16750 INFRASTRUCTURE AND CABLE PLANT DESIGN CRITERIA

0.1 INFRASTRUCTURE: QUESTIONS TO ASK DURING DESIGN

The following list of questions, covering the functional groups covered within, is intended as a guideline to assist the A&E in completing the infrastructure design for this Project.

0.1.1 Outside Plant

Outside Plant consists of backbone pathways that interconnect buildings on campus and carry non-UW vendor cable to the campus.

- ❑ 1. What is the layout and quantity of outside plant pathways needed?
- ❑ 2. Have pathways been provided for non-UW vendors to the Router Room?
- ❑ 3. Is there any synergy in connecting to other facilities as part of this Project?

0.1.2 Router Room (RR)

The Router Room functions as the intra-building interconnection point for the campus voice, data, multimedia systems and non-UW service provider network.

- ❑ 1. Is a RR required as part of this project?
- ❑ 2. Is the RR properly sized with adequate pathways within the Room and outside the Room to other facilities?
- ❑ 3. Is the RR accessible without stairs?
- ❑ 4. Has C&C space been secured for non-UW vendor space?
- ❑ 5. As a minimum, have criteria addressed under 0.1.3 (MDF Rooms) been met for the RR?
- ❑ 6. Has C&C been contacted to identify all the components specific to the RR build-out?

0.1.3 Main Distribution Frame (MDF) Room

The MDF Room functions as the interconnection point between the building's internal systems and the communications services entering from the campus tunnel system. The MDF Room is reserved exclusively for the communications utility.

- ❑ 1. Where in the core will the MDF Room have best access both to the campus utility tunnel system and the base of the vertical riser?
- ❑ 2. Has access been provided from a public hallway?

- ❑ 3. Has the MDF Room been sized and proportioned correctly to accommodate connections to the service provider's infrastructure as well as C&C's high-speed computer, voice, and multimedia networks?
- ❑ 4. Will there be assignable space on this floor?
- ❑ 5. Is there adequate floor and wall space to support equipment and electronics?
- ❑ 6. Do sufficient conduits, sleeves, and tray connect the MDF Room to the tunnel system entrance and the base of the riser?
- ❑ 7. Has the MDF Room been provisioned adequately in terms of door placement, core drills, and other required elements?
- ❑ 8. Has campus-wide communications master keying been specified?
- ❑ 9. Have sufficient power outlets and lighting levels been included?
- ❑ 10. Has a separate communications grounding system been provided?
- ❑ 11. Is the MDF Room environmentally secure and clean?
- ❑ 12. Have HVAC requirements been addressed so that 64-78F degrees and maximum 30-55% RH can be maintained?

0.1.4 Intermediate Distribution Frame (IDF) Rooms and Riser System

The IDF Room functions as the cross-connection point between the cable plant in the vertical riser system and the station cables to the individual outlet locations. Regularly the electronic equipment is housed here. These IDF Rooms are reserved exclusively for communications services.

- ❑ 1. How many IDF Rooms are required for each floor?
  a) Does this location meet the maximum 295-foot (90-meter) distance requirement to any given outlet or will additional IDF's be required on the same floor?
  b) Does functionality and/or square footage of the floor mandate enlarging the IDF?
- ❑ 2. Which IDF Room type best meets the minimum size requirements specified?
- ❑ 3. Where in the core area will the IDF Rooms stack vertically?
- ❑ 4. Has the space been proportioned to accommodate the needs of voice/data/multimedia networks?

- ❑ 5. Has access been provided from a public hallway?
- ❑ 6. Has the formula for riser sleeves been applied?
- ❑ 7. Has riser stack been extended to the roof with dedicated power provided?
- ❑ 8. Has a schedule of the riser sleeve assignment for each floor been included on the drawings?
- ❑ 9. Has the IDF Room been provisioned adequately in terms of door placement, core drills, and other required elements?
- ❑ 10. Has campus-wide communications master keying been specified?
- ❑ 11. Have sufficient power outlets and lighting levels been included?
- ❑ 12. What active/passive systems have been provided to ensure maintenance of 64-75 degrees F. and no more than 30-55% RH?

0.1.5 Horizontal Distribution System

Tray provides a common path for cable that becomes cost effective when replacing 3+ runs of conduit from the outlet to the IDF or MDF Room.

- ❑ 1. Has tray been sized based on the rule of thumb of one 1 volumetric sq.in. either per 100 ASF or per maximum outlets possible in a room, whichever is greater?
- ❑ 2. Has extra tray capacity been added for potential bottlenecks created by complex interconnects with high-technology spaces, departmental inter-room routes, non-C&C low-voltage cable, and CATV drop locations?
- ❑ 3. Where separate sections of tray converge, has the main tray been sized up to accommodate the cable from multiple trays?
- ❑ 4. Has separate infrastructure been provided for horizontal riser tie paths vs. horizontal station drop paths?
- ❑ 5. Has necessary access been provided where ceiling is solid or space is restricted or crowded?
- ❑ 6. Is mounting of cable tray specified to meet required vertical and horizontal clearances?
- ❑ 7. Have conduit and firestopping been provided through fire-rated partitions?
- ❑ 8. Is grounding continuous per NEC?

0.1.6 Station Conduit and Communications Outlets

The use of numbered outlets and an Outlet Schedule to help organize the review and future management of these locations reduces the time necessary to review submittals and facilitates discussion of specific outlet locations during design, construction, installation, and service activation.

- ❑ 1. How many outlets are there per room?
- ❑ 2. Is there at least one standard outlet in rooms wrapped with SMR?
- ❑ 3. Is there a wall phone outlet in public use rooms (e.g. computer labs)?
- ❑ 4. Are there any public pay phone locations?
- ❑ 5. Are there any Code Blue phone locations?
- ❑ 6. Have outlets been located for public areas such as elevators, loading docks, ADA safe havens, front door access, data outlet locations in hallways, etc?
- ❑ 7. Do the Plans and Outlet Schedule reflect the Owner-assigned room numbers upon occupancy?
- ❑ 8. Is raceway capacity-fill below the 40% allowable?
- ❑ 9. What routing will the conduit take to the tray and/or IDF Room?
- ❑ 10. Are conduit/SMR paths dedicated and unrestricted?
- ❑ 11. Have co-located electrical outlets been provided?
- ❑ 12. Have dedicated circuits been identified?
- ❑ 13. Have dedicated power requirements for technology spaces been addressed?
- ❑ 14. Has C&C been contacted to determine whether the UW will maintain and monitor elevator phones?
- ❑ 15. Are there out-of-phase building components to install which support temporary occupancy, elevator inspection, building controls, etc.?
- ❑ 16. Has Owner installed supporting cable plant/service (see 15 above) been coordinated?
- ❑ 17. Is there a need for wireless system component?

0.2 CABLE PLANT: QUESTIONS TO ASK DURING DESIGN

The following list of questions, covering the functional groups covered within, is intended as a guideline to assist the A&E in completing the Cable Plant design for this Project.

0.2.1 General

- ❑ 1. Will Cable Plant documents be included with the infrastructure or addressed separately at a later date?
- ❑ 2. Has A&E determined client needs in concert with C&C for voice, data, and multimedia services?
- ❑ 3. Do the Plans and Outlet Schedule reflect the actual University room numbers upon occupancy?
- ❑ 4. Have appropriate columns been added to Outlet Schedule and filled-in?
- ❑ 5. Has a line item been included in the Cable Plant time schedule for C&C-required live-service lead-time prior to move-in date?

0.2.2 Outside Plant Cable Requirements

- ❑ 1. Will any service provider work be required?
- ❑ 2. Will C&C work be required?
- ❑ 3. Has C&C been contacted to identify all the components specific to the Router Room/MDF build-out?

0.2.3 Riser Cable

- ❑ 1. Have risers been designed for voice, data, and multimedia services?
- ❑ 2. Have risers been sized to reflect maximum Project area potential?
- ❑ 3. Has a separate twisted-pair voice riser been calculated?
- ❑ 4. Has voice riser cable count been rounded-up to nearest 100-pair cable?
- ❑ 5. Has a separate data riser been designed?
- ❑ 6. What kind of riser will be used for cable TV service?
- ❑ 7. Do the documents indicate type and extent of innerducts for optical fiber cables?

- ❑ 8. Has a CATV system design been engineered?
- ❑ 9. Has firestopping been addressed?
- ❑ 10. Have the cable listings designated by the NEC been applied properly? Have they been indicated on risers?
- ❑ 11. Have Riser Room elevations been labeled "**For bid purposes only. To be coordinated in the field with C&C for actual locations."**

0.2.4 Station Cable

- ❑ 1. What is the standard bundle for this Project?
- ❑ 2. Are there additional needs for special wiring (automated systems, wireless, etc)?
- ❑ 3. Have locations been determined for modified standard bundle (e.g., wall phones, elevator phones, ADA safe-haven phones, loading dock phones, pay phones)?
- ❑ 4. Have multiple-outlets required by landscape furniture been addressed?
- ❑ 5. Have C&C-managed outlet needs been reflected on the Outlet Schedule?
- ❑ 6. Has a multimedia outlet schedule been created?
- ❑ 7. Has firestopping been addressed?

