LOS ANGELES CITY COLLEGE

Technology Design Standards

Information Technology Infrastructure

Final

January, 2007

Prepared for:

Los Angeles City College

VANTAGE

TABLE OF CONTENTS

INTRODUCTION

This document provides a standardized approach to the design of the Information Technology (IT) Infrastructure for Los Angeles City College (LACC). The information included in this document is provided as reference for project's architects, engineers and other consultants in order to establish an initial understanding of how integrated technologies will impact architectural designs and construction for the new and renovated building projects on campus.

This document addresses minimum guidelines for the design of Technology Rooms, pathways (inter-building and intra-building), and structured cabling system.

DESIGN STANDARDS FOR TECHNOLOGY ROOMS

There are a number of names used to describe Technology Rooms, including Telecommunications Rooms (TR), IDF Closet, Tele/Data Closet, Equipment Rooms (ER), BDF, MDF etc. For the purpose of this document relevant to the individual building projects, LACC has identified two classifications of Technology Rooms, the BDF and IDF. LACC reserves the use of the MDF, Main Distribution Frame and Data Center to spaces that support the entire Campus.

Technology Rooms provide an environmentally suitable and secure space for installing cable, associated hardware, rack and wall mounted technology equipment.

I. DESIGN CRITERIA FOR THE BDF

The BDF is a telecommunications acronym for Building Distribution Frame, in the context of this document the main Technology Room for the building is the BDF. The BDF will act as the entrance facility for connection to the campus optical fiber and data network backbone. The BDF will support the termination of backbone and campus cabling and house centralized communications and server equipment supporting the entire building.

The BDF will also support other building information systems such as media distribution, security, building management systems (BMS) and other building signaling systems. In most cases the BDF will also support the function of an IDF supporting the connection point between backbone and horizontal cabling infrastructure.

A. Architectural and Building System Requirements in the BDF

Room Size	The Minimum space allocated to the BDF shall be 150sq. ft. with a minimum dimension of 15ft in one direction.
Room Location	If the BDF supports the outside cabling connections, it shall be located on the ground floor and located so that it can support two physically separate points of entry. The BDF shall be accessible for the delivery of large equipment throughout its useful life. Ideally, the BDF will be stacked directly under the IDFs to support the distribution of services between the rooms. Do not locate BDFs in any place that may be subject to water infiltration, steam infiltration, humidity from nearby water or steam, heat (e. g., direct

	sunlight) or any other corrosive atmospheric or adverse environmental conditions. Avoid locations that are below water level unless preventive measures against water infiltration are employed. Locate the BDF far enough away from sources of EMI to reduce interference with the telecommunications cabling, including EMI from electrical power supply transformers, motors, generators, radio transmitters, radar transmitters, and induction heating devices. As BDFs are frequently occupied by technicians and sensitive electronic equipment, the room location should not be adjacent to sources of constant, excessive, low or high frequency noise, such as air-handling equipment, pumps, generators, etc.
Room Use	The BDF shall be dedicated solely to Technology and related facilities. Equipment that does not support the BDF (e. g., pipes, duct work, distribution of building power) shall not be located in or pass through the BDF.
Architectural Requirements	
Ceiling Height	The minimum ceiling height shall be 8.5 ft. above the finished floor with ceiling protrusions (e. g., sprinkler heads) placed to assure a minimum clear height of 8 ft. clear of obstructions, to provide space over the equipment frames for cables and suspended cable trays. To permit maximum flexibility and accessibility of cabling pathways, false ceilings are not recommended in BDFs.
Doors	BDFs shall have lockable doors that are at least 3.5 ft. wide and 6.5 ft. tall. Since large equipment is often located in the BDF, a double door 6 ft. wide by 7.5 ft. tall is recommended. Door sills are not recommended because they impede the movement of equipment. NOTE: Doors that open outward provide additional usable space and reduce constraints on BDF layout.
Flood Prevention	Locate BDFs above any threat of flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens).
Wall Requirements	BDF walls should extend from the finished floor to the structural ceiling (e. g., the slab). The BDF should not have windows installed, nor is it desirable to locate BDFs on perimeter/curtain walls where windows comprise the majority surface of the wall.
Backboard	Provide AC-grade plywood, 8 ft. high with a minimum thickness of 0.75 in. around the perimeter of the room. Plywood shall be either fire-rated or treated on all sides with at least two coats of fire- resistant paint. The bottom of the plywood shall be mounted 6 in. AFF (above finished floor).
Structural Requirements	The floor rating under distributed loading must be greater than 4.8 kPa (100 lbf/ ft. 2) and the rating for concentrated loading must be greater than 8.8 kN (2000 lbf) in areas that will support telecommunications equipment such as batteries and UPS equipment. If access flooring is used in the BDF, it must be rated accordingly.

