orange pairs at outlet onto modules and spare the White/Green & White/Brown pairs around cable and terminate all pairs at closet end on Siemon category 5E S66M1-50 blocks. These cables shall be designated as V1 along with the outlet number assigned. Place the red voice icon furnished with mod in the designated area on jack.

Pooled Classroom/Teaching Center/Podium

- One Siemon modular jack to be designated as stations Voice (part # MX-U3-02). Each module is an angled two pair six position jack. Provide the icon and place in designated area on modules (part # CT-ICON-03).

Labeling Standards

- V1 – First telephone (or voice) cable at a given outlet.

Major Component updates-

- Replaced Mohawk/Siemon connectivity with Belden/Belden solution.
- Replace Siemon Racks with CPI racking system.
- Updated Standards Contact information to Lee Rouse.