0.2.5 Termination Hardware

- ❑ 1. Do the MDF/IDF Room elevations show assignment of backboard space as well as general hardware and cable route layout?
- ❑ 2. Has labeling been addressed?

0.2.6 Outlet Devices and Configuration

- ❑ 1. Which of the standard outlet devices are required for this Project?

Part 1 INFRASTRUCTURE DESIGN CRITERIA

1.1 The Basic Model

1.1.1 Major Components

The infrastructure design for University projects consists of five major components

- Outside Plant Infrastructure
- Router Room
- MDF/IDF Rooms and Riser System
- Horizontal Distribution System -- Cable Tray and Conduit
- Station Distribution System -- Horizontal Pathway and Outlets

The communications infrastructure design standards have been formulated to be independent of cable plant details.

1.1.2 The design standards for the infrastructure system are described below. Detailed installation specifications are contained in **Section 16751**. Specific pages from the reference drawings (**SD-CM-1** through **SD-CM-52**) are cited at the end of some applicable paragraphs.

1.2 General Planning Considerations

1.2.1 The communications infrastructure design can be reasonably determined before the number of actual offices and communications outlets is known. This can be accomplished by using the assignable square footage (ASF) of the building as a benchmark.

1.2.2 The ASF is the sum of all areas on all floors of a building assigned to, or available for assignment to, an occupant or use. Space defined as building service, circulation, mechanical, or structural is excluded.

1.2.3 Formula for Planning and **ESTIMATED BUDGETARY** Purposes: Estimate the maximum number of outlets that must be supported if all assignable space was remodeled to contain nothing but high-density office space. Use 100 ASF as a standard office size for this calculation. The number of communications outlets to be equal to the total building ASF divided by 100. Initially during the actual design process the criteria for determining number of actual outlets is different.

1.2.4 These actual calculations are applicable at the initial programming phase and for budget purposes only. Contact C&C for specific design requirements based on actual size and functionality of rooms.

1.3 Outside Plant Infrastructure Systems

1.3.1 General

1.3.1.1 Backbone pathways consist of intra- and interbuilding pathways. Backbone pathways may be either vertical or horizontal. Interbuilding backbone pathways (outside plant) extend between buildings. Intrabuilding backbone pathways are contained within a building.

1.3.1.2 Outside plant pathways interconnect separate buildings in campus environments as well as, in some cases, to the property line for connection of service provider. These consist of underground, buried, aerial, and utilidor pathways. When determining the size of the pathway, the quantity and size of cables, with an allowance for growth, shall be considered.

1.3.1.3 During the initial planning stage, all buildings identified on the site plan shall have a fundamental communications design plan developed, regardless of whether service is requested. The communications design plan shall include a pathway design that interconnects buildings. Contact C&C for directions in preparing a plan.

1.3.1.4 Pathway specifications shall accommodate the applicable seismic zone requirements.

1.3.1.5 The integrity of all firestop assemblies shall be maintained when penetrated by cable, wires, and pathways.

1.3.1.6 Discuss appropriateness of wireless component with C&C.

1.3.2 Entrance Considerations

1.3.2.1 The building entrance consists of the communications service entrance to the building, including the entrance point through the building wall, and continuing to the router or MDF room. The entrance may contain the backbone pathways that link to the MDF and to other buildings in campus situations. Antenna entrances, if provided, constitute part of the entrance facility.

1.3.2.2 The University and other service providers involved in providing service to the building shall be contacted to establish their requirements and explore alternatives for delivering space. The location of other utilities, such as electrical, water, gas, and sewer, shall be considered in the site selection of the communications entrance facility.

1.3.2.3 An alternate entrance facility must be provided where security, continuity of service, or other special needs exist.

1.3.3 Outside Plant Pathways

1.3.3.1 Entrance and interbuilding pathways shall be provided. As a minimum, a facility shall be provided for the University communication services. The basic methods for provisioning are underground, buried, aerial, and utilidor pathways.

1.3.3.2 In determining the total number of pathways required, the planner shall consider

- Type and use of building
- Growth
- Difficulty of adding pathways in the future
- Alternate entrance, and
- Type and size of cables likely to be installed

1.3.4 General Considerations for Pathway Types

1.3.4.1 Underground

An underground facility is a component of the interbuilding pathway consisting of conduit, duct, and trough, and may include maintenance and/or handhole(s).

1.3.4.2 Direct buried

1.3.4.2.1 ... A direct-buried facility is a component of the interbuilding pathway where the communications service cables are completely encased in the earth. Direct burial is achieved by trenching, or plowing.

1.3.4.2.2 The route selected shall be coordinated with the landscaping, fencing, trees, paved areas, and other services, and should follow a natural parallel line of sight such as property lines, sidewalks, and driveways. Because of possible fences and shrubbery, a distance of approximately six feet shall be maintained from the property lines.

1.3.4.2.3 The design and installation of other services in a joint-use trench shall be coordinated and shall meet applicable codes.

1.3.4.3 Trenching

When trenching for the installation of direct-buried cable, it is desirable to place conduit or duct in the same trench for possible future use.

1.3.4.4 Aerial

An aerial facility is a component of the interbuilding pathway consisting of poles, cable-support strand, and support system. When contemplating the use of aerial facilities, consider the following list:

- Aesthetics of the building and surrounding location

- Storm loading
- Applicable codes and municipal ordinances
- Clearances and separation for electrical and road
- Mechanical protection
- Span lengths
- Building attachments
- Future cable plant reinforcement
- Number of cables involved

1.3.4.5 Utilidor

Utilidor pathway design will incorporate the following

- Corrosion-resistant pathway and associated hardware shall be used.
- Metal pathways and supports shall be bonded to ground.
- Provide a minimum 5-inch clearance between power and communication tray side-rails and utilidor wall for vertical communication cable pathway.
- Provide two stacked cable trays along utilidor wall below power distribution tray. Communication cable tray shall be 12 inches below power tray and second communication tray shall be a minimum of 10 inches from bottom of tray to top of tray below.

1.3.4.6 Outside plant pathway design considerations

Conduit and duct are available in a variety of types, shapes, and sizes as follows

- Plastic Conduit
  - PVC Type B - a thin-wall plastic requiring concrete encasement.
  - PVC Type C - a heavier walled plastic that can be direct buried.
  - PVC Type D - ultraviolet (sunlight) and flame resistant.
  - Multiple Plastic Duct (MPD) comes in molded formations of 4, 6, and 9 ducts and section lengths of approximately 1 meter (36 inches). MPD can be direct buried but needs special attention depending on soil conditions.
- Steel - a rigid metal conduit made of galvanized steel.
- Fiberglas - a light, rigid, laminated duct.

1.3.4.6.1 Innerduct (also known as subduct) is typically a nonmetallic pathway within a pathway used in compliance with appropriate code to facilitate subsequent placement of additional cable in a single pathway.

1.3.4.6.2 A minimum of two 4-inch pathways, with at least one spare 4-inch pathway, should be considered for each entrance point.

1.3.4.6.3 The conduit shall extend into undisturbed earth and a minimum of 600 mm (24 inches) beyond the exterior of the foundation. When terminated in a pull box, conduit shall be reamed and bushed. When terminated at the inside of the building wall, the conduit shall have a smooth, bell-shaped finish unless it extends further into the building, space, or area. The conduit or sleeve shall be securely fastened to the building.

1.3.4.6.4 Bends in underground conduit and duct are undesirable. However, when required, bends in conduit and duct runs shall be limited to the equivalent of no more than two 90-degree bends between pull points.

1.3.4.6.5 The inside radius of a bend in conduit shall be at least six times the internal diameter.

1.3.4.6.6 Separation from other service structures and depth of cover shall be provided per applicable codes.

1.3.4.6.7 Underground conduit should be installed such that a slope exists at all points of the run to allow drainage and prevent the accumulation of water. A drain slope of no less than 100 mm per 30 meters (4 inches per 100 feet) is desirable.

1.3.4.6.8 Conduits shall be reamed to eliminate sharp edges and terminated with an insulated bushing.

1.3.4.6.9 Pull strings or rope shall be placed in installed conduits.

1.3.5 Space Design Considerations

1.3.5.1 Maintenance holes

1.3.5.1.1 A maintenance hole is used to pull in and splice cables in an underground, concealed manner. Maintenance holes shall be equipped with a sump, corrosion-resistant pulling iron, cable racks, and ladders that are grounded per applicable electrical code. Concrete used for maintenance holes shall be of at least 3,500 lb/in^2 strength. Communications maintenance holes shall not be used as a pathway for power and light conductors.