Mechanical (HVAC) Requirements	Provide BDF with either dedicated HVAC equipment, or access to the main HVAC delivery system. Technology equipment requires the HVAC system to function 24 hours per day, 365 days per year. If a building's HVAC system cannot ensure continuous operation (including weekends and holidays), provide a stand- alone HVAC unit with independent controls for the BDF. If an emergency power source is available in the building, connect the HVAC system that serves the BDF to it. The HVAC system that serves the BDF should be tuned to maintain a positive air pressure differential with respect to surrounding areas with a minimum of one air change per hour in the BDF. Provide equipment to control humidity and air quality if needed. Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). Maintain positive pressure with a minimum of one air change per hour in the IDF. Provide: • Temperature 70 degrees F +/- 10 degrees • Relative humidity 50% +/- 20% Estimated Heat Loads: 5,000 to 7,500 BTU per equipment cabinet. UPS and stand-alone air conditioning systems produce additional heat, if present.
Electrical Requirements	
Lighting	Provide adequate and uniform lighting that provides a minimum equivalent of 50 foot-candles when measured 3 ft. above the finished floor level. Locate light fixtures a minimum of 8.5 ft. above the finished floor. Locate light switches near the entrance to the BDF. Emergency lighting systems which operate on trickle-charge storage batteries are desirable as a safety precaution in the event of an inadvertent power outage. Coordinate the lighting layout with the equipment cabinet layout, especially overhead cable trays, to ensure the light is not obstructed. Power for the lighting should not come from the same circuits as power for the technology equipment.
Equipment Power	Provide individual branch circuit serving a single load from the feeder panel directly to a branch circuit receptacle (for cord- and- plug connected equipment), or equipment power terminal (for hardwired equipment). Provide branch circuits for equipment power that are protected and wired for 120V, 20A and 120V, 30A. As a minimum, provide (1) 120V, 20A (NEMA 5-20R) dedicated circuit, with one duplex receptacle per circuit per rack and (2) 208V, 20A (NEMA L6-20R) dedicated circuit per BDF mounted at the base of one equipment cabinet (second rack from the wall.
Convenience Power	Provide separate duplex 120 V, 15A convenience outlets (NEMA 5-15R) for tools, test sets, etc., located at least 18 in. above the finished floor, placed at

	approximately 6 ft. intervals around perimeter walls and identified and marked as such.
Dedicated Power Feeders	Provide BDFs with a power supply circuit that serves only the BDF and terminates in its own electrical panel. The feeders that supply the power for technology equipment in BDFs should be dedicated only to supplying that equipment. More than one dedicated feeder may be required for large installations with a wide variety of technology equipment. Power required for other equipment in the room (e. g., fluorescent lighting, motors, air conditioning equipment) should be supplied by a separate feeder, conduit, and distribution panel.
Backup Power	Because of the "mission- critical" nature of the BDF, backup power must be provided by the Central Plant generator. In addition, a standalone UPS with a minimum of 15 minute battery capacity at full load shall be provided.
Bonding and Grounding	Provide a copper signal ground busbar in each BDF. The ground conductor shall be a 1/0 copper cable, cad-welded directly to the Ufer Ground or Main Building Entrance Ground, or building steel.
Conduit Sleeve Penetrations	Provide horizontal conduit sleeves into the BDF for the distribution of the horizontal cable from the cable tray. Provide vertical conduit sleeves from the IDF if stacked above to support the distribution of backbone cables. Conduit sleeves consist of a minimum of (4) 4" conduit sleeves stubbed into the BDF extended 6" on both sides.
Fire Suppression	Provide sprinkler heads in wire cages to prevent accidental operation. Coordinate the layout of fire protection systems with the equipment layout to avoid obstructing sprinklers, access to the alarm, or other protective measures. Mount portable fire extinguishers (with appropriate ratings) in the BDF as close to the entrance as possible.

B. Communications Requirements in the BDF

Ladder Rack	Provide Ladder Rack within the BDFs to route cable to or from sleeves, risers, ducts, cable trays to termination fields within equipment racks or mounted on walls. This cable ladder system shall be contained within the confines of the BDF.
Ladder Rack Materials and Applications	BDF cable ladder may be mounted horizontally or vertically on walls and over equipment cabinets and racks. Vertical ladder will be used to support riser cable from floor to ceiling as it passes between floors. The Cable Runway system shall be mounted to walls, the top of equipment rack, or hung with threaded rods for bracing and support. Refer to Local Building Codes for additional seismic bracing for code compliance.
Ladder Rack Bonding and	In the BDFs, the ladder rack system shall be bonded to the Telecommunications Ground Bus with 6AWG stranded copper wire.

