9.0 IT / TELECOMMUNICATIONS / AV / SECURITY / SMART BUILDINGS

9.1 INFORMATION TECHNOLOGY AND TELECOMMUNICATION

The purpose of this section of the report is to outline the basis of design for the Information and Communications Technology (ICT) infrastructure serving the building and to address implications to the Cornell Roosevelt Island Campus ICT infrastructure.

The ICT systems provided include the Structured Cabling System (SCS) in support of the LAN, WAN, WLAN, VoIP and IPTV, Video Surveillance System (VSS), Building Automation and Control System (BACS), Access Control System (ACS), Elevator monitoring, Parking controls, etc. Pathways for owner provided DAS infrastructure are provided..

Two distribution options were considered for the IT infrastructure at the onset of the project:

- Option 1 - traditional SCS, star based topology, consisting of fiber optic backbone and copper horizontal cabling used to support traditional LAN infrastructure
- Option 2 - Fiber Distribution Network (FDN), PON based topology, consisting of fiber optic and passive splitters distribution to end devices used to support emerging Optical LAN technology.

The client has opted to proceed with a design based on a traditional copper distribution. This will not eliminate the option to implement an Optical LAN (OLAN) in the future but since design will incorporate TRs and environmental requirements associated with a traditional distribution, it would eliminate some of the potential savings.

The following criteria are based on Option 1 and differences with Option 2 are noted.

9.1.1 CODES AND STANDARDS

The following Codes and Standards will be used in the design of ICT and Special Systems:

- ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Costumer Premises
- ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard
- ANSI/TIA/EIA-568-C.3 – Optical Fiber Cabling Components Standard
- ANSI/TIA/EIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces
- ANSI/TIA/EIA-606-B – Administration Standard for Commercial Telecommunications Infrastructure
- ANSI/TIA/EIA-607-B – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- BICSI – Telecommunications Distribution Methods Manual
- BICSI – Cabling Installation Manual
- BICSI - NTS Design Manual
- National Fire Protection Association (NFPA) Standards

- American National Standards Institute (ANSI) Standards
- American Society for Testing and Materials (ASTM) Standards
- National Electric Code (NEC) Standards
- National Electrical Manufacturers' Association (NEMA) Standards
- Underwriters Laboratories (UL) Standards
- Institute of Electrical and Electronic Engineers IEEE Standards
- The Occupational Safety and Health Act of 1970 (OSHA)
- Cornell University Design and Construction Standards

9.1.2 DESIGN OBJECTIVES AND STRATEGIES

Function

The basic requirements for the ICT Infrastructure include:

- Pathway(s) to the Telecom Service Provider (more than 5 feet from building is by others). It was agreed with the site team to run pathways to building envelope.
- Telecom Entrance Facilities for demarcation of service provider equipment and surge protection from external sources
- Equipment Room (ER) to house LAN core equipment, application servers, data storage, and other active communications head end equipment not located remotely
- Telecommunications Rooms (TRs) to house LAN access switches located to provide 100% horizontal cabling coverage within 90m (295ft) maximum cable length
- Risers to support fiber distribution from ER to TRs on each floor
- Cabling and pathway support for:
  - Local Area Network (LAN)
  - Server and Storage Systems not supported remotely
  - Voice and TV over Internet Protocol (VoIP and IPTV) systems
  - Ubiquitous private Wi-Fi
- Support of other active communications systems (BMS, security, AV, radio, etc.) as deemed appropriate with respect to ICT spaces, pathways, cabling, and LAN
- Miscellaneous circuits such as dedicated alarms, central station connections, fax, ISDN, etc.

For Option 2, OLAN, the TRs could be substantially reduced to only accommodate a passive optical splitter and any rack mounted ONTs, which do not require separate HVAC provisioning. The pathways would also be substantially reduced. No separate copper backbone would be required for analog connectivity.

Performance

The following are the performance criteria that will be used for the ICT infrastructure:

- Continuous, durable and structurally sound pathways, housings and support mechanisms for cabling distribution

- Horizontal cabling capable of supporting minimum 1 Gigabit Ethernet to the terminal outlets
- Backbone cabling capable of supporting minimum 10 Gigabit Ethernet (upgradable to 40/100 Gigabit Ethernet).

For Option 2 the current terminal supported performance is 1.25/2.5 Gbps, (upstream/downstream). The standard for 10GbE PON is in development. Upgrades are performed keeping the existing infrastructure functional since the two standards use different wavelengths.

Management and Security

Management and security relate to the ease with which physical network management tasks may be completed and the ability to deter unauthorized access to the cabling infrastructure. Items include but may not be limited to:

- All telecom spaces in the building shall be secured.
- Shared ICT spaces will provide space for the accommodation of other active communications systems without the introduction of internal partitions.
- Consideration shall be given to appropriate access and staging clearance to ease moves, additions, and changes (MAC) to the infrastructure.

For Option 2 the management is centralized at the OLT (Optical Line Terminal) reducing complexity and operator error failures. MACs are simplified as if benefiting from an intelligent patching system.

Flexibility and Growth

The following items are recommended to be considered in the design to enhance the flexibility and facilitate future growth:

- Typical work area outlets will support at least one additional spare port beyond anticipated Day 1 requirements. This recommendation was considered only for the wireless access point outlets.
- For specialty areas, a flexible modular layout of communications outlets will be provided to accommodate a wide variety of potential demand profiles for spaces expected to be subject to frequent change.
- An allowance of at least 25% additional capacity in rooms, racks, and cabinets to accommodate growth will be provided.
- A minimum of 100% growth capacity in backbone pathways will be provided.
- A minimum of 25% growth capacity in horizontal pathways will be provided.
- A cabling pathway system that facilitates the removal and replacement of cabling with minimal destructive or interruptive work will be provided.
- Power and cooling provisions for telecommunications spaces will be based on room size rather than Day 1 equipment loads to accommodate the future requirements of an ‘at capacity’ room.
- The ICT Infrastructure will be designed to support a variety of technology systems. The rooms, spaces and pathways will be designed to accommodate flexibility and growth.

Option 2 inherently offers more flexibility and growth capability than any traditional LAN distribution.

Reliability and Safety
The design incorporates the following safeguards against events that may otherwise disrupt operation, damage equipment or harm users. Items include the following:

- Reliability will be optimized via the use of standards compliant manufacturers, equipment and testing procedures.
- A dual incoming service pathway is recommended. We subsequently learned that the site has only one incoming service path. Presently there are negotiations with a second service provider
- Horizontal cabling will be 100% plenum rated regardless of whether the cabling passes through a plenum for general fire safety performance and guard against potential changes to the HVAC strategy during design, construction or operation.
- Additional copper pairs and fiber strands will be provided to allow for redundant manual or automatic fail-over links along any backbone connection.