1.3.5.1.2 Types

- Type A - end-wall entrance only
- Type B - handhole
- Type J - end- and side-wall entrance
- Type V - shaped like a V with one end-wall and two side-wall entrances

1.3.5.1.3 Maintenance hole size considerations shall include the ultimate duct structure, the need for equipment located in the maintenance hole.

1.3.5.1.4 Maintenance hole frames and covers shall meet the requirements of the location. These include types for heavy vehicular traffic (e.g., types B, SB) and those for lighter loads (e.g., type R).

1.3.5.1.5 Maintenance holes and handholes shall be located flush in ground and every 270-degrees of bend or 200 feet of conduit run.

1.3.5.2 Handholes

1.3.5.2.1 Considerations for the use of handholes are as follows:

1.3.5.2.1.1 A handhole may be used to aid cable pulling when
- Bends exceed either two 90-degree bends or a total of 180-degrees or
- Section length of conduit requires the pulling of cable in two segments

1.3.5.2.1.2 A handhole shall not exceed 1.2 meter (4 feet) in length by 0.76 meter (2.5 feet) in width by 0.91 meters (3 feet) deep and should not be used in runs of more than three (3) 4-inch trade size conduits.

1.3.5.2.1.3 A handhole shall not be used in place of a maintenance hole in a main system facility.

1.3.5.2.1.4 A handhole shall not be utilized for splicing cables together.

1.3.5.2.1.5 Conduit entering the handhole shall be aligned on opposite walls of the hole at the same elevation.

1.4 Router Room

1.4.1 General

1.4.1.1 The Router Room (RR) functions as the interconnection point between the campus voice, data, and multimedia systems, franchise service provider network, and the communication services entering the interbuilding communications system. The RR provides space for wall-mounted and freestanding equipment.

1.4.1.2 The RR shall be designed exclusively for communication services use and shall not be shared with other systems (including electrical power, fire alarm distribution, or security system equipment, storage, or custodial services). Major plumbing, electrical, and mechanical distribution systems must be routed outside the RR.

1.4.2 Router Room Location

1.4.2.1 Locate the RR in "less valuable" space (generally in the lowest level of a facility) with good access to both the service provider networks and the campus interbuilding outside plant system. Orient room to avoid immediate adjacency to elevator shafts or below rooms which have future potential for water leakage.

1.4.2.2 Provide access directly off a public hallway. Service personnel should never need to enter offices, store rooms, restrooms, or other spaces to gain access to the RR.

1.4.2.3 The RR must be accessible without stairs.

1.4.3 Router Room Design Criteria

1.4.3.1 The RR shall be designed to contain the campus entrance and distribution facilities. C&C space must be secured from the outside vendor space.

1.4.3.1.1 Service Providers: Provision rack and/or wall space for service providers for each of the following: data, voice, and CATV services. Contact C&C for space and configuration requirements.

1.4.3.1.2 C&C Systems: At a minimum, provision (a) floor space for rack as follows
- (2) video equipment racks (Stantron Series 200)
- (3) data equipment racks (19" B-Line)
- (3) voice equipment racks (23" B-Line)

AND (b) wall space for interbuilding distribution terminations.

1.4.3.1.3 HVAC Equipment: Provide a separate, adjacent room to house HVAC equipment required to meet 24/7 operational requirements. Condenser cooling water and refrigerant piping shall be routed outside the RR.

1.4.3.1.4 In addition, the RR may be provisioned with facilities typically found in MDF's and IDF's. If the RR also contains MDF or IDF facilities, then these spaces shall be separately provisioned within the RR, per the respective design criteria for these types of rooms.

1.4.3.1.5 Contact C&C for additional elements specific to A&E design of the RR.

1.4.4 Outside Plant Infrastructure System Connections

1.4.4.1 Include pathways between the RR and a location where access to C&C's outside plant system is available. Generally, this pathway will connect the RR to the communications cable tray in the University's utilidors. Coordinate the capacity and routing with C&C.

1.4.4.2 Include pathways between the RR and the franchise service provider network facilities.

1.4.5 Riser System Connection

1.4.5.1 Horizontal distribution from the RR shall consist of cable tray and 4-inch conduit. Limit use of conduit to wall penetrations and through areas with inaccessible ceilings. The cable fill capacity of the cable tray and conduit shall be coordinated with C&C and be at least equivalent to the capacity of the riser system.

1.4.5.2 When the RR functions as an MDF Room or an IDF Room, use cable tray and 4-inch conduit between the RR and the vertical riser(s). The capacity of the system shall be at least equal to the capacity of the riser system(s).

1.4.5.3 When cable tray is used to connect the RR to the riser system(s), specify a separate tray for any station cable or feeder cable.

1.4.6 General Provisioning

1.4.6.1 The floor must have commercial floor loading capacity of at least 100 lbf/ft^2 of distributed load and 2000 lbf for concentrated load.

1.4.6.2 Locate a double door on one of the shorter walls of the room. The door swing shall not in any way restrict access to riser sleeves, conduits, cable tray, or the equipment racks. An outward door swing is preferred (coordinate with project Architect). The door shall be 36-inches wide and 7-feet high. Fixed center posts and doorsills are not acceptable. It shall be keyed to the campus-wide communications master, not to the building master.

1.4.6.3 The fire rating of the walls and doors shall be maintained by using firestopping materials that comply with code.

1.4.6.4 Do not install false ceilings in the RR.

1.4.6.5 Provide 24-inch ladder rack (with capacity equivalent to incoming pathways and sized per NEC Article 318) around the periphery of the Room and over the rows of equipment racks to support and distribute cable within the room. The size and configuration may require cross-room segments. Tray shall be located six inches from walls and racks.

Ladder rack shall be configured in a 3-tier system: DC power distribution on the top-most layer, optical fiber cabling in the middle, and copper cable plant on the bottom. Label trays as to services within.

In addition, provide plastic rack with downspouts for fiber jumper routing.

All conduits/sleeves shall stop between 1½– 3 feet above tray in room.

1.4.6.6 If floor ducts enter the RR, use duct elbow fittings to terminate the ducts at the plywood-lined wall. Terminate elbow fittings three inches above the finished floor.

1.4.6.7 Conduit penetrations into the RR shall stop at most three inches beyond the wall, floor or ceiling. Conduits shall be reamed and finished with a threaded, grounding-type bushing.

The elevation of the conduit penetrations shall be planned to be at 12 feet above finished floor. Where circumstances require conduit penetrations at a higher elevation, the conduits shall be extended into the room and brought to an elevation of 1½– 3 feet above cable tray.

1.4.6.8 Provide ACX Douglas fir plywood backboards on ALL walls, extending from 1-foot AFF to 9-feet AFF and using standard 3/4-inch by 8-foot sheets. Care must be exercised in selecting sheets without void.

Because cable must be secured every four feet vertically as well as horizontally, provide additional plywood along the path where cable will be routed. This may

require extending plywood backboard above 9-feet AFF to accommodate securing riser cables routed through sleeves above.

Backboards shall have two coats of fire-resistant matte white paint.

1.4.6.9 Secure racks to floors, fasten racks together into rows, and provide seismic bracing in accordance with structural design criteria of building.

Provide vertical cable management units between voice, data and multimedia racks.

1.4.7 Electrical Provisioning

1.4.7.1 Provide a 208Y/120V panel board rated at 100 amps fed from the building standby power system. It shall have an equipment ground bus with a dedicated equipment grounding conductor back to service ground bus. Refer to Section XX in this document for additional panel board criteria. Label faceplates with circuit identification number.

1.4.7.2 Provide dedicated, 120V 20A circuits to serve no more than two (2) 4x4 outlet boxes, each having two duplex receptacles.

Locate outlet boxes eight feet on center around the room, directly above the top edge of the backboard.

Locate outlet boxes two feet on center attached to ladder rack above equipment racks. Receptacles shall be 20A twistlock type. Coordinate NEMA configuration of receptacles with C&C.

Install a convenience outlet on any non-C&C circuit below the light switch, 18-inches AFF.

Provide DC power plant for information systems equipment. Contact C&C for system scope.

1.4.7.3 Provide illumination at a minimum level of 50-foot candles. Hang fixtures above the 9-foot 6-inch level or ceiling mount. Fixtures are to be positioned parallel to rack rows and distribution frames AND located between rack rows. Coordinate exact positioning of fixtures with pathways in RR to avoid interference with ladder rack, riser sleeves, equipment racks, etc.

Locate a standard wall switch within the RR on the strike-side of the door within easy reach. If there is more than one entry to the room, 3-way switches are required.

1.4.7.4 Provide a complete communication equipment grounding system. This includes a ground bus mounted on the wall in the RR. This bus shall be bonded to the building electrode grounding system. It also shall be bonded to the ground bus located in the MDF and each IDF.