Grounding	
Equipment Cabinets	Provide a minimum of (4) Equipment Cabinets in the BDF.
Cabinet Size and Construction	Each cabinet shall house two 19" internal mounting frames. It shall be possible to adjust the position of each rack in both horizontal directions. Each cabinet to provide a minimum of 77" (44U) space for equipment in the vertical plane. Each cabinet shall have a minimum load-carrying capacity of 1000 lbs. (450 kg.). Provide grommeted openings at the top of each cabinet requiring top access. The openings shall be a series of 4" diameter holes with bushings. The openings shall allow the cables to easily enter the cabinet and be routed into the cabinet's cable management. Each cabinet to be provided with a fan tray mounted at the top of the cabinet at the front. Provide covered vents on the top surface of the cabinet above the fan tray. Each cabinet to have a lockable Plexiglas front door with documentation wallet and a lockable sheet steel rear door with vents.
Power Requirements	Each cabinet to have a minimum of (2) mounted power strips at the rear of the cabinet with eight power sockets each. One strip will connect to the UPS and one strip will connect to a dedicated 20amp circuit. The power receptacles on the connector strip shall be NEMA 5-20R compatible. The plug shall be NEMA 5-20P compatible.
Installation Requirements	Provide all mounting components and accessories to securely fix cabinets to floor. Provide appropriate seismic transverse and longitudinal bracing per any local codes and the current NUSIG (National Uniform Seismic Installation Guidelines). Provide cable bend management fixtures to maintain the proper bend radius as the cables drop into the cabinet. Do not allow cables to be unsupported as they run from conduit or cable ladder to equipment cabinets. To support the cables entering and exiting the cabinet from below remove bottom plate of the cabinet to allow cables to pass through. Since the cabinets are to be located in a row, provide side panels for each end of each row only. Do not provide side panels between adjacent cabinets. Connect cabinets in rows together using baying kits.
Bonding and Grounding	The equipment cabinets shall be bonded to the Telecommunications Ground Bus with 6AWG stranded copper wire.

II. DESIGN CRITERIA FOR THE IDF

The IDF, Intermediate Distribution Frame is the room type that supports the connection point between backbone and horizontal distribution cable and network edge devices. IDFs are generally considered to be floor-serving (as opposed to building or campus-serving) spaces.

A. Architectural and Building System Requirements in the IDF

Room Size	IDFs shall be approximately 80 to 120 sq.ft., depending on the size of the area the room is supporting. At a minimum, the IDFs shall be 8 X 10, with a minimum clear dimension of 8 ft. in one direction.
Room Location	There must be at least one IDF per floor. Multiple rooms are required if the cable length between the IDF and the telecommunications outlet, including slack, exceeds 295 ft.
Room Use	The IDF shall be dedicated solely to Technology and related facilities. Equipment that does not support the IDF (e. g., pipes, duct work, distribution of building power) shall not be located in or pass through the IDF.
Architectural Requirements	
Ceiling Height:	The minimum ceiling height shall be 8.5 ft. above the finished floor with ceiling protrusions (e. g., sprinkler heads) placed to assure a minimum clear height of 8 ft. clear of obstructions, to provide space over the equipment frames for cables and suspended cable trays. To permit maximum flexibility and accessibility of cabling pathways, false ceilings are not recommended in IDFs.
Doors	IDFs shall have lockable doors that are at least 3.0 ft. wide and 80 in. tall. Door sills are not recommended because they impede the movement of equipment. NOTE: Doors that open outward provide additional usable space and reduce constraints on IDF layout.
Flood Prevention	Locate IDFs above any threat of flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens).
Wall Requirements	IDF walls should extend from the finished floor to the structural ceiling (e. g., the slab). The IDF should not have windows installed, nor is it desirable to locate IDFs on perimeter/curtain walls where windows comprise the entire surface of the wall.
Backboard	Provide AC-grade plywood, 8 ft. high with a minimum thickness of 0.75 in. around the perimeter of the room. Plywood shall be either fire-rated or treated on all sides with at least two coats of fire- resistant paint. The bottom of the plywood shall be mounted 6 in. AFF (above finished floor).
Structural Requirements	Provide a minimum floor loading of 2.4 kPa (50 lbf/ ft. 2).
Mechanical (HVAC)	Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). Maintain positive pressure with

Requirements	a minimum of one air change per hour in the IDF. Provide: • Temperature 70 degrees F +/- 10 degrees • Relative humidity 50% +/- 20% Estimated Heat Loads: 5,000 BTU per equipment cabinet or rack.
Electrical Requirements	
Lighting	Provide adequate and uniform lighting that provides a minimum equivalent of 50 foot-candles when measured 3 ft. above the finished floor level. Locate light fixtures a minimum of 8.5 ft. above the finished floor. Locate light switches near the entrance to the IDF. Emergency lighting systems which operate on trickle-charge storage batteries are desirable as a safety precaution in the event of an inadvertent power outage. Coordinate the lighting layout with the equipment cabinet layout, especially overhead cable trays, to ensure the light is not obstructed. Power for the lighting should not come from the same circuits as power for the technology equipment.
Equipment Power	IDFs shall be equipped to provide adequate electrical power. As a minimum, provide (1) 120V, 20A dedicated circuits, with one duplex receptacle per circuit per rack.
Convenience Power	Provide separate duplex 120V, 15A convenience outlets (NEMA 5-15R) for tools, test sets, etc., located at least 18 in. above the finished floor, placed at approximately 6 ft. intervals around perimeter walls and identified and marked as such.
Backup Power	A standalone UPS with a minimum of 15 minute battery capacity at full load shall be provided
Bonding and Grounding	Provide a copper signal ground busbar in each IDF. The ground conductor shall be a 1/0 copper cable, cad-welded directly to the Ufer Ground or Main Building Entrance Ground, or building steel.
Conduit Sleeve Penetrations	Provide horizontal conduit sleeves into the IDF for the distribution of the horizontal cable from the cable tray. Provide vertical conduit sleeves from the IDF above if stacked to support the distribution of backbone cables. Conduit sleeves shall consist of a minimum of (4) 4" conduit sleeves stubbed into the IDF and extended 6" on both sides.
Fire Suppression	Provide wet-pipe system with sprinkler heads in wire cages to prevent accidental operation.