Option 2 inherently is far more reliable; five nine availability (5.26 min of unplanned disruption per year) for OLAN compared with only three nines (8.26 hours of unplanned disruption per year) for traditional LAN.

9.1.3 STRUCTURED CABLING SYSTEM (SCS)

The Structured Cabling System is comprised of the following main components:

- ICT spaces
- Backbone distribution
- Horizontal distribution
- Grounding and bonding system

ICT Spaces
The following summarizes the anticipated spatial program required to support the ICT design and systems integration strategies proposed for Option 1 – Conventional fiber backbone with UTP horizontal cabling option, which was the chosen base of design. The differences for the fiber based option are listed in the comparison table in section 9.1.4.

Entrance Facility Room
The Entrance Facility (EF) room serves as demarcation point between the telecommunications service provider's cabling and the owner's cabling. The Entrance Facility room will house service provider's equipment and cable terminations (and also potentially that of any second provider). The space will also accommodate any campus backbone connectivity too.

The EF will be located in the basement in room B15A.

The EF room technical requirements are listed in the table below:

Architectural	
Minimum size	6’ x 4’ (per CIT standard requirements)
Ceiling	9’ minimum clearance AFF, no ceiling, dust proof (sealed) No water drainage pipes or HVAC ducts passing through
Location, Access & Doors	Accessible from common corridors Away from sources of Electromagnetic Interference (EMI), water and steam infiltration No windows Single door opening outward
Locks & Security	Lockable doors; tied into university Best Access BASIS software system.
Occupancy	Infrequent
Floor Type	Polished/Sealed Concrete or tile
Floor Void	No.
Walls & Partitions	Dust proof finish Walls capable of equipment support (plywood backboard) No skirting/baseboard
HVAC	
Equipment	Air conditioning required
Redundancy	Not required
Humidity Control	Require 30-65%, 24hrs/day for 365 days/year
Temperature Control	Require 60 – 80°F, 24hrs/day
Ventilation	Require fresh filtered air frequently Minimum two air changes per hour Building ventilation may be used under the conditions stated in CU Design and Construction standards.
Electrical	
Convenience Power Outlets	Convenience wall receptacles 120VAC, 20 A every 6’ At least one quad receptacle at each plywood backboard
Power Load	Approximately 25 watts per square feet
Emergency Power	Required on all circuits
Telecommunications Ground	Telecommunications Grounding Bar required
Uninterruptible Power Supply	Provided by the telecommunications service provider
Lighting	Provide as per standard; see lighting section Emergency light required
Fire Protection	
Fire suppression	Pre-action system, with protective wire cages as per Cornel standard; Cornell to confirm if wet system is acceptable
Detection	Area smoke detectors as required by code for early warning
Extinguishers	Dedicated Carbon Dioxide (CO2) extinguisher for protection of electronic equipment
Fire Stopping	All penetrations through fire rated barriers to be fire stopped using approved methods and materials

Table 1 - Entrance Facility Room Technical Requirements

Equipment Room (ER)

The Equipment Room serves the entire building and the CUP building and houses the main cross-connect of the SCS and active equipment for the technology systems.
The room's technical requirements are listed in the table below:

Architectural	
Size	10' x15' (per CIT standard requirements) Assumed remote DC will be used and reduced to 9' x11'
Ceiling	9 ' minimum clearance AFF, no ceiling, dust proof (sealed) No water drainage pipes or HVAC ducts passing through
Location, Access & Doors	Accessible from common corridors Accessible for delivery of large equipment Easy access to backbone pathways Away from sources of Electromagnetic Interference (EMI), water and steam infiltration No windows Double door opening outward
Locks & Security	Lockable access by access control system and intrusion detection; tied into university Best Access BASIS software system.
Occupancy	Infrequent
Floor Type	Antistatic tile or equivalent
Floor Void	No
Walls & Partitions	Dust proof finish Walls capable of equipment support (plywood backboard) No skirting/baseboard
HVAC	
Equipment	Dedicated units on emergency power Supplemental cooling solutions may be needed depending on the layout and density of equipment in the data cabinets, vendor selection and the agreed cooling strategy; energy efficient solutions recommended
Redundancy	Recommended (N+1 redundancy)
Humidity Control	Require 30-65%, 24hrs/day for 365 days/year
Temperature Control	Require 60 – 80°F, 24hrs/day
Ventilation	Require fresh filtered air frequently Minimum two air changes per hour Building ventilation may be used under the conditions stated in CU Design and Construction standards.
Electrical	
Power Distribution	Minimum of two dedicated 3-wire 120VAC, 30 A , non-switched, duplex receptacles on separate circuits for each rack/cabinet Dedicated power panels for the room required Flexible and intelligent power distribution recommended

Architectural	
	depending on the layout of the ER, vendor selection and the agreed power distribution strategy.
Convenience Power Outlets	Convenience wall receptacles around perimeter walls At least one quad receptacle at each plywood backboard
Power Load	Approximately 100 watts per square feet
Emergency Power	Required on all circuits
Telecommunications Ground	Telecommunications Main Grounding Bar required
Uninterruptible Power Supply (UPS)	Power conditioning and protection capable of maintaining the full rack/cabinet power load during cutover to the emergency generator is recommended. The UPS should be a local unit (specified under the electrical section) to supply the entire room load for up to 20 minutes Powerware 9125 2000VA UPS and a 48 EBM extended battery module is CIT standard
Lighting	Provide as per standard; see lighting section
Fire Protection	
Fire suppression	Pre-action system, with protective wire cages as per Cornel standard; Cornell to confirm if wet system is acceptable
Detection	Area smoke detectors as required by code but we also recommend an early detection system for providing alarms in advance of a fire occurring.
Extinguishers	Dedicated Carbon Dioxide (CO2) extinguisher for protection of electronic equipment
Fire Stopping	All penetrations through fire rated barriers to be fire stopped using approved methods and materials

Table 2 - Entrance Facility Room Technical Requirements

Telecommunications Room (TR)

The TRs are floor serving spaces and house the horizontal cross-connects and floor serving active equipment for the building technology systems. Each TR will serve the outlets located in the respective zone / floor. Note that TRs are designed based upon requirements of conventional ICT Infrastructure (fiber backbone and UTP copper horizontal with access switches in each TR). If OLAN solution is implemented, the TR space power and cooling requirements will be substantially reduced.