Position the ground bus bar horizontally, low on the backboard near the voice riser terminations without obstructing the path of future floor-to-floor and horizontal cables. Route ground wire off the edges of the backboard preserving unobstructed mounting surfaces.

1.4.8 Environmental Requirements

1.4.8.1 The RR must be secure and environmentally clean. Seal the floor to eliminate dust and static electricity charges.

1.4.8.2 The RR has year-round, 24/7 HVAC requirements independent from the building's central needs. Provide dedicated controls within the RR. A separate system will be required.

Room temperature shall not exceed 64-75 degrees F. The humidity level shall not exceed 30-55% RH. Measure these values at 5-feet AFF. Ensure a temperature change of no more than plus or minus 5-degrees or a humidity change of no more than plus or minus 10% over a 24-hour period of time. Contact C&C for estimated room equipment heat rejection.

1.5 Main Distribution Frame (MDF) Room

1.5.1 General

1.5.1.1 The MDF functions as the interconnection point between the building’s internal systems and the communications services entering from the inter-building communications system. The MDF Room provides space for wall-mounted and freestanding equipment supporting the centrally-administered communications systems, as well as the point-of-presence for franchised utilities (i.e., the local telephone and cable TV companies).

1.5.1.2 The MDF Room shall be designed for exclusive communications services use and shall not be shared with equipment not serving the room (including electrical power, fire alarm distribution, or security system equipment, storage or custodial services). Major plumbing, electrical, and ventilation distribution systems must be routed outside the MDF Room.

1.5.2 MDF Room Location

1.5.2.1 Locate the MDF Room in an area (generally in the basement) with good access to both the campus inter-building utility system and the base of the vertical riser system(s). Orient room to avoid immediate adjacency to elevator shafts or below rooms which have future potential for water leakage.

1.5.2.2 Provide access directly off a public hallway. Service personnel should never need to enter offices, storerooms, restrooms, or other spaces to gain access to the MDF Room.

1.5.2.3 REMODELS: If located within a larger Mechanical or Electrical Room, the MDF Room shall be partitioned, secured and ventilated with unrestricted and level access to a public hallway.

1.5.3 MDF Room Size

1.5.3.1 The MDF Room shall be a minimum of 12-feet long by 10-feet wide. For buildings exceeding 50,000 ASF, room size shall increase a minimum of 30 square feet per each additional 50,000 ASF. As room size increases, a 3:2 length-to-width ratio shall be maintained.

1.5.3.2 In some MDF Rooms, additional space will be required to support franchised utilities' distribution equipment. C&C will inform the Project Manager and the A&E wherever this is the case.

1.5.3.3 In the event that program space is assigned on the same level as the MDF Room, the MDF Room shall be sized and provisioned to serve as an Intermediate Distribution Frame (IDF) Room. This includes pathways for station cable and riser cable.

1.5.4 Outside Plant System Connections

1.5.4.1 Include a pathway between the MDF Room and a location where access to C&C's outside plant system is available. Generally, this pathway will connect the MDF Room to the communications cable tray in C&C's outside plant system. The exact location shall be coordinated with C&C.

1.5.4.2 This pathway shall consist of a minimum of three 4-inch conduits or one 12-inch by 4-inch cable tray. Route the cable tray or conduit to provide support for feeder cables that connect to C&C's outside plant system and for riser cables that serve the IDF Rooms.

1.5.4.3 Cable tray (and any C&C approved pullboxes located in a conduit run) shall be mounted at a height and routed in a manner that is easily accessible to cable installation and service personnel using standard 8-foot ladders.

1.5.5 Riser System Connection

1.5.5.1 When the MDF Room is not aligned vertically with the IDF Rooms on the upper floors, or when there are two or more vertical stacks of IDF Rooms, use cable tray and/or 4-inch conduit to connect the MDF Room and the vertical riser(s). The number of connecting conduits shall equal the number of sleeves at the base of the riser system(s). Assign sleeves for each IDF room. Identify assignment on drawings.

1.5.5.2 When cable tray is used to connect the MDF Room to the base of the riser system(s), size the tray to provide a cross-sectional area equivalent to the required number of conduit sleeves through the walls.

1.5.6 General Provisioning

1.5.6.1 Floor Loading

The floor must have commercial floor loading capacity of at least 100 lbf/ft^2 of distributed load and 2000 lbf/ft^2 for concentrated load.

1.5.6.2 Locate the door of the MDF Room on one of the shorter walls of the room. The door should be offset toward either side of this wall and as far from the MDF as possible. The door swing shall not in any way restrict access to riser sleeves, entrance conduits, cable tray, or the main backboard. An outward door swing is preferred. Coordinate with project architect. The door shall be 36-inches wide and 6-feet 8-inches high. It shall be keyed to the campus-wide communications master, not to the building master.

1.5.6.3 The fire rating of the walls and doors shall be maintained by using firestopping materials that comply with code.

1.5.6.4 Do not install false ceilings in the MDF Room.

1.5.6.5 Provide ladder cable tray (with capacity equivalent to incoming pathways and sized per NEC Article 318) around the periphery of the MDF Room to support and equitably distribute cable within the room. The size and configuration may require cross-room segments. Tray shall be located six inches from the backboard wall.

1.5.6.6 Penetrations

When conduit enters the MDF Room, it must be reamed and bushed.

1.5.6.6.1 Ceilings

Conduits, sleeves, and slots that penetrate into the MDF Room, shall stop within 1½–3 feet above the plywood backboard and/or cable tray.

1.5.6.6.2 Walls

Conduits, sleeves, and slots which penetrate into the MDF room, shall stop no more than three inches into the room and be located within 1½–3 feet above the plywood backboard and/or cable tray.

Locate wall penetrations for conduits, horizontal riser sleeves, or sleeves from cable tray in the vicinity of the MDF within three feet above the backboard.

1.5.6.6.3 Floors

Conduits, sleeves, and slots that penetrate into the MDF Room, shall stop 3-inches AFF.

1.5.6.7 Install ACX Douglas fir plywood backboards on ALL walls, extending from 1-foot AFF to 9-feet AFF and using standard 3/4-inch by 4-foot by 8-foot sheets. Care must be exercised in selecting sheets without voids.

Because cable must be secured every four feet vertically as well as horizontally, provide additional plywood along the path where cable routes up to cable tray, conduit, or sleeves.

Backboards shall have two coats of fire-resistant matte white paint.

1.5.7 Electrical Provisioning

1.5.7.1 Provide a 208Y/120V panel board rated at 100 amps fed from the building standby power system. It shall have an equipment ground bus with a dedicated equipment grounding conductor back to the service ground bus.

1.5.7.2 Provide a minimum of three dedicated, 120V 20A circuits to serve three 4x4 outlet boxes, each having four 2-duplex receptacles.

Typically, additional outlet locations will be specified by C&C based on the size and configuration of the MDF Room as well as on the equipment power requirements specific to this project.

Locate the basic three outlet boxes at three of the four corners of the room, directly above the top edge of the backboard.

Install a convenience outlet on any non-C&C circuit below the light switch, 18-inches AFF.

1.5.7.3 Provide fluorescent lighting at a minimum level of 50-foot candles. Hang fixtures above the 9-foot 6-inch level or ceiling-mount without blocking conduit penetration and cable tray or interfering with cable routing and equipment installation.

Locate a standard wall switch within the MDF Room on the strike-side of the door within easy reach. If there is more than one entry to the room, 3-way switches are required.

1.5.7.4 Provide a communications equipment grounding system and bond it to the building electrode grounding system.

Route the equipment grounding system through the MDF Room and each IDF Room with a termination on the ground bus bar in each room.

Position the ground bus bar horizontally, low on the backboard near the voice riser terminations without obstructing the path of future floor-to-floor and horizontal cables. Route ground wire off the edges of the backboard preserving unobstructed mounting surfaces for C&C use.

1.5.8 Environmental Requirements

1.5.8.1 The MDF Room must be secure and environmentally clean. Seal the floor to eliminate dust and static electricity charges.

1.5.8.2 The MDF Room has year-round, 24/7 HVAC requirements independent from the building's central needs. Provide dedicated controls within the MDF Room. A separate system may be required. For design purposes assume a continuous 8000 BTU heat load.

For design purposes, maintain the MDF Room temperature in the range 64-75 degrees F. The humidity level shall not exceed 30-55% RH. Measure these values at 5-feet AFF. Ensure a temperature change of no more than plus or minus 5-degrees or a humidity change of no more than plus or minus 10% over a 24-hour period of time.

1.6 Intermediate Distribution Frame (IDF) Rooms

1.6.1 General

1.6.1.1 The IDF Room provides space and access to horizontal and riser pathways to support voice, data, and multimedia services.