B. Communications Requirements in the IDF

Ladder Rack	Provide Ladder Rack within the IDFs to route cable to or from sleeves, risers, ducts, cable trays to termination fields within equipment racks or mounted on walls. This cable ladder system shall be contained within the confines of the

	IDF.
Ladder Rack Materials and Applications	IDF cable ladder may be mounted horizontally or vertically on walls and over equipment racks. Vertical ladder will be used to support riser cable from floor to ceiling as it passes between floors. The Cable Runway system shall be mounted to walls, the top of equipment rack, or hung with threaded rods for bracing and support. Refer to Local Building Codes for additional seismic bracing for code compliance.
Ladder Rack Bonding and Grounding	In the IDFs, the ladder rack system shall be bonded to the Telecommunications Ground Bus with 6AWG stranded copper wire.
Equipment Racks	Provide a minimum of (3) Equipment racks in a standard IDF.
Size and Construction	Each rack shall consist of a modular EIA 19" mounting frame, with a minimum of 77" (44U) space for equipment in the vertical plane. The rack shall be manufactured from extruded aluminum / steel with a minimum load-carrying capacity of 1000 lbs. (450 kg.). Each rack will have both horizontal and vertical cable management. Provide side-mounted vertical cable management on both sides of each rack. Provide strain relief and cable management at the rear of each rack to ensure tidy routing of all feeder and horizontal cables. Each rack to have a minimum of eight power sockets mounted on a strip at the rear of the rack. The power receptacles on the connector strip shall be NEMA 5-20R compatible. The plug shall be NEMA 5-20P compatible.
Power Requirements	Each cabinet to have a minimum of (2) mounted power strips at the rear of the cabinet with eight power sockets each. One strip will connect to the UPS and one strip will connect to a dedicated 20amp circuit. The power receptacles on the connector strip shall be NEMA 5-20R compatible. The plug shall be NEMA 5-20P compatible.
Installation Requirements	Provide all mounting components and accessories to securely fix racks to floor and supporting walls. Provide appropriate seismic transverse and longitudinal bracing per any local codes and the current NUSIG (National Uniform Seismic Installation Guidelines), and fix each rack to the overhead ladder. Provide cable bend management fixtures to maintain the proper bend radius as the cables drop into the rack. Do not allow cables to be unsupported as they run from conduit or cable tray to equipment cabinets.
Bonding and Grounding	The equipment racks shall be bonded to the Telecommunications Ground Bus with 6AWG stranded copper wire.

DESIGN CRITERIA FOR THE COMMUNICATION CABLE SYSTEM SUPPORT INFRASTRUCTURE

The horizontal communication cable system infrastructure includes the pathway and support hardware which concentrates, supports and protects horizontal cable between its origination point in the IDF or BDF and the workstation outlet location. It also provides a permanent pathway that facilitates the addition or replacement of cable over time. Horizontal support hardware is further defined as continuous, (e.g. Conduit, Cable Tray) and non-continuous (e.g. J-Hooks, Bridle Rings).

I. COMMUNICATION DISTRIBUTION CABLE TRAY

Distribution cable tray shall be installed above the accessible ceiling for the creation of main pathways for the management of high volumes of cable through corridors, and for access and egress to BDF and IDFs.

Construction	Cable tray shall be the wire basket type manufactured of ASTM A510 high strength steel wires or equal, and comply with NEMA VE1 or the proposed IEC 61537 standards. The cable tray shall be UL (Underwriters Laboratory) listed.
Dimensions	The cable tray shall be a minimum of 18 in. wide, with a depth of 4 in. Narrower cable tray may be used for locations with lower volumes of cable.
Support Requirements	A trapeze-style support shall be used along the span of the cable tray. The trapeze shall be constructed of channel stock (i.e.Unistrut) and 5/8 in. threaded rod. The trapeze support elevation should allow a minimum of 12 in. between the top edge of the cable tray and the slab above. Appropriate threaded rod anchors shall be selected and approved by the Project Structural Engineer. Trapeze supports shall be placed a minimum of every 10 ft. and at cable tray intersections and terminations. Seismic bracing for the cable tray as required by code, shall be installed along cable tray routes. Coordination of lateral and oblique bracing locations shall be coordinated with the other disciplines whose equipment and systems share the area above the suspended ceiling.
Bonding and Grounding Requirements	The cable tray shall be bonded to the Telecommunications Grounding Bus Bar in the IDF(s) on the same floor. All non-contiguous segments of the Cable tray shall be bonded together using 6AWG stranded copper wire, with crimp-on lugs bolted to each segment of the cable tray to ensure electrical continuity throughout the length of the cable tray system.
Firestopping Requirements	Cable trays that penetrate fire-rated walls shall be equipped with wall penetration sleeves at each location, and have appropriate firestopping materials installed after the placement of cable has been completed.