The TRs will be located in order to provide ubiquitous coverage throughout the facility whilst maintaining maximum 295' horizontal cabling length, in compliance with the industry standards. It is recommended that the TRs be centrally located within the zone they serve and vertically aligned between floors whenever possible.

The room's technical requirements are listed in the table below:

Architectural	
Size	Approximately 9’ x 8’ net space (column free space, with doors preferably opening to the outside where possible) For Option 2 a shallow closet will suffice
Ceiling	9’ minimum clearance AFF, no ceiling, dust proof (sealed) No water drainage pipes or HVAC ducts passing through
Location, Access & Doors	Accessible from common corridors Easy access to backbone and pathways Away from sources of Electromagnetic Interference (EMI), water and steam infiltration No windows Centrally located Vertically aligned between floors Single door opening outward
Locks & Security	Lockable access by access control system and intrusion detection; tied into university Best Access BASIS software system.
Occupancy	Infrequent
Floor Type	Antistatic tile or equivalent
Floor Void	None
Walls & Partitions	Dust proof finish Walls capable of equipment support (plywood backboard) No skirting
HVAC	
Equipment	Dedicated units on emergency power Supplemental cooling solutions may be needed depending on the layout and density of the equipment and the agreed cooling strategy; energy efficient solutions recommended
Humidity Control	Require 30-65%, 24hrs/day for 365 days/year
Temperature Control	Require 60 – 80°F, 24hrs/day
Ventilation	Require fresh filtered air frequently Minimum two air changes per hour Building ventilation may be used under the conditions stated in CU Design and Construction standards.
Electrical	
Power Distribution	Minimum of two dedicated 3-wire 120VAC, 20 A , non-switched, duplex receptacles on separate circuits for each rack/cabinet Dedicated power panels for the room required
Convenience Power Outlets	Convenience wall receptacles around perimeter walls At least one quad receptacle at each plywood backboard

Architectural	
Power Load	Approximately 50 watts per square feet
Emergency Power	Required on all circuits
Telecommunications Ground	Telecommunications Grounding Bar required
Uninterruptible Power Supply (UPS)	Power conditioning and protection capable of maintaining the full rack/cabinet power load during cutover to the emergency generator is recommended. The UPS should be a local unit (specified under the electrical section) to supply the entire room load for up to 20 minutes Powerware 9125 2000VA UPS and a 48 EBM extended battery module is CIT standard
Lighting	Provide as per standard; see lighting section
Fire Protection	
Fire suppression	Pre-action system, with protective wire cages as per Cornel standard; Cornell to confirm if wet system is acceptable
Detection	Area smoke detectors as required by code
Extinguishers	Dedicated Carbon Dioxide (CO2) extinguisher for protection of electronic equipment
Fire Stopping	All penetrations through fire rated barriers to be fire stopped using approved methods and materials

Table 3 – Typical TR Technical Requirements

Backbone Distribution
The backbone distribution is the part of the SCS that provides connectivity between ER, TRs and the EF.

The backbone distribution system consists of:
- Pathways and related spaces
- Cabling system including backbone cables and associated connecting hardware
- Miscellaneous support facilities.
- Refer to ICT Spaces paragraph above for ICT spaces descriptions and requirements.

Backbone pathways
The purpose of the backbone pathways is to accommodate, protect and support the backbone cabling.

Technical requirements:
- Accommodation of current cabling needs
- Provide 100% spare capacity for future growth, based on what is installed day 1.
- Backbone pathways in accessible ceiling/floor spaces to consist of cable trays

- Backbone pathways in inaccessible ceiling/floor spaces to consist of conduits
- Backbone pathways in secure accessible vertical risers to consist of sleeves and vertical cable tray support
- Backbone pathways in inaccessible vertical risers to consist of conduits
- Backbone pathways that pass through fire rated floors/walls shall be rated per current Building Codes requirements.
- Backbone pathways shall comply with TIA/EIA and CIT Design and Construction Standards as well as local standards requirements and recommendations.

Backbone cables
The backbone cabling system is the transmission media part of the SCS between the ER, TRs and the EF.

Technical requirements:
- Topology: star
- Spare capacity: minimum 50% for future growth
- Media type: fiber optic cabling throughout. Multi-pair copper only limited quantity for miscellaneous analogue connections.

A minimum of Multimode OM4 type (50/125 micron laser optimized) and single-mode OS2 type fiber optic cables will be provided to support opening day connectivity needs for the technology systems, as well as emerging and anticipated future technologies. LC-type connectors will be used.

Standards are under development for 40 and 100 Gbps transmission. The backbone cables recommended for the project will be able to support these applications.

The distribution for Option 2 will use single mode fiber. It is recommended to provide both types of fiber in the backbone, in accordance with the CIT standard, for an increased flexibility.

Based on the fact that IP telephony and fiber based telecom services are prevalent today, the voice system design will be based on IP Telephony. Therefore copper backbone cables will only be provided for end-to-end copper applications such as dedicated alarms and any power fail type direct dial emergency telephone lines on a selective and as needed basis.

Horizontal Distribution
The horizontal distribution is the part of the SCS that provides connectivity between TRs and the Equipment Outlets (EOs).

A horizontal distribution system consists of:
- Cable pathways and related spaces

- Cabling system including horizontal cables and associated connecting hardware
- Miscellaneous support facilities

Refer to ICT Spaces paragraph above for TR description and requirements.

Horizontal pathways

The horizontal pathway system consists of components that conceal, protect, support, and provide access to horizontal cables from the Equipment Outlet to the horizontal cross connect or interconnect in the TR. Pathway implementation involves both the pathway for containment of cables as well as related spaces, such as pull boxes that aid in the installation of cable.

Technical requirements:

- Accommodation of current cabling needs.
- Provide 25-50% spare capacity for future growth.
- Horizontal pathways in accessible ceiling/floor spaces to consist of cable trays.
- Horizontal pathways in inaccessible ceiling/floor spaces to consist of conduits.
- Specific horizontal pathways such as cable tray, conduit, etc. will be coordinated with the architect and electrical engineer.
- Wall mounted Equipment Outlet will be served by a back box with conduit stub-up/down.
- Pathways will be hidden from view in public and architecturally significant areas. Distribution methods will be coordinated with the architect.
- Horizontal pathways that pass through fire rated floors/walls shall be rated per current Building Codes requirements.
- Horizontal pathways shall comply with the TIA/EIA and CIT standards requirements and recommendations.

Horizontal cables

The horizontal cabling system is the transmission media part of the distribution system that provides connectivity between the Telecommunications Room and Equipment Outlet.