1.6.1.2 The model for the vertical distribution system consists of a minimum of one IDF Room on each floor, vertically aligned and interconnected to other IDF's with conduit sleeves to form a vertical riser system for the cable plant.

1.6.1.3 IDF Rooms are for the EXCLUSIVE use of C&C-administered communications services and shall not be shared with departmental groups, other support groups or utilities (such as custodial services, electrical power, or fire alarm). Major plumbing, electrical, and ventilation distribution systems must be routed OUTSIDE these Rooms.

1.6.2 IDF Room Location

1.6.2.1 Locate the IDF Room near permanent architectural features (e.g., staircases and shafts for utilities, ventilation, and elevators) in the core area.

1.6.2.2 Provide access directly off a public hallway. Service personnel should never need to enter offices, storerooms, restrooms, or other spaces to gain access to the IDF Room.

1.6.2.3 To establish acceptable placement and number of IDF Rooms, limit the straight-line distance from the IDF Room to the farthest point in the program area to about 150 feet. Each IDF Room shall be located centrally within the 10,000 ASF footprint it shall serve.

Maximum station cable length from the IDF Room to outlet locations shall not exceed 295 feet (90 meters) terminal-to-terminal**.**

1.6.3 Number of IDF Rooms per Floor

1.6.3.1 Provide a minimum of one IDF Room per floor.

1.6.3.1.1 Enlarge the IDF Room when the area to be served exceeds 10,000 ASF.

1.6.3.1.2 Provide additional IDF Rooms when maximum station cable length will exceed 295 feet (90 meters) terminal-to-terminal.

1.6.4 **IDF Room Size**

Two types of IDF Room configurations are acceptable.

1.6.4.1 Standard “Walk-in” IDF Rooms:

1.6.4.1.1 10 by 7 feet serving areas not to exceed 5,000 ASF

1.6.4.1.2 10 by 9 feet serving areas not to exceed 7,500 ASF

1.6.4.1.3 10 by 11 feet serving areas not to exceed 10,000 ASF

1.6.4.1.4 Where ASF exceeds 10,000 ASF, enlarge IDF proportionately.

1.6.4.2 “Shallow” IDF Rooms (with double doors opening into the hallway) may serve areas of 5,000 ASF or less. These shall be a minimum of 8-feet wide by 3-feet deep (interior, clear dimensions).

1.6.5 Riser System Pathway

1.6.5.1 The pathway through a vertical riser system typically consists of a number of sleeves or conduits. The quantity installed will be fewest at the top of the riser system and will progressively increase in number as the riser moves down to the base. Since the maximum floor area served by each IDF Room is fixed, a simple formula specifies the number of sleeves required between floors:

The IDF Room(s) located on the highest floor of a building shall have a minimum of four 4-inch sleeves to the IDF Room directly below, and the number of sleeves shall

increase by one sleeve every other floor. For example, a six-story building would have four sleeves on floors 6 and 5, five sleeves on floors 4 and 3, six sleeves on floors 2 and 1.

1.6.5.2 In addition, install from the top riser room to the roof a minimum of one 4-inch conduit and co-located power receptacle. Provide one watertight enclosure for each riser stack for conduit termination of these utilities.

Assign sleeves for each IDF Room. Identify assignment on drawings.

1.6.5.3 Connect IDF Rooms that cannot be vertically aligned with a minimum of two 4-inch conduits in addition to the number dictated by the sleeve pattern described above. These additional conduits are required to provide the same effective cable capacity of the short conduit sleeves.

1.6.5.4 For a “satellite” IDF Room that does not have its own riser system, adjust the quantity of conduits in the sleeve pattern described above to reflect the increased cable quantity merging into the serving IDF Room for the vertical riser and station cable traveling through its sleeve system.

1.6.5.5 Cluster penetrations to minimize obstruction of backboard space resulting from routing of cables.

1.6.6 General Provisioning

1.6.6.1 Floor Loading

The floor must have commercial floor loading capacity of at least 50 pounds per square foot.

1.6.6.2 Doors

Walk-in IDF Rooms: locate the door on one of the shorter walls of the room. The door should offset toward either side and as far from the main backboard as possible. The door swing shall not in any way restrict access to riser sleeves, entrance conduits, cable tray, or the main backboard. An outward swing is preferred. Coordinate with the project architect.

"Shallow**"** IDF Rooms: Provide double doorways that open outward. Fixed center posts and doorsills are not acceptable. Key the active leaf that is on the right; fix the left-most door at top and bottom with deadbolts.

All doors shall be 36-inches wide and 6-feet 8-inches high.

Key locks to the campus-wide communications master key, not to the building master.

1.6.6.3 Fire rating

The fire rating of the walls and doors shall be maintained by using firestopping materials that comply with code.

1.6.6.4 False ceilings

Do not install false ceilings in IDF Rooms.

1.6.6.5 Ladder tray

Provide ladder cable tray (with capacity equivalent to incoming pathways and sized per NEC Article 318) around the periphery of the IDF Room to support and equitably distribute cable within the room. The size and configuration may require cross-room segments. Tray shall be located six inches from the backboard wall.

All conduits/sleeves shall stop between 1½-3 feet above tray/backboard in room.

1.6.6.6 Penetrations

When conduit enters the MDF Room, it must be reamed and bushed.

1.6.6.6.1 Locate penetrations of vertical riser sleeves (or conduits) along the sidewall to the right of the main backboard. Vertically align these penetrations with those in the IDF Rooms above and below.

1.6.6.6.2 Locate penetrations by conduits, horizontal riser sleeves, or sleeves from cable tray in the vicinity of the main backboard (opposite the riser penetrations), within three feet above the backboard.

1.6.6.6.3 Ceilings

Conduits, sleeves, and slots that penetrate into the MDF Room, shall stop within 1½–3 feet above the plywood backboard and/or cable tray.

1.6.6.6.4 Walls

Conduits, sleeves, and slots which penetrate into the MDF room, shall stop no more than three inches into the room and be located within 1½–3 feet above the plywood backboard and/or cable tray.

Locate wall penetrations for conduits, horizontal riser sleeves, or sleeves from cable tray in the vicinity of the MDF within three feet above the backboard.

1.6.6.6.5 Floors

Conduits, sleeves, and slots that penetrate into the MDF Room, shall stop 3-inches AFF.

1.6.6.7 Install ACX Douglas fir plywood backboards on ALL walls, extending from 1-foot AFF to 9-feet AFF and using standard 3/4-inch by 8-foot sheets. Care must be exercised in selecting sheets without voids.

Because cable must be secured every four feet vertically as well as horizontally, provide additional plywood along the path where cable will be routed.

Backboards shall have two coats of fire-resistant matte paint.

1.6.7 Electrical Provisioning

1.6.7.1 Provide a minimum of three dedicated, 120V 20A grounded circuits per NEC to serve three 4x4 outlet boxes, each having two-duplex receptacles.

Locate the basic three outlet boxes at the three of the four corners of the room, directly above the top edge of the backboard. Install a convenience outlet on a dedicated circuit below the light switch, 18-inches AFF.

1.6.7.2 Provide fluorescent lighting at a minimum level of 50-foot candles. Hang fixtures above the 9-foot 6-inch level or ceiling-mount without blocking conduit penetration or interfering with cable routing and equipment installation.

Locate a standard wall switch within the IDF Room on the strike-side of the door within easy reach. If there is more than one entry to the room, 3-way switches are required.

In **"**shallow**"** IDF Rooms having double doors, position the wall switch directly inside, on the hinge-side of the right leaf. Where there are pairs of double doors, install 3-way switches to the right of each pair of doors.

1.6.7.3 Provide a communications equipment grounding system.

Route the equipment grounding system (**SD-CM-11**) from the MDF Room through each IDF Room with a termination on the ground bus bar in each Room.

Position the ground bus bar horizontally, low on the backboard near the voice riser terminations without obstructing the path of future floor-to-floor and horizontal cables. Route ground wire off edges of the backboard preserving unobstructed mounting surfaces.

1.6.8 Environmental Requirements

1.6.8.1 The IDF Rooms must be secure and environmentally clean. Seal the floors to eliminate dust and static electricity.

1.6.8.2 For design purposes, assume a continuous 3,500 BTU heat-load and a room temperature similar to adjacent hallway and office spaces, in a range not to exceed 64-75 degrees F. The humidity level shall not exceed 30-55% RH. Measure these

values at 5-feet AFF. Ensure a temperature change of no more than plus or minus 5-degrees or a humidity change of no more than plus or minus 10% within a 24-hour period.

1.7 Horizontal Distribution System - Cable Tray and Conduit

1.7.1 General

1.7.1.1 Install a cable tray system on every floor of the building to provide a horizontal pathway system between the nearest IDF Room and the individual communications outlets in each room. Maximum tray depth not to exceed three inches.

1.7.1.2 Install appropriately sized conduit instead of cable tray where the path travels over inaccessible ceilings or in areas where cable tray access parameters cannot be met.