II. COMMUNICATION CABLE SYSTEM CONDUIT

Provide Communications cable conduit in locations where access to cable tray is unavailable or where portions of the pathway span are inaccessible (i.e. embedded in walls or inaccessible ceilings). Provide conduit for small quantities of cable where cable tray is impractical. Conduit materials may be used to house non-rated cables between end points to ensure NEC Code compliance.

Conduits serving individual workstation outlets shall be a minimum of 1 in. The 1 in. conduits shall be connected to double-gang, deep device boxes (2-1/2 in. deep), equipped with a single-gang mud ring at the outlet location. Individual workstation conduits are to be dedicated to only one outlet box each, and shall not be "daisy-chained" together.

The following conduit type shall be utilized as described below:

Rigid Galvanized Steel (RGS)	Rigid conduit shall be used in areas exposed to the outside elements above ground and used for the containment of non-rated cable as specified in the NEC. RGS shall be installed using threaded couplers and fittings.
Intermediate Metallic Conduit (IMC)	IMC conduit shall be used in areas exposed to the outside elements. IMC conduit shall not be used for non-rated cable installations but it may be used to carry riser-rated cable and innerduct in vertical and horizontal cable applications. IMC conduit shall be installed using threaded couplers and fittings.
Thinwall Electrical Metallic Tubing (EMT)	EMT shall be used for installations within the confines of an environmentally-controlled building. EMT conduit is not acceptable for non-rated cable installations. EMT conduit may be used, however, to carry riser-rated cable and innerduct in vertical and horizontal cable applications. EMT conduit may be used as sleeves for wall penetrations, and for floor core riser penetrations. EMT conduit connectors and fittings shall be installed using "Set-Screw" type or air-tight "Compression" type fittings.
Flexible Conduit ("Flex")	Flexible conduit shall not be used for communication cable installation when EMT conduit is available. Flex conduit may used for connections into modular furniture or similar applications. When using Flex conduit, increase the diameter of the Flex by one trade size over what the requirement would be using smooth-wall conduit.
Plastic Conduit/Polyvinyl Chloride (PVC)	Plastic and PVC conduit shall be used for underground duct construction between buildings and vaults. PVC conduit shall not be used within buildings per NEC Code and UBC (Uniform Building Code). The PVC conduit shall be a minimum of Schedule 40 PVC. Plastic.

A. Conduit Installation Guidelines

Support Requirements	Conduits shall be installed with support systems such as channel stock/threaded rod trapeze supports. Individual conduits may be supported using threaded rods with clamps. Conduits may be attached to the underside of cable trays and affixed to walls where practical. Seismic bracing shall be installed as required by local building codes, DSA, and NUSIG (National Uniform Seismic Installation Guidelines). Accommodations for lateral and oblique bracing struts must be coordinated with the other disciplines that vie for critical ceiling space.
Bonding and Grounding	Bonding of conduits to the Telecommunications Grounding System is required. At the termination of conduit runs within IDFs, attachment of a ground wire between the Telecommunications Ground Bus to grounding rings installed on conduit box connectors should be accomplished to ensure electrical continuity of the conduit system.
Firestopping	Partially filled and empty conduits that pass through fire-rated walls or through floors shall be firestopped in accordance with Local Fire Codes. Material shall be flexible firestopping putty or pillows.

III. INNERDUCT

Innerduct shall be installed to establish multiple pathways in a larger conduit or provide a pathway across a cable tray. Innerduct shall be used for the protection of fiber optic cabling, but copper cabling may be installed in the innerduct to prevent tangling with other cables already present. Innerduct shall be used to protect fiber optic cabling in cable trays, exposed areas in ceilings, IDFs, and BDFs.

IV. COMMUNICATION CABLE SYSTEM PULL BOXES

A pull box shall be installed in conjunction with conduit installations to provide access to cables at appropriate locations for distribution to tributary locations, and to facilitate cable installation.