Technical requirements:

- Topology: star
- Spare capacity: minimum 25% for future growth
- Horizontal cable length shall not exceed 295’ from the horizontal cross-connect to the outlet including slack or service loops
- Media type: copper Category 6 UTP for general outlets and Category 6A for Access Point (AP) outlets.

It is recommended that the Backbone and Horizontal Distribution Systems be end-to-end solutions from reputable manufactures that will provide minimum 20 years extended product and applications warranties.

Equipment Outlet

It is important that all spaces be properly designed to accommodate the needs of both the occupants and the equipment that the occupants use. Equipment may include: computers, telephones, wireless access points, printers/ copiers/scanners, CCTV cameras, projectors, and other IP based technology systems devices. These devices require access to the horizontal cabling via the Equipment Outlets.

Technical requirements:
Consideration shall be given to the following guidelines / requirements drawn from the industry, and professional experience for planning and location of Equipment Outlets:

- All Equipment Outlets serving equipment that requires local power shall be located within 3' of an appropriate power outlet
- Typical wall outlets mounted at 18" above finished floor (AFF)
- Equipment Outlets for elevator telephones to be located in each of the elevator machine rooms.
- Equipment Outlet will be provided for BMS panels, cameras and any other IP devices.
- Equipment Outlet outlets will be provided throughout the building for installation of Wireless Access Points (AP) for the WLAN(s) allowing for ubiquitous coverage.

Consolidation Points

Functional Description:
A connection facility within the horizontal system for interconnection of cables extending from building pathways to the Equipment Outlet. They will be used along with Multi User Telecom Outlets (MUTOAs) in areas where increased flexibility in reconfiguring the space is required.

CIT has requested not to use consolidation points in this project.

For OLAN option, the ONT (Optical Network Terminal) provides copper RJ45 ports that can be PoE enabled. The number of ports and mounting option varies with the model and manufacturer. The passive optical splitter acts as a consolidation point and could be located in the TR or closer to the user location as to provide flexibility in relocating the ONTs. A wall mounted ONT that looks like a regular RJ45 data outlet from the user's perspective is also available.

Grounding and Bonding System

Functional Description
The overall purpose of the telecommunications grounding and bonding infrastructure is to equalize potentials between metallic surfaces mainly in the event of lighting, ac electrical system faults, electromagnetic induction, or electrostatic discharge.

If the minimum installation requirements of the ac grounding electrode system and equipment grounding system are met, they will be sufficient in providing an effective grounding reference for the telecommunications equipment.

The Telecommunications Main Grounding Busbar (TMGB) serves as the dedicated extension of the AC grounding electrode system for the telecommunications infrastructure. It serves as the central attachment point for the Telecommunications Bonding Backbone (TBB) and equipment.

A Telecommunications Grounding Busbar (TGB) is the grounding connection point for the system and equipment in the area served by a TER and TR.
A telecommunications Bonding Backbone (TBB) is a bonding conductor intended to equalize potentials between TRs on multiple floors of a building with an ultimate connection to the TMGB.

Technical Requirements

- Bonding within the telecommunications infrastructure is achieved so that voltages are equalized between equipment within EFs, ER, and TRs.
- The TMGB must be a predrilled copper busbar with holes for use with standard-sized lugs. TMGB should be placed close to the cable entrance facility. It should be able to accommodate bonding conductors that originate at various equipment and metallic surfaces and allow for future growth.
- TMGB shall be bonded to the AC grounding electrode system via the AC main service panel board.
- TMGB should also be bonded to nearest structural steel member, if available.
- Additional bonding to the TMGB should be made for: primary and secondary surge protectors, cable trays, ladder racks, equipment racks, power conditioning equipment, battery racks, entrance conduits, and cable sheaths as applicable.
- The TGB must be predrilled copper busbar with holes for use with standard-sized lugs. It should be able to accommodate bonding conductors that originate at various equipment and metallic surfaces and allow for future growth.
- TGB should be referenced to the equipment ground terminal of the nearest electrical panel board to equalize potentials between them.
- TGB should also be bonded to nearest structural steel member, if available.
- Specification of a TBB is an optional method; it may not be beneficial for a large site.
- A minimum of a 6 AWG bonding conductor shall be used for distances up to 100 feet. For longer distances size shall be calculated based on NEC guidelines.

9.1.4 LOCAL AREA NETWORK (LAN)

The Local Area Network (LAN) provides communications between supported system devices, servers, data storage, the Internet, the public switched telephone network, and any Wide Area Networks (WANs).

The LAN will have the following characteristics (Option 1):

- TCP/IP and Ethernet network transmission platform.

- Includes switches, routers, firewalls, and network operating software.
- Core/distribution switches located in ER.
- Distribution/access switches located in TRs

For Option 2, OLAN, the network switches are replaced by a Optical Distribution Network (ODN) comprised of:

- Optical Line Terminal (OLT), located in the ER, and
- Optical Splitters, passive splitters, located on each floor
- Optical Network Terminal (ONT), a media converter, located at the work area outlet

An illustration of the LAN distribution for the different options discussed above is represented in figure 1 below:

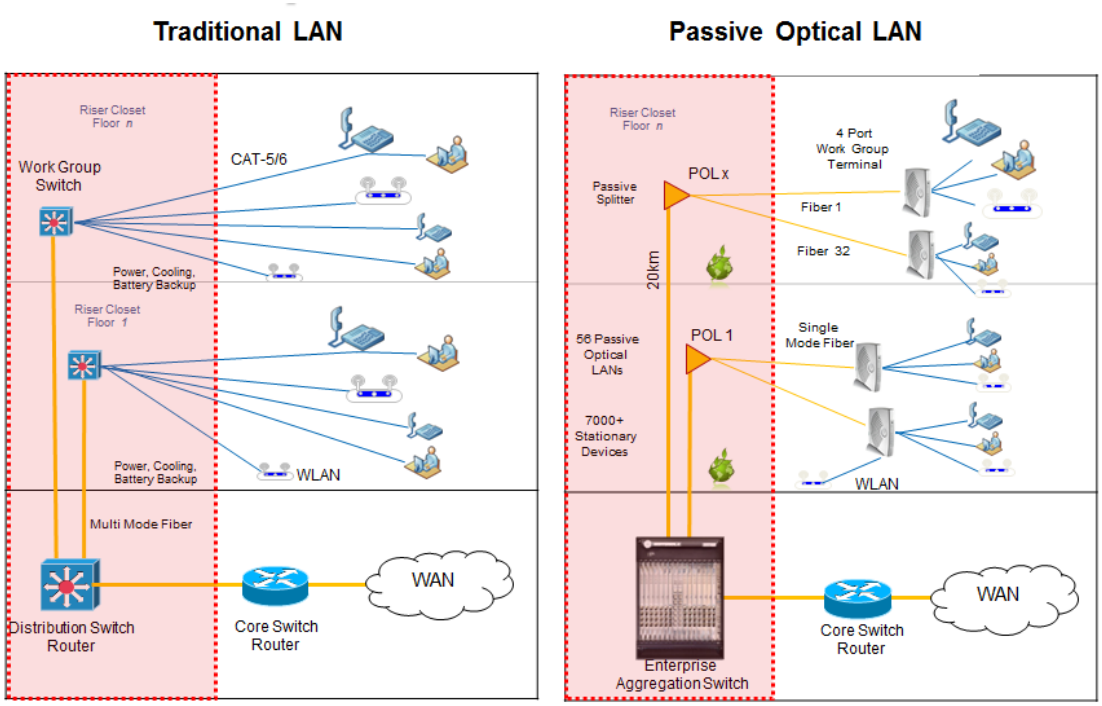

Figure 2 – LAN distribution options

Distribution Comparison – Option 1 versus Option 2

The differences between the various options proposed above as related to the different areas they impact are summarized in the table below:

	Option 1 (Traditional LAN)	Option 2 (OLAN)
TR	9' x11' space on each level of each wing to house horizontal cable terminations and network equipment. 24/7/365	Network equipment not required. Size could decrease to a shallow TR to house fiber optic splitters. No power or cooling required.

	Option 1 (Traditional LAN)	Option 2 (OLAN)
	power and cooling required.	
Backbone distribution	3-4" C from ER to each TR stack for MM/SM fiber and possible copper	2-4" C from ER to each TR stack for SM fiber
Horizontal distribution	Copper based star distribution from TR 295' distance limitation PoE capability	Fiber based star from TR (splitter) 20km link distance limitation (depending on number of splits) PoE capability
LAN distribution	TCP/IP and Ethernet platform Core distribution/ head end equipment in ERs	All active equipment located in ER or in areas served.
Bandwidth to desk	Up to 1 Gigabit (depending on the oversubscription, no guaranteed bandwidth)	Up to 1.2 /2.4 Gigabit (depending on the number of splits; with guaranteed bandwidth capability)

Table 4 – Distribution option comparison

OLAN is a relatively new distribution method in the enterprise arena, but it has been used for longer time in the service provider market and in the government market. CIT and the other stakeholders will have to decide which distribution method to use for this building and for the campus.

Note that OLAN offers a significant cost advantage if implemented for a larger number of ports and is best suited for a campus environment due to long reach of the fiber. However there are solutions geared for medium size buildings, like this one, that would offer significant advantages compared to a traditional copper based LAN.

LAN active equipment will be provided under a separate scope. Supporting infrastructure is included in the ICT scope of work.

9.1.5 APPLICATIONS SERVERS AND STORAGE SYSTEMS

These systems will be provided by the Owner. Supporting infrastructure is included in the ICT scope of work. Considering sustainability goals for this building it is recommended that these systems be remotely located in a different Cornell campus or cloud based.

9.1.6 VOICE SYSTEM

The voice communications characteristics relating to the ICT design will be assumed as follows:

- Voice over Internet Protocol (VoIP) technology platform
- Fully integrated with the LAN
- No cabling or labeling differentiation between voice and data functionality
- Head-end software and/or hardware equipment located in Equipment Room
- May use the Wi-Fi system to support VoIP enabled mobile handsets

- Separate copper backbone provided for POTS lines to be used on an as needed basis.

This system will be provided by the Owner. Supporting infrastructure is included in the ICT scope of work.

9.1.7 WI-FI SYSTEM

OLAN supports both legacy voice applications (no need for copper backbone) and VoIP.

A Wi-Fi system uses certified products based on the IEEE 802.11 standards to extend the functionality of a wired Local Area Network to wireless enabled devices. Characteristics of the Wi-Fi System relating to the ICT design include:

- TCP/IP and Ethernet network transmission platform
- Fully integrated with the LAN
- No cabling or labeling differentiation between Wi-Fi and data functionality
- Head-end software and/or hardware equipment located in Equipment Room
- May support VoIP enabled mobile handsets for staff members

This system will be provided under a separate scope. Supporting infrastructure is included in the ICT scope of work.
OLAN also fully integrates with this system.

9.1.8 TV DISTRIBUTION AND DIGITAL SIGNAGE

The TV distribution system is intended to provide more features than just traditional television. It has the ability to unify live television, archived video, live streams, and digital signage within a scheduled or on-demand interactive environment. Characteristics relating to the ICT design may include:

- Internet Protocol Television (IPTV) technology platform
- Fully integrated with the LAN
- No cabling or labelling differentiation between TV and data functionality
- Head-end software and/or hardware equipment could be located in Equipment Room or remotely.
- No dedicated coaxial cable system.

This system will be provided by the Owner. Supporting infrastructure is included in the ICT scope of work.
OLAN also fully integrates with IP video and additionally supports RF video distribution if necessary.

9.1.9 DISTRIBUTED ANTENNA SYSTEM (DAS)

The Design and construction Standards requires that DAS pathways and cabling shall be included in capital projects designs. Characteristics relating to the DAS design may include:

- Each segment will utilize a combination of fiber optics and co-axial cabling

- Head-end software and/or hardware equipment could be located in Equipment Room or remotely.

This system will be provided by the Owner. Coordination of DAS component placement is included in the ICT scope of work.
DAS distribution could be supported over the same infrastructure as OLAN.

9.2 AUDIOVISUAL

9.2.1 GENERAL

Audiovisual technologies will enable the production, distribution and presentation of sound and image media (i.e. computer graphics, video) within the First Academic Building (FAB). Systems shall accommodate a wide range of analog and digital media to support the School's academic, research, administrative and other activities.

The use of Audio Visual systems in the classrooms and other spaces is an important ingredient in the pedagogy of Cornell University's FAB. While not uniformly used by all professors, the ability to provide this type of service must be uniform and appropriate within budget constraints.

This section identifies the scope of audiovisual facilities and systems to be developed within the project in future design phases. This section also conveys how audiovisual systems and infrastructure shall be integrated within the areas identified. Audiovisual systems shall optimize the display potential for local (in room) sources including but not limited to computers and video source equipment such as document cameras and DVD/Blu-Ray players.