1.7.1.3 Cables shall be primarily installed inside cable trays. Consideration will be given to affixing cabling systems to the side of the tray, such as a broadband video distribution system. Coordinate all systems not installed within the tray with C&C.

1.7.2 Pathway Capacity

1.7.2.1 Size communications raceway for maximum fill capacity per fill tables in electrical code.

1.7.2.2 Increase the size of pathways to reflect the increased capacity required to serve the defined technology rooms and support spaces.

1.7.3 Tray Sizing

Several factors affect tray capacity

- Number of outlets served
- Square footage
- Non-C&C low-voltage cable
- Cable bottlenecks (e.g. access to technology spaces)

1.7.3.1 For planning purposes, size cable tray capacity with a minimum of one volumetric square-inch of cross-sectional area for every 100 ASF of floor area served or for the maximum number of outlets possible in a room -- *whichever is greater*. This should allow adequate space for C&C-administered cables.

1.7.3.2 Increase the size of those segments of cable tray most likely to incur heavy pathway use by localized cable, to relieve potential bottlenecks. Special attention shall be given to those portions of tray that feed technology spaces.

1.7.3.3 Minimum cable tray dimensions shall be 6-inches wide by 4-inches deep (i.e., 24 sq in) which, for planning purposes, is sufficient for short or “dead-end” routes serving no more than 1,800 ASF.

1.7.4 Sleeve Sizing

Use sleeves having the equivalent area of the cable tray to pass through walls along the corridor or into the IDF Room.

The relationship of tray capacity to quantity of 4-inch conduits is provided below:

6-inch by 4-inch tray	two (2) 4-inch conduits
12-inch by 4-inch tray	three (3) 4-inch conduits
18-inch by 4-inch tray	four (4) 4-inch conduits

1.7.5 Tray Routing

1.7.5.1 Route the cable tray system for each floor of the building in public hallways.

Never route cable tray above private offices, labs, or restrooms.

1.7.5.2 Installation of cable tray below the ceiling is preferred. It may be exposed in the hallway or integrated into the building design.

1.7.5.3 Interconnect cable tray sections with conduit of equivalent capacity where hard, vaulted, or other ceiling types prevent access to cable tray along a hallway in a continuous fashion.

1.7.5.4 Provide unrestricted access to cable tray routes every four feet where other systems must traverse above or below tray. Where necessary, consolidate the routing of conduits from communications outlets located in neighboring rooms to a location above one ceiling panel and the other services above an alternate panel.

1.7.5.5 Coordinate routing of tray with other system drawings to indicate air space reserved for installation of cable tray (**SD-CM-10**).

1.7.6 Wall Penetrations

Cable tray shall not pass directly through walls. Stop tray at the wall and install multiple 4-inch threaded conduit sleeves of equivalent capacity. Cap any sleeves not in use.

Provide firestopping of all penetrations through fire-rated assemblies.

1.7.7 Tray Mounting

1.7.7.1 Cable tray may be mounted using any of the industry-accepted methods (cantilever mounting is not required).

1.7.7.2 Cable trays should be mounted below 12-feet AFF with a 12-inch minimum vertical clearance above and an 18-inch minimum horizontal clearance on at least one side, thus allowing for direct access to the tray from below.

1.7.7.3 Avoid changes in mounting level heights unless a continuous transition is provided.

1.7.7.4 Prior approval is required from C&C for any situations where proper clearance cannot be maintained or a change in mounting levels occurs. Any such locations should be indicated on the drawings for comment and coordination during the review process.

1.7.8 Tray Grounding

1.7.8.1 Install cable tray as a continuous system, connecting tray to the building grounding electrode system in compliance with NEC.

1.7.8.2 Place a bare copper conductor inside the tray, properly connected. Jumpers are not allowed. Bond conductor for each section at either side of joints.

1.8 Station Distribution System - Outlets, Station Conduit, and Surface Metal Raceway (SMR)

1.8.1 Outlet Boxes

1.8.1.1 Each outlet box requires a dedicated conduit feed.

1.8.1.2 The communications outlet locations drive the design of the horizontal distribution system for stations. This process precedes assignment of specific users to spaces. Therefore, the initial design will reflect the communications guidelines discussed herein combined with the program needs known to-date. Refinements will evolve during the design process through a collaborative effort including the A&E, C&C, and client representative as design elements (such as the furniture plan) are finalized.

1.8.1.3 The capacity of the infrastructure system shall be designed to support the cable plant required to activate all station outlets, even though all station outlets will not be activated upon initial occupancy of the building.

1.8.1.4 Provide every assignable room with a minimum of one standard communications outlets.

1.8.1.5 Provide infrastructure for building systems that will use C&C-managed network services. This includes

- Elevator telephones
- Emergency telephone systems
- Public telephones
- CCTV
- Card access control
- Building Automation System
- Lighting control
- Equipment monitoring systems
- Cash registers

Coordinate provisioning for such systems with the other project team members.

1.8.1.6 Where SMR is used throughout a room, provide a minimum of one standard outlet with dedicated conduit feed. Infrastructure for wall-mounted phone units is not a substitute.

Specify SMR hardware that accommodates the cable bend radius requirements for fiber and multimedia applications.

1.8.1.7 The capacity of outlet boxes, station drop conduits and SMR supports only the needs of C&C-supported communications services and cannot be shared with other utilities or departmentally-managed systems. Therefore, allocate separate outlet boxes, conduit, and SMR where additional infrastructure is required. An internal system of SMR or cable tray may be needed to manage client cable and cords within specific rooms or labs.

1.8.1.8 Indicate the communications outlet location using the communications icon. Typically this coincides with the junction box in the wall. In the special case of SMR, the icon indicating the location of the communication outlet along the raceway represents two (2) 2x4 cutouts in-line (**SD-CM-1**).

Number outlet locations and complete all columns on the Outlet Schedule relevant to the infrastructure phase to facilitate discussion and review. Take special care to reflect “two faceplates” in the comment column when SMR is used.

1.8.2 Location of Outlet Boxes

1.8.2.1 Designate outlets in readily accessible locations.

1.8.2.2 Coordinate placement to avoid door swings and other building details not shown on the communications drawings such as radiators and built-in cabinetry.

1.8.2.3 Coordinate locations of critical outlets with Architect. Architect shall dimension these outlets on the architectural plan. These outlets include podium floor boxes, kiosks, and other floor box locations.

1.8.2.4 Coordinate the juxtaposition of each communications box to neighboring boxes and other permanent features (such as light switches, thermostats, splashboards and panel boxes) to provide adequate space to mount a faceplate or phone unit.

1.8.2.5 Co-locate an electrical outlet with each communications outlet to provide power for any computer equipment that may be located there. Common usage of high-draw small appliances requires that consideration must be given to limiting the number of electrical outlets per circuit. Technology support spaces have extraordinary power requirements.

Dedicated circuits shall be provided in some technology spaces.

Address any additional power requirements needed by the client.

1.8.2.6 Communications outlets and electrical outlets shall be installed at a uniform height.

University facilities shall be designed to comply with the Americans with Disabilities Act.

Some CATV outlets will be vertically co-located at both 18-inches AFF and 96-inches AFF interconnected by 2-inch conduit.

For wall-mounted phone boxes, locate highest-operable parts essential to basic operation of the phone unit no higher than 48-inches AFF.

For pay phones, contact the local phone company for height and other needs.

1.8.2.7 Coordinate the mounting height of outlets intended to serve building systems with the respective discipline's design engineer.

1.8.3 Non-perimeter Outlet Box Locations

Where the size of a room makes it difficult to provide service from outlet boxes in the wall or on a column, approval of alternate infrastructure is required on a case-by-case basis by C&C.

1.8.3.1 Common solutions are

- Power poles to raceway in the ceiling
- Floor boxes
  - fed from same floor tray
  - fed from floor below ("poke-thrus")
  - in-floor distribution systems ("Walker" duct)

1.8.3.2 There are two acceptable configurations for floor boxes.

- Co-locate separate double-gang capacity boxes for communication and for power.
- Locate University custom-designed podium floor box in auditoria and technology rooms.

1.8.3.3 Annotate outlet locations with dimensions from fixed landmarks when positioning is critical (e.g., interfacing with landscape furniture).

Annotate floor outlet locations that can be obscured later by carpeting, desks, or other furniture.

1.8.4 Station Conduit and Outlet Box Sizing

Station conduit connects the outlet box to the cable tray or creates a home-run to the nearest IDF Room.

1.8.4.1 For typical “desk” locations, run a 1-inch conduit from the cable tray (or nearest IDF Room) to a standard 4-inch by 4-inch by 2.125-inch double gang electrical junction box with a 4-inch by 4-inch mud-ring (**SD-CM-27** and **SD-CM-28**).