Materials	For indoor use, use NEMA Type 1 pull boxes. For areas exposed to heavy moisture, chemicals or weather elements, NEMA Type 3 or 4 pull boxes shall be installed. The pull box shall be equipped with hinged covers, or removable covers which are screwed or bolted on. The pull boxes shall have hardware for supporting and securing cabling and pulling eyes to facilitate cabling installation.
Placement	A pull box shall be installed after 100 feet of conduit has been placed, and/or after 180 degrees of directional change in the conduit pathway has been affected. The installation of a pull box shall not be used for directional change.
Support Requirements	Pull boxes shall be attached directly to the ceiling slab, or suspended by 4-point threaded rod supports anchored to the ceiling. Pull boxes require seismic bracing to comply with Local Building Codes. Seismic bracing

	shall be installed as required by local building codes, DSA, and NUSIG (National Uniform Seismic Installation Guidelines). Accommodations for lateral and oblique bracing struts must be coordinated with the other disciplines that vie for critical ceiling space.

V. HORIZONTAL CABLE SUPPORT HARDWARE (NON-CONTINUOUS)

Horizontal Cable Support Hardware such as J-Hooks shall be used in locations where the communication cable is not supported by continuous systems such as cable trays or conduit.

Provide J-Hooks every 48" at a minimum, attached to threaded rod or ceiling hangers to provide support for cable bundles or innerduct. The J-Hooks shall be metal stampings configured in a "J" form providing a broad cradle or saddle for supporting for of cable.

VI. DESIGN CRITERIA FOR INTERBUILDING COMMUNICATION DUCTBANKS AND TRANSITION STRUCTURES

Interbuilding Communication Infrastructure Ductbanks shall be installed to carry communication cables between the tunnel system and buildings on Campus. The Duct shall be constructed of contiguous segments of PVC conduit. The Ductbanks shall be encased in slurry.

Transition Structures, manholes, shall be installed as required to allow technicians access to cable and splices to perform maintenance or to modify distribution configurations. The size of the Transition Structures shall be selected for installation by the number of ducts and potential cable count the structure must contain.

The following provides general requirements for all Interbuilding Communication Duct Banks and Transition Spaces as components of the overall communication cable system infrastructure.

A. Interbuilding Communication Ductbanks

Interbuilding Communication Ductbanks shall be designed to provide a permanent and durable pathway system which is available for the delivery of entrance cable from the campus connection point in the adjacent utility tunnel or as part of a campus Interbuilding backbone system connecting several buildings to the Campus Loop.

Configuration	There shall be minimum of (4) 4" conduits between the Campus Buildings and the Campus connection point. The Ductbanks shall be configured in arrays, with several rows stacked together such as 1 x 4, 2 x 2, 3 x 4 and shall correspond to the arrangement of duct openings in pre-cast concrete vaults and manholes where transitions occur.
Construction Materials and Methods	Ductbanks shall be encased in slurry.. Where Ductbanks share underground pathways with other underground infrastructure components such as water lines, gas lines, sanitary systems, it is critical that the communications infrastructure be installed with the highest level of durability. The duct material itself shall be Trade Size 4 (4-inch diameter), PVC Schedule 40 or equal, and suitable for contact with concrete. Conduits shall be cut square, with the cut ends reamed and deburred. Plastic bushings are

	to be installed over the each end of every conduit. Place a ¼"nylon or polyethylene pull rope in each conduit from end to end. Install conduit plugs in each empty outside plant conduit to prevent the introduction of noxious gases or water into the building.	
Ductbank Placement	Duct routing shall be coordinated with the Campus Infrastructure project, with consideration for distance between Transition Structures and difficulty of cable pulls, particularly when high-count multipair copper cables are necessary. The minimum radius for curves is 15 feet. Slurry-Encased Ductbank Dimension Guidelines	
	Ground Cover	Minimum of 24 inches
	Top Level of Slurry	Minimum 3 Inches above top duct
	Slurry on Outer Sides of Ductbank	Minimum 3 inches
	Slurry Between Ducts	1.5 inch (above, below and to each side)
	Bottom Level of Slurry	Minimum 3 inches
Ductbank Marking	A metallic warning tape, detectable with magnetic location equipment, should be buried directly over the path of the Ductbank approximately 18" below the surface.	
Ductbank Termination At The Building	Communication Ducts should be terminated with bell-end connectors, flush with the inner surface of the wall.	

B. Communication Transition Structures

Ductbank Transition Structures shall be provided allow access to cable installed within underground ductbanks. The transitions structures shall provide a location for the storage of splice cases and slack loops of cable. The transition structures shall facilitate the distribution of cable to multiple locations by providing a junction point for ducts radiating in several directions.