9.2.2 DISPLAY DEVICES

Due to the benefits of natural light and architectural design strategies to maximize this, a baseline for technology will be direct view flat panel displays which are typically an LCD based technology. These displays typically offer appropriate visual contrast in a range of ambient light conditions.

Display sizes will be based upon the distance from the farthest or "least favored" viewer in a room or area, where the nominal display height will be related to a proportion of this distance.

In rooms where a direct view display will be too small to provide adequate viewing a projection screen and ceiling mounted projector will be provided.

9.2.3 VIDEO SOURCES

Common video sources will include network enabled content, local user laptops and video/web conferencing feeds. Some rooms will include a presentation lectern with a variety of video source equipment including document cameras and Blu-ray players.

Personal devices will also be a main video source into the audiovisual systems. The concept of Bring Your Own Device (BYOD) will be implements in the design. Users will be able to connect their devices including laptops, smart phones and tablets both wirelessly and via wired connections in rooms with presentation systems.

9.2.4 AUDIO AND AUDIOCONFERENCING

Audio quality is of paramount importance for good communication and collaboration. Poor audio quality leads to miscommunication, confusion, and listening fatigue. The different types of spaces need to be designed with the proper audio systems – as well as good room acoustics – in order for the presentations and meetings to be as effective as possible.

Smaller spaces such as the huddle rooms will utilize a microphone built into a web camera ant utilize collaborative communication software such as WebEx for audio conferencing.

For the larger spaces, dedicated table-top microphones and ceiling speakers will be utilized. An audio digital signal processor with integral high quality audio echo cancellation and noise suppression will be provided.

9.2.5 INTEGRATED CONTROL FOR END USERS AND OPERATORS

Advancements in control system technology and philosophy will be leveraged to give the new building an intuitive but powerful user experience.

For the end users who utilize the classrooms, conference rooms and collaboration spaces, this means simple keypads and touch panels. For touch panels, the graphical user interface needs to be simple, intuitive, and elegant; requiring a minimal amount of training. Further, all of the touch panels in all of the rooms should be identical, so that there is only one learning curve to overcome.

IT operations will be able to utilize the IP network tools to better support the end users. Each system will report back to a network server its status at all times. If any of the room technology malfunctions, emails will be able to be sent to the appropriate staff. These features will allow the IT staff to provide a higher level of service to the users.

9.2.6 EXTENSIBILITY AND DURABILITY

Integrating architectural and AV design strategies leads to long term benefits, because usage becomes part of the architectural fabric of the venue.

While incorporating audiovisual equipment seamlessly into the fit and finish of each space may appear to challenge longer term upgrades or modifications, the benefits gained from ease of use stay constant. Displays and cameras in locations that optimize line of sight and loudspeakers located to provide uniform coverage at lower sound levels will still be valid even if equipment features change over time.

9.2.7 OPERATION MANAGEMENT

A primary goal of the facility wide audiovisual control capability is to limit the need for personal response and management of audiovisual systems. Remote

capability to schedule, activate, trouble shoot and strategically manage audiovisual systems will be tailored to the specific needs of Cornell as part of the control systems specification.

9.2.8 TEMPLATE AND UNIQUE SPACES

To better distinguish usability informed by function, the project's various rooms, zones or building areas have been categorized by an audiovisual design archetype. These archetypes have been developed to provide a reference point for use and function while allowing for variations to suit a particular group or location in the building. Additional unique spaces and office wised systems are covered in a following section.

The following Archetypes have been created to encompass a majority of the audiovisual enabled spaces within the project:

- Seminar Rooms
- Large Conference Rooms
- Medium/Small Conference Rooms
- Huddle Rooms
- Lounges/Collaboration Areas

Several spaces which require audiovisual equipment are unique enough to require their own detailed functionality requirements and description these spaces are as follows:

- Lecture Hall
- Divisible Seminar Room
- Boardroom
- Multipurpose Room
- Café

NOTE: Cost of information provided herein is for reference only. All AV related equipment costs are part of Owner provided Furniture, Fixture and Equipment budget and outside of the base building cost.

The general functionalities of each space are outlined in the following functionality matrix:

Space	Voice Reinforcement	Assistive Listening	Audio Conferencing	Web Conferencing	Video Conferencing	Visual Presentation	Remote Observer	Distance Learning	Lecture Capture
Lecture Hall	Yes	Yes	No	No	No	Yes	Infrastructure Only	No	Infrastructure Only
Seminar Room	Yes	Yes	Yes	No	Infrastructure Only	Yes	Infrastructure Only	Infrastructure Only	Infrastructure Only
Divisible Seminar Room	Yes	Yes	Yes	No	Infrastructure Only	Yes	Infrastructure Only	Infrastructure Only	Infrastructure Only
Boardroom	Yes	Yes	Yes	Yes (using VC mics/cam/spkr)	Yes	Yes	Yes	No	Infrastructure Only
Large Conference Room	Yes	Yes	Yes	Yes (using VC mics/cam/spkr)	Yes	Yes	Yes	No	Infrastructure Only
Medium Conference Room	No	No	Yes	Yes (using VC mics/cam/spkr)	Yes	Yes	Yes	No	No
Small Conference Room	No	No	Yes	Yes (using VC mics/cam/spkr)	Yes	Yes	Yes	No	No
Huddle Rooms	No	No	No	Just USB Camera	No	Yes	No	No	No
Cafe	Yes	Yes	No	No	No	Yes	No	No	No
Multipurpose Room	Yes	Yes	No	No	No	Yes	No	No	No

Cornell NY Tech - FAB

Audiovisual System Functionality Matrix

9.2.9 SEMINAR ROOMS

Description:

The seminar rooms will be used primarily for class instruction however the room may also be used for other activities such as small breakout group interactions and “hack-a-thon” collaborative sessions. The furniture in these spaces will be flexible and allow for a variety of setups to accommodate the various functions. On the first level, the two seminar rooms will have a divisible partition between the spaces. The systems in these rooms will have the ability to be combined or act independently as described below.

Capability Requirements:

- Audio and video content presentation.
- Infrastructure to support audio and video lecture capture capability.
- Audio reinforcement for a single presenter or multiple presenters simultaneously.

Architectural and Interior Features:

- A portable lectern will be required to house audio and video source equipment such as a room PC, document camera and control touch panel.
- Blocking will be required for support in walls which will have an ancillary display.
- Structure will be required to support a ceiling mounted projection screen and the ceiling mounted projector.
- A location will be required to house the audiovisual equipment rack. In the standalone seminar rooms, the equipment racks will be integrated into the teaching desk/lectern.