This box provides sufficient room to mount the standard double-gang voice/data/multimedia faceplate and can accommodate additional devices to support future technologies (e.g., optical fiber cable).

1.8.4.2 For wall-mounted phone locations, run a 3/4-inch conduit from the cable tray (or nearest IDF Room) to a standard 2-inch by 4-inch by 2.125-inch double-gang electrical junction box with single-gang plastic ring.

1.8.4.3 Where multimedia outlets require dedicated infrastructure, specify a minimum 1-inch conduit to a 4-inch by 4-inch by 2.125-inch box with a 4-inch by 4-inch mudring (**SD-CM-29**).

1.8.4.4 See **SD-CM-40** for elevator phone situations.

1.8.4.5 Specify a 3/4-inch dedicated conduit to the nearest cable tray or directly to the nearest IDF Room or MDF Room for security systems (e.g., alarms for monitoring equipment or card access to buildings) and to the MDF Room for communications response systems (e.g. per American Disabilities Act regulations) that require a phone or data connection.

1.8.5 Surface Mounted Raceway (SMR)

1.8.5.1 Surface mounted raceway (SMR) may be used to add flexibility in placement of outlet locations.

SMR may be dedicated raceway (for communications outlets only) or dual-channel raceway (to accommodate C&C-managed utilities, i.e., electrical and communications outlets).

1.8.5.2 Provide multiple feeds to the SMR from the cable tray at 8-foot intervals.

1.8.5.3 For each feed, install a 1.25-inch conduit from the cable tray to a standard single-gang electrical junction box (2-inch by 4-inch by 2.125-inch) aligned horizontally within the wall behind the communications channel of the SMR (**SD-CM-33** through **SD-CM-36**).

1.8.5.4 When SMR is divided into two internal channels serving both electrical power and communications outlets, route conduit feed for communications cable in the UPPER channel.

1.8.5.5 For divided SMR, the outlet location icon typically represents a cutout configuration equivalent to two (2) single-gang outlets positioned horizontally along the channel designated for communications cable.

1.8.5.6 Formed steel products (e.g., Wiremold) require two (2) cutouts with device brackets (**SD-CM-33** and **SD-CM-34**).

Where multiple communications and/or electrical outlets are co-located, specify a 2-inch horizontal separation between cut-outs to accommodate faceplates.

1.8.5.7 For extruded aluminum products (e.g., Isoduct) where the cover doubles as the faceplate, the equivalent of two (2) pair of electrical cutouts is needed (**SD-CM-35** and **SD-CM-36**).

1.8.5.8 Departmentally-managed horizontal station cable shall be installed in SMR separately from C&C-managed horizontal cable.

1.8.6 Pathway Capacity

1.8.6.1 Maintain the required area of the conduit path through the SMR feed point and into the junction box.

1.8.6.2 Actual cable-carrying capacity of SMR is calculated by subtracting the intrusion depth of the device used.

Products are available that position the outlet devices outside the SMR-channel so that full capacity of the SMR is utilized **(SD-CM-33** and **SD-CM-34)**.

1.8.7 Conduit Routing

1.8.7.1 Provide the most direct and unobstructed path from the outlet to the cable tray and/or IDF Room.

1.8.7.2 Do not specify 90-degree fittings.

1.8.7.3 When intermediate access locations (e.g., pullboxes and junction boxes) are necessary, pre-approval is required from C&C.

1.8.7.3.1 Position pullboxes directly above the outlet location for predictability.

1.8.7.3.2 Update and submit field drawings to the University prior to cable plant installation.

1.8.7.4 If a conduit run contains more than 270-degrees of bend, a pullbox may be required (the location of which must be approved by C&C).

1.8.7.5 NEVER allow more than 270-degrees of bends between outlet and cable tray or in direct runs between outlet and IDF Room. No bend shall exceed 90-degrees.

Three 90-degree bends are allowable only under the following conditions
- When total conduit length is no more than 33 feet
- If conduit size is increased to the next larger trade size

1.8.8 Wall Penetrations

Under NO circumstances may communications cable be fed through walls even in cases where divided SMR provides this option for electrical power cable. Each room shall have its own conduit feed(s) as directed herein.

1.8.9 Raised Floor

Review proposals for raised floors with C&C for applicability.

1.9 Elevators – Temporary Services

Prior to Cable Plant installation phase for this Project, it may be necessary to provide temporary elevator cable for elevator inspection sign-off.

Connections to elevator equipment shall be indicated on the appropriate floor plan(s). A detail shall be included in the Contract Documents.

1.9.1 Provisioning of other major building communication components need to be in place for temporary activation of elevator car(s).

1.9.2 Contact C&C to determine whether UW will monitor elevator phone.

1.9.3 Typically the phone unit is provided by the Contractor.

1.9.4 Connections to elevator equipment shall be indicated on the appropriate floor plan(s). A detail shall be included within the Contract Documents.

1.9.5 Coordinate selection of cab instrument with C&C.

1.9.6 Elevator traveler cabling shall be specified as part of elevator specification.

1.10 Design Requirements Based on Typical Functions

Contact C&C to discuss the number and placement of outlets in the functional spaces listed below.

1 One-person Offices
2 Multi-person Offices
3 Open/Landscape Offices
4 Photocopy/Mail Rooms
5 Storage Areas
6 Kitchens
7 Conference, Seminar, and Breakout Rooms
8 Classrooms, Lecture Halls, and Auditoria
9 Technology Rooms and Support Spaces
10 Computer Equipment Rooms
11 Computer Drop-in, Training, and Teaching Labs
12 Libraries

13 Darkrooms
14 Science/Research Labs
15 Class III Chemical Storage Rooms
16 Clean Rooms
17 Cold Rooms
18 Animal Housing, Cage Washing, and Procedure Rooms
19 Building Control, Mechanical, and Electrical Rooms
20 Janitor Closets
21 Elevators
22 Lobbies and Corridors
23 Loading Docks
24 Housing and Food Services
25 Construction Trailer
26 Temporary Building
27 Parking Facilities
28 Isolated Open Area
29 Leased Facilities

END OF PART 1

PART 2 CABLE PLANT AND OUTLET TERMINATION DESIGN CRITERIA

2.1 The Basic Model

2.1.1 Preparation of cable plant designs for University Projects has been simplified. A canonical model has been established, including three major components

- A Vertical Riser System
- A Horizontal Distribution System
- A Standard Modular Jack Outlet Device

2.1.2 The design standards for the cable plant system and outlet device configurations are described below. Detailed installation guide specifications are contained in Section 16752. Specific pages from the reference drawings (**SD-CM-1** through **SD-CM-52**) are cited at the end of some applicable paragraphs.

2.1.3 The A&E shall edit the information in Section 16752 by deleting those portions that do not apply to the project at hand and by adding other information as required to provide the Contractor with a complete specification package. Paragraphs known to require editing are highlighted by double brackets. If a labeled sub-section is deleted, the A&E shall not re-number the entire section. Instead, the labeled heading shall be retained followed by the words “Not in Contract.”

2.2 General Planning Considerations

2.2.1 Generally, the design of communications system cable plant can begin only after a thorough investigation of client requirements. The design process must also resolve questions of available technology, media, topology, and capacity planning. The A&E shall coordinate this survey of occupant needs with C&C. C&C input early on in the design process will make effective use of A&E time as well as save money for the project over the course of construction.

2.2.2 The A&E shall prepare Construction Documents after carefully reviewing both the material in the following paragraphs and Section 16752 for additional detailed information. The A&E must edit Section 16752 so that the design conveyed by the Documents does not contradict information given the Contractor by the guide specifications.

2.2.3 In the guide specification, the Contractor is told that each product specification is accompanied by a specific product recommendation. If substitutions to the recommended products are proposed, complete manufacturer’s product literature (not generic distributor’s catalog sheets) and samples shall be submitted to the Owner for evaluation and written approval prior to use.

No substitutions shall be allowed for Category 5e cable and termination devices.

2.2.4 Horizontal cable shall be installed to all locations regardless of occupancy. In all cases, all outlets in each room shall be cabled but not necessarily made active**.** On a case-by-case basis, alternate solutions may be proposed to C&C for approval.

2.2.5 The cable plant design is reflected on the Outlet Schedule prepared in accordance with the guidelines presented earlier in Section 16A10. The first step is to determine which of all the outlets located throughout the project will actually be cabled (regardless of whether or not they will be active). The A&E shall meet with the occupant's representative and University/C&C personnel to make this determination.

Once the Outlet Schedule has been completed to indicate all outlets to be cabled, the remainder of the design can be based on the station pair count requirements associated with each IDF Room.

2.2.6 It should be noted that the cable plant model described below is based on current technology. Although voice technology changes fairly slowly, data and multimedia communications currently are in a period of rapid commercial and technological change with respect to high-speed computer networks.