Selection of Transition Structure Type	The type of structure chosen for installation shall be dependent on the number of ducts in the span. The ductbank transition structure shall be preformed concrete structures have weight-bearing cover/lid capacities that range from light pedestrian traffic to deliberate heavy vehicular traffic. The appropriate rating should be selected based on the anticipated exposure of the structure to these differing traffic types.
Placement of Transition Structures	Structures shall be placed after 180 degrees of directional change has been affected in the ductbank route. In straight or relatively straight runs, there shall be no more than 400 feet between structures. Structures shall not be used as the apex of 90-degree change in duct direction. Sweeps and structures shall be planned such that the sweep occurs outside of the structure, allowing straight cable pulls through the structure itself.
Transition	Transition structures require the following equipment:

Structure Accessories and Equipment	• A sump, or gravel drainage in the case of small hand holes • Corrosion-resistant pulling eyes • Cable racking • Grounding cables installed per applicable codes or practices • Ladders and steps • Watertight duct plugs

DESIGN CRITERIA FOR COMMUNICATION CABLING

I. CABLING SYSTEM REQUIREMENTS

The communications-cabling system will be based on the following design guidelines:

- The cabling system will be standards compliant (EIA/TIA 568A)
- The cabling system will provide a high level of flexibility, capability and resilience.
- The cabling system shall include high performance copper and optical fiber cabling, as well as wireless systems where appropriate.
- Communications Outlets will be provided throughout the facility. Each outlet will support voice, data and digital media connectivity.

A. Cabling System Overview

The communications cabling system at LACC is based on a flexible design that will allow any communications connector to be used for voice or data. All communications station cable is terminated on RJ45 connectors at the faceplate and RJ45 patch panels in the IDF Closets. The voice riser cable will be extended from 66 blocks in the BDF to each IDF with one pair terminated on each port of a voice riser patch panel. This system will support add, moves and changes by simply moving a patch cord.

B. Communications Outlet Configurations

All communications outlets will support a combination of voice, data and media applications. The jack position A (top right) on standard outlets will be utilized primarily for voice applications, therefore provide a grey insert at this position to designate voice, all others will be white. For applications where there is no anticipated voice, provide all white inserts.

The table below describes the typical outlet configurations.

Standard Wall Mounted Outlet	Standard wall mounted outlets will be the typical outlet configuration throughout the buildings. Standard wall mounted outlets will consist of four Category 6e unshielded communications cables terminated on RJ45 connectors at the faceplate.
Wall Mounted Phone Outlet	Wall mounted phone outlets will consist of one Category 6e unshielded communications cables terminated on RJ45 connectors at the faceplate. The faceplate will be mounted 48" above the finished floor, unless directed otherwise by the Architect.
Duplex or Quad Wall Mounted Outlet	In classrooms and other spaces requiring only one data connection per user, a duplex or quad outlet will be provided as appropriate to the seating and equipment layouts. Duplex outlets will consist of two Category 6e unshielded communications cables and Quad outlets will consist of four Category 6e unshielded communications cables terminated on RJ45 connectors at the faceplate.
Floorbox / Poke-through	In areas that need communications outlets in the floor, the typical floorbox and poke though will consist of four Category 6e unshielded communications cables terminated on RJ45 connectors in the floor device.
Audiovisual Communications Outlets	At instruction or presentation locations, provide communications outlets dedicated to the audiovisual presentation system. If no audiovisual system exists, the AV communications outlet will still be provided at the instructor's location consisting of of two Category 6e unshielded communications cables terminated on RJ45 connectors in the floor device.
Ceiling Mounted Outlet	At the video projection locations ceiling mounted outlets will consist of Three Category 6e unshielded communications cables terminated on RJ45 connectors at the faceplate mounted in the accessible ceiling tile or mounted on the surface as applicable. This supports (1) cable for the video projector and (2) cables for the wireless access point.
Wireless Access Point	Communication outlets support wireless access points will be co-located at the projector locations in all classrooms. The co-located wireless access points will use (2) of the three cables provided at that location. In other areas, wall mounted 1' above the accessible ceiling or 1' below an inaccessible ceiling. The outlets supporting the wireless access points will consist of two Category 6e unshielded communications cables terminated on

	RJ45 connectors at the faceplate.

C. Communications Outlet Population in Specific Room Types

Office Single Occupancy <80sf	(2) Standard Outlet (4 cables and connectors)
Office Single or Double Occupancy >80sf	(2) Standard Outlets located on two walls that are perpendicular to the door wall.
Division Dean's Office	(3) Standard Outlets located on three walls
Conference / Meeting Rooms	(1) Standard outlet located on the wall where furniture or casework has been installed. (1) Quad located in a floorbox under the conference room table or integrated into the conference room table.
Classrooms	(1) Duplex outlet on each of the three walls in the classroom (not including the front wall). (1) Standard outlet dedicated to AV next to the multi-media input panel. (1) Standard outlet mounted at the ceiling projector location for ceiling mounted projector and wireless access point.
Computer Labs	Same as above plus, Computer Labs – (1) Data drop per seat

D. Backbone Cable (Inside Building)

The Backbone cable will connect each IDF back to the BDF. Backbone connectivity will be supported by multipair copper cabling for voice and optical fiber cables for data.

- Multipair telephone riser cable will be run from 66 blocks in the BDF to rack mounted voice patch panels in the IDFs with (2) pair of riser cable terminated on RJ45 connectors.
- Optical fiber will be run from the BDF to each IDF consisting of (6) Singlemode and (6) high performance, 50 micron Multimode elements terminated on SC connectors rack mounted in optical fiber patch panels.
- Category 6e cable will be run from the BDF to the IDFs located less then 290 feet away and shall consist of (12) Category 6e cables terminated on RJ45 connectors terminated in patch panels.