Infrastructure Requirements:

- Conduit stub-ups will be located in the front of the room at the instructor desk location
- Wall mounted back box located inside the room for a control touch panel.
- Wall mounted specialty back box located at each ancillary display location.
- Flush mounted junction box located behind equipment rack location.

Electrical Requirements:

- Power required at each projection screen location.
- Power required at each projector location.
- Power required at each ancillary display location.
- Power required at teaching desk location which will also serve as the main equipment rack location.

Mechanical Requirements:

- Proper ventilation will be required at the main audiovisual equipment rack location.

Lighting Space Requirements:

- Multiple lighting zones with presets will be required to accommodate the multiple uses of the space including general illumination and presentation lighting.

Wired IP Network Requirements:

- (2) Network drops at the audiovisual equipment rack
- (1) Network drop at the teaching desk

Display:

Two 16:10 aspect ratio projection screens and two ceiling mounted projectors with a minimum resolution of 1920 x 1200. Projectors and projection screens will be sized appropriately for the room size to provide detailed viewing capability.

Additionally, two flat panel displays will be located at the back of the room to display additional video signals and to provide better viewing angles and sightlines in alternate room configurations. These monitors can also be used for confidence monitors for presenters located in the front of the room.

Video Inputs:

Video inputs will be located at the main teaching desk location.

Video Signal Routing and Processing:

The main teaching desk will also house the audiovisual equipment rack. A matrix switch will be located in the in the equipment rack and will route all video to each display in the space. Each display will have the capability to show unique content.

Audio:

A lectern mounted microphone will be provided in addition to two channels of wireless microphones. Ceiling microphones will be provided to be used for audio conferencing to pick-up audio from the audience. These microphones will also be used if the systems are upgraded to include lecture capture, distance learning or video conferencing.

Audio Signal Routing and Processing

An audio digital signal processor will be provided for routing, mixing and processing of audio signals.

Audio Reinforcement:

Program and speech audio reinforcement will be via overhead, distributed loudspeakers.

Audio Conferencing:

A VoIP based audio conferencing dialer will be integral to the audio digital signal processing unit.

Video Conferencing:

Infrastructure will be provided to accommodate videoconferencing for a distance learning application.

Control:

A touch panel will be provided as part of the main teaching desk to control multiple aspects the system including video and audio routing, volume and room systems such as lighting and shades. Additionally, a wall mounted control panel will be provided to control the space without the lectern being required.

Lecture Capture:

Infrastructure to support the implementation of a lecture capture system will be provided in the design. All video and audio switching will be sized to accommodate the addition of lecture capture equipment in the future.

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

- Connection to the lighting control system
- Connection to the HVAC system
- Connection to the central room scheduling system
- Connection to the central audiovisual management system
- Connection to shade control system

Basis of Design Cost Estimate:

$80,000 for audiovisual equipment and installation per room with an additional cost of $20,000 to add distance learning capabilities.

9.2.10 LARGE CONFERENCE ROOMS

Description:

The large conference rooms will be used for two types of events: large meetings for faculty and staff and presentations. It was desired that the furniture in this space be flexible, however the layout will most likely remain in the same configuration for both meetings and presentations.

Capability Requirements:

- Audio and video content presentation
- Audio reinforcement for a single presenter or multiple presenters simultaneously
- Audio conferencing
- Video conferencing
- Web Conferencing

Architectural and Interior Features:

- Structure will be required to support a ceiling mounted projection screen and the ceiling mounted projector.
- A location will be required to house the audiovisual equipment rack.
- Table boxes will be required to conceal the technology system connections and help manage cables.
- Shades will be required to reduce outside light from entering the space.
- A neutral wall finish for video conferencing.

Infrastructure Requirements:

- Floor boxes will be located under the table location for connection of microphone cables, audio/video connections and wired network connections.
- Wall mounted back box located inside the room for a control touch panel.
- Wall mounted back box located outside room for scheduling touch panel.
- Flush mounted junction box located behind equipment rack location.
- Wall mounted back box located below the screen for video conferencing camera.
- Wall mounted back box located in the rear of the room for an alternate video conferencing camera position.

Electrical Requirements:

- Power required at the projection screen location.
- Power required at the projector location.
- Power required in each floor box.
- Power required at the main equipment rack location.

Mechanical Requirements:

- Supplemental cooling will be required at the main audiovisual equipment rack location.
- Diffusers should be located away from projections screens.

Lighting Space Requirements:

- Multiple lighting zones with presets will be required to accommodate the multiple uses of the space including general illumination, videoconferencing illumination and presentation lighting.

Wired IP Network Requirements:

- (2) Network drops at the audiovisual equipment rack
- (1) PoE network drop outside the room for room scheduling touch panel
- (1) Network drop in each floor box

Display:

A single 16:10 aspect ratio projection screen and ceiling mounted projector with a minimum resolution of 1920 x 1200. Projector and projection screen will be sized appropriately for the room size to provide detailed viewing capability.

Video Inputs:

Video inputs will also be located at the table to accommodate laptop and other portable video sources.

Video Signal Routing and Processing:

The main presentation lectern will have internal switching to provide a maximum of two video signals to the main matrix switch located in the main equipment rack. The matrix switch will route all video to the main display and the far end of the video conference.

Audio:

A lectern mounted microphone will be provided in addition to two channels of wireless microphones. Ceiling mounted microphones will be used for audio and video and web conferencing. Additionally the microphones will be used to provide voice lift within the room to help all participants can hear conversations in the space.

Audio Signal Routing and Processing:

An audio digital signal processor will be provided for routing, mixing and processing of audio signals.

Audio Reinforcement:

Program audio reinforcement will be via overhead, distributed loudspeakers. Speech reinforcement will be reinforced only by the distributed, overhead loudspeakers.

Audio Conferencing:

A VoIP based audio conferencing dialer will be integral to the audio digital signal processing unit and utilize the room's integrated microphones and speakers.

Video Conferencing:

A high-definition video conferencing codec will be provided in this space. Pan, tilt and zoom cameras will be located at the front and rear of the room to capture those seated at the table and a presenter located at the front of the room. Due to the large size of the room and the requirement to use a projector to get a large enough image for adequate viewing in the room, the video conferencing experience will not be as ideal as it would be in a smaller purpose built video conferencing room.

Control:

A touch panel will be provided at the table to control multiple aspects the system including video and audio routing, volume and room systems such as lighting and shades. Additionally, a wall mounted control touch panel and a table top control touch panel will be provided to control the space and other room systems such as lighting and shades.