Given this seemingly constant flux in network requirements, the work described by the following paragraphs is often not included in the initial construction contract. *Typically, the cable plant design is not prepared until about 8 months prior to occupancy.* This allows the latest changes in communications equipment and cabling to be included in the specifications.

2.2.7 Vertical Riser System

2.2.7.1 The vertical riser system is installed from the MDF Room to each IDF Room. It consists of

- Category 3, 24-gauge copper shielded twisted-pair cable
- Optical fiber, protected by plenum innerduct
- One or more 75-Ohm coaxial cables

2.2.8 Horizontal Distribution System

2.2.8.1 The typical horizontal distribution system consists of a small bundle of station cables installed from each outlet to the nearest IDF Room.

2.2.8.1.1 Each of these "standard bundles" consists of three cables, each having an unshielded sheath containing 4 twisted-pair of 24-gauge copper. These station cables support both voice and data services. There shall be

- one (1) sheath of Category 5e for Voice,
- two (2) sheaths of Category 5e for Data.

2.2.8.1.2 In addition, one or more 75-Ohm coaxial cables may be required as part of the horizontal CATV system.

2.2.8.1.3 Technology spaces will require a variety of video, audio**,** and control cables

(See section elsewhere on classrooms).

2.2.9 Standard Modular Jack Outlet Device

2.2.9.1 A standard modular jack outlet device provides access to both voice and data services. This outlet device, as specified in Section 16752 of the Communications Standards, can be employed in various configurations to match physical mounting constraints. This outlet arrangement is often referred to as the Telecommunications Data Utility (TDU) (**SD-CM-27**).

2.3 Backboard Elevation Layouts

The A&E shall consult with the University on specific requirements for space to be allocated to service provider and for C&C voice, data, and multimedia systems.

Space for multimedia distribution equipment in the MDF Room and typical IDF Room will vary based on the system design. However, an area consisting of six square feet (2 feet x 3 feet) should be reserved on the backboard near one of the electrical receptacles.

2.4 Outside Plant Cabling Requirements

It is the Contractor's responsibility to provide notification of the scheduled elevator inspection date to the University so that arrangements may be made for installation and termination of MDF Cable.

Verify with C&C who shall provide external connectivity to the building MDF Room for voice, data, and multimedia services.

2.5 Riser Cable

2.5.1 Voice Service

The design shall include separate shielded twisted-pair riser cables from the MDF Room to each IDF Room.

2.5.1.1 These voice-dedicated riser cables shall run parallel to each other after leaving the MDF Room and pass through the vertical riser system until reaching their intended IDF Room. Each cable shall be installed as a continuous length without splices and terminated on the distribution frames in the MDF Room and appropriate IDF Room.

2.5.1.2 Twisted-pair Riser Cable

The pair count in the cable to a particular IDF Room shall be determined by the following formula:

total assignable square footage divided by 100, multiplied by four, rounded *UP* to the nearest 100 pair cable

1700 sq ft/100 = 17 x 2 = 68
= (rounded UP) 100

To facilitate cable and termination block management, pair-count per sheath shall be no less than 100 or no more than 300 pair.

2.5.2 Data Service

2.5.2.1 Optical Fiber Riser Cable shall be installed in innerducts from distribution frame to distribution frame. Innerduct shall be rated for type of installation environments encountered (i.e., riser, plenum, direct buried, etc.). Indicate types of duct used in schedule or on riser diagram.

2.5.3 Multimedia Service

2.5.3.1 Coaxial Riser (CATV)

2.5.3.2 Optical Fiber Riser (Video/Audio)

2.6 Station Cable

The A&E shall complete the portion of the Outlet Schedule (**SD-CM-7**) which indicates to the Contractor which outlets will be cabled with the standard bundle, which receive cabling for telephone only, and which receive special cabling instructions. The Outlet Schedule will be reviewed by both the client and the University/C&C representative so that expectations for service delivery will be met.

2.6.1 In each room with multiple outlets, at least one shall be cabled regardless of occupancy. The other locations are provided so that the client can have additional outlets cabled as necessary.

2.6.2 The "standard bundle" of cables installed from each outlet location to the IDF Room consists of three (3) 4-pair, unshielded twisted-pair cables. There shall be one (1) sheath of Category 5e for voice and two (2) sheaths of Category 5e for data.

2.6.3 Required CATV drops shall consist of one or more RG-6 coaxial cables from outlets in a given room to a centrally-located splitter or tap in the IDF Room.

2.6.4 Required Video/Audio cable shall consist of

2.6.5 Exceptions to installing the standard cable bundle include wall-mounted telephones - one (1) 4-pair cable, elevator telephones - one (1) 4-pair cable, and pay telephones in lobbies (cable installed by the service provider). This information shall be indicated on the Outlet Schedule. Other exceptions include special data outlets found in computer lab environments, computer rooms**,** or food service areas. These needs shall be determined in consultation with the occupant's representative and C&C.

Security systems requiring connections for telephone lines in IDF Rooms generally use one (1) 4-pair cable.

2.7 Termination Hardware

Voice and data service cables are terminated separately. Voice service shall be on blocks and data service on patch panels.

2.7.1 A general backboard layout detail shall be prepared for each MDF and IDF Room showing the specific number and arrangement of termination hardware required in each MDF/IDF Room. The A&E shall submit the proposed layout to C&C for approval (**SD-CM-21** through **SD-CM-23**).

2.7.2 Only cabled C&C-administered outlets shall have space reserved on the termination hardware.

2.8 Standard Outlet Devices

2.8.1 C&C uses a single basic outlet device that provides jacks for voice and data connections (**SD-CM-27** and **SD-CM-28**). Depending on various physical mounting constraints, these devices will be used with a variety of faceplates (**SD-CM-44**).

2.8.2 For multimedia applications, the design of the distribution system will determine the choice of appropriate outlet device. Devices shall consist of a combination of separate parts (modular coupler splice or bulkhead adapter) or be a pre-assembled unit (**SD-CM-29**). The proximity and quantity of sufficient power outlets shall be considered as part of the design.

2.8.3 If circumstances preclude the use of the standard outlet devices, the A&E shall make a proposal to C&C of alternative components. Samples must be provided so that C&C can evaluate the proposed configuration and interactions with other components.

2.8.4 The A&E will edit the Outlet Schedule to reference the configuration appropriate to each outlet location. The configuration details needed by the Contractor shall be included directly in the Construction Documents.

2.9 Outlet Device Configurations

2.9.1 Standard Outlet Box

The configuration of standard outlet devices within the standard 4-inch by 4-inch outlet box shall position voice/data modules on the left-hand side. Blanks will be

provided on the right-hand side when there are no multimedia or optical fiber connections required (**SD-CM-27** and **SD-CM-28**).

2.9.2 Wall-mounted Telephones

There are a number of different types of wall-mounted telephone instruments in use at the University and each requires a different type of outlet device. Coordinate with C&C which outlet device is appropriate.

2.9.2.1 It shall be indicated on the Outlet Schedule which device shall be installed by the Contractor at wall-mounted telephone outlets.

2.9.3 Surface Mounted Raceway (SMR) Outlet Configurations

2.9.3.1 Outlet device mounting options for SMR are currently based on single-gang configurations. To deliver services via a standard cable bundle, two single-gang openings are required in-line for each communications icon with a 2-inch separation between them (and any electrical outlets in the channel below in divided SMR).

2.9.3.2 If future needs arise for an SMR location, an additional pair of single-gang outlets can be cut into the SMR and outfitted with the required cable and modular jacks.

2.9.3.3 If future needs are known during the design process, additional single-gang configurations should be indicated in the Construction Documents and the Outlet Schedule. Blank faceplates shall be used.

2.9.4 Floor Boxes - Co-located Communications and Power

Currently, the C&C approves several alternatives for floor boxes for co-located communications and power needs (**SD-CM-37**) Coordinate selection with C&C.

2.9.5 Custom Podium Floor Box

To support technology functionality in classrooms, lecture halls, auditoria, and other specially designated spaces, C&C uses a custom-designed floor box (**SD-CM-39.1** through **SD-CM-39.5**) that is compatible with the custom-designed podium.

2.9.6 Landscape Furniture Cabling

Horizontal station cable is terminated at a wall, column, or in the floor. Channels in Landscape Furniture are for departmental routing of phone/computer cords. **IMPORTANT:** Any requirements by the Project to route station cable through Landscape Furniture must be pre-approved by C&C.

2.9.7 Elevator Telephones

2.9.7.1 Contact C&C to determine whether UW will monitor elevator telephone.

2.9.7.2 Typically, the telephone unit is provided by the Contractor.

2.9.7.3 Connections to elevator equipment shall be indicated on the appropriate floor plan(s). A detail shall be included in the Contract Documents.

2.9.7.4 Coordinate selection of cab instrument with C&C.

2.9.7.5 Elevator traveler cabling shall be specified as part of elevator specification.

END OF PART 2