E. Link Cable (Between IDFs on the same floor)

The link cable will connect each multiple IDFs on a floor.

- Category 6e cable will be run between IDFs located less then 290 feet away and shall consist of (6) Category 6e cables terminated on RJ45 connectors terminated in patch panels.
- Optical fiber will be run from the between IDFs (6) high performance, 50 micron Multimode elements terminated on small form factor LC connectors rack mounted in optical fiber patch panels.

F. Backbone Cable (Campus Connection)

1. Optical Fiber

LACC is planning to adopt a fully meshed optical fiber physical network to support their fully meshed data network. Each building at a minimum will have fiber connections to both the Omega Data Center located in the Admin building and the Alpha Data Center in the Sci-Tech building. The optical fiber will be run form the campus connection point to the BDF in each building.

- Each fiber connection (minimum of two into the building from diverse routes) consists of (24) Single-mode and (24) 50 micron Multi-mode elements.
- The following buildings will have additional meshed fiber connections:

Building	**Additional Meshed Link**
Building 1	Building 2
Building 3	Building 4
Building 5	Building 6

2. Copper Voice Cable

LACC is fully deployed with voice over IP (VoIP) system. The copper identified in this report is intended for areas where it is mandated by local or state laws for safety reasons (e.g. elevators).

- Provide 1.5 pair of outside grade telephone cable for each 125 assignable sf, terminated on protection blocks in the BDF.

II. LABELING

Labeling shall be consistent across all projects. Please ensure that the labeling corresponds to the final room number which may be different then the Architect's number scheme on the construction documents.

A. IDF Closets

All BDF and IFD rooms will be uniquely numbered as follows:

- Floor – A, B A is the first IDF or BDF on the floor, B is the second.
- Example: 1A, First floor, first IDF

B. Equipment Racks

All equipment racks will be uniquely numbered as follows:

- Building Name – IDF Number – Rack Number
- Rack Numbers will start with 1 from the wall
- Example: Allied Health - 1A -1

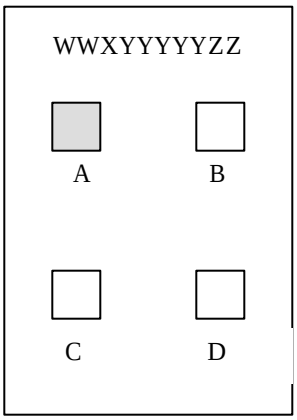
C. Workstation Outlets

All workstation outlets will be clearly labeled as follows:

WW	IDF Closet
X	Rack Number
YYYYY	Room Number – Use minimum spaces up to 5
ZZ	Outlet Number – Clockwise around room from door.
A, B ,C, D	Jack Numbers

Example: 1A0112101

IDF 1A, Rack 01, Room 121, Outlet 01



D. Patch Panels

All patch panels will be clearly labeled matching the workstation labels, as follows:

- YYYYYZZA

YYYYY	Room Number - Use minimum spaces up to 5
ZZ	Outlet Number - Clockwise around room from door.
A	A, B, C, D Jack Number

- Example corresponding to outlet above: 12101A 12101B:
- Room 121, Outlet 01, Jack A

TECHNOLOGY DEPLOYMENT

I. BUDGET ALLOCATION

This section identifies the allocation of budget resources related to technology for LACC so each building project had the same level of budgetary support as the other building projects on Campus. This section defines the equipment that falls under Group 1 and Group 2 (FFE) budgets.

A. Group 1 Building Construction Budget

The following Information Technology systems and infrastructure shall be included in the Group 1 building budget. This describes the minimum systems and infrastructure required on day one to allow the building to open fully functionally. These systems include:

Technology Category	**Equipment**
Cabling Infrastructure	Equipment rooms, conduit, cable tray, device backboxes, conduit ductbanks and associated components.
Communications Cabling	Category 6e copper and optical fiber cabling, faceplates, connectors, patch panels, equipment racks and associated components to support telephone and data signal distribution throughout the building.
Wireless Network Access Points	Access points to provide wireless data network connectivity throughout the building.
Data Network Campus Connection	Data Network equipment to provide a connection between the building and the campus data network.
Data Network Building Backbone	Data network equipment providing network connection between each IDF in the building and the campus connection point.
Academic / Administrative Data Network	Data network equipment providing data connectivity in each classroom, for faculty and staff, academic and administrative use. (Note that connectivity for students is provided in Group 2 or is assumed to be wireless).

B. Group 2 Equipment Budget

The following Information Technology Systems equipment should be included in the Group 2 budget:

Technology Category	**Equipment**
Data Network Connectivity for	Equipment to provide data connectivity for student use. (Note that connectivity for students is also provided in Group 1 via the wireless

Students	network).
Information Technology Equipment	Computers (including laptops and PCs located in Labs and Classrooms), telephone handsets, printers and other peripherals.