Lecture Capture:

A lecture capture system is currently not planned for this space, however the cameras and microphones which are part of the video conferencing system could be utilized by a lecture capture system in the future. All video and audio switching will be sized to accommodate the addition of lecture capture equipment in the future.

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

- Connection to the lighting control system
- Connection to the shade control system
- Connection to the HVAC system
- Connection to the central room scheduling system
- Connection to the central audiovisual management system

Basis of Design Cost Estimate:

$100,000 for audiovisual equipment and installation per room.

9.2.11 MEDIUM/SMALL CONFERENCE ROOMS

Description:

The medium and small conference rooms will be used for two types of events: small meetings for faculty and staff and presentations. It was desired that the furniture in this space be flexible, however the layout will most likely remain in the same configuration for both meetings and presentations.

Capability Requirements:

- Audio and video content presentation
- Audio conferencing
- Video conferencing
- Web conferencing

Architectural and Interior Features:

- The main display wall will require blocking to support the weight of the display.
- A location will be required to house the audiovisual equipment rack.
- Table boxes will be required to conceal the technology system connections and help manage cables
- Shades will be required to reduce outside light from entering the space.
- A neutral wall finish for video conferencing.

Infrastructure Requirements:

- Floor boxes will be located under the table location for connection of microphone cables, audio/video connections and wired network connections.
- Wall mounted back box located inside the room for a control touch panel.
- Wall mounted back box located outside room for scheduling touch panel.
- Wall mounted specialty back box located at the display location.
- Flush mounted junction box located behind equipment rack location.

Electrical Requirements:

- Power required at the display location.
- Power required in each floor box.
- Power required at the main equipment rack location.

Mechanical Requirements:

- Supplemental cooling will be required at the main audiovisual equipment rack location.

Lighting Space Requirements:

- Multiple lighting zones with presets will be required to accommodate the multiple uses of the space including general illumination, videoconferencing illumination and presentation lighting.

Wired IP Network Requirements:

- (2) Network drops at the audiovisual equipment rack
- (1) PoE network drop outside the room for room scheduling touch panel
- (1) Network drop in each floor box

Display:

A single 16:9 aspect ratio large format flat panel LCD display with a minimum resolution of 1920 x 1080 will serve as the main display in the space. The display will be sized appropriately for the room size to provide detailed viewing capability.

Video Inputs:

Video inputs will be located at the table to accommodate laptop and other portable video sources.

Video Signal Routing and Processing:

A central matrix switch will route all video for the table inputs and source equipment located in the equipment rack to the main display and the far end of the video conference.

Audio:

Microphones will be located in the ceilingfor audio and video conferencing.

Audio Signal Routing and Processing

An audio digital signal processor will be provided for routing, mixing and processing of audio signals.

Audio Reinforcement:

Program audio reinforcement will be via wall mounted loudspeakers flanking the main display and be supplemented by overhead, distributed loudspeakers. Far end audio from audio and video conferencing calls will be reinforced only by the distributed, overhead loudspeakers.

Audio Conferencing:

A VoIP based audio conferencing dialer will be integral to the audio digital signal processing unit and utilize the room's integrated microphones and speakers.

Video Conferencing:

A high-definition video conferencing codec will be provided in this space. A pan, tilt and zoom camera will be located at the front of the room to capture those seated at the table.

Control:

A wall mounted control panel and a table top control touch panel will be provided to control multiple aspects of the system including video and audio routing, volume and room systems such as lighting and shades.

Lecture Capture:

A lecture capture system is currently not planned for this space, however the camera and microphones which are part of the video conferencing system could be utilized by a lecture capture system in the future. All video and audio switching will be sized to accommodate the addition of lecture capture equipment in the future.

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

- Connection to the lighting control system
- Connection to the shade control system
- Connection to the HVAC system
- Connection to the central room scheduling system
- Connection to the central audiovisual management system

Basis of Design Cost Estimate:

$60,000 for audiovisual equipment and installation per room.

9.2.12 HUDDLE ROOMS

Description:

The huddle rooms will be used for small informal gatherings and project meetings. These rooms will not be schedulable and will focus on group and project team interaction. All of the huddle rooms in the project will have the same functionality with the exception of the huddle rooms located in the galleria. The galleria huddle rooms will have no audiovisual systems.

Capability Requirements:

- Audio and video content presentation
- Web conferencing via user provided device

Architectural and Interior Features:

- No specific architectural features related to audiovisual systems for this space.

Infrastructure Requirements:

- Wall mounted specialty back box located at the display location.

Electrical Requirements:

- Power required at the display location.

Mechanical Requirements:

- No specific mechanical requirements related to audiovisual systems for this space.

Lighting Space Requirements:

- No specific lighting requirements related to audiovisual systems for this space.

Wired IP Network Requirements:

- (1) network drop at display location

Display:

A single 16:9 aspect ratio large format flat panel LCD display with a minimum resolution of 1920 x 1080 will serve as the main display in the space. The display will be sized appropriately for the room size to provide detailed viewing capability.

Video Inputs:

Video inputs will be located on the display wall to accommodate laptop and other portable video sources.

Audio:

The displays built-in speakers will be used for any program audio playback.

Audio Conferencing:

Audio conferencing calls will be made with a user provided device. This device will have the capability to utilize a web camera with integral microphone for audio conferencing.

Video Conferencing:

Any video collaboration in the huddle rooms will utilize web conferencing solutions installed on personal devices which will be connected to the audiovisual equipment in the room. A web cameral will be located at the display with a USB connection for users to connect to their laptop.

Control:

The display will be remotely controlled via a central control system to be automatically turned off based on schedule and space occupancy. Local control of the video sources will be via handheld remote or hard buttons located on the display.

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

- Connection to the central audiovisual management system

Basis of Design Cost Estimate:

$3,100 for audiovisual equipment and installation per room.

9.2.13 LOUNGE/COLLABORATION AREAS

Description:

Lounges and collaboration areas will be used for small, informal group gatherings and as a touchdown area for students and faculty between classes and meetings. There are no specific audiovisual requirements for these areas, however since these areas may have higher traffic than enclosed spaces they would make a good location for digital signage displays.

Capability Requirements:

- Digital signage display

Architectural and Interior Features:

- Any wall with a digital signage display will require blocking to support the weight of the display.

Infrastructure Requirements:

- Wall mounted specialty back box located at display location.

Electrical Requirements:

- Power required at the display location.

Mechanical Requirements:

- No specific mechanical requirements related to audiovisual systems for this space.

Lighting Space Requirements:

- No specific lighting requirements related to audiovisual systems for this space.

Wired IP Network Requirements:

- (1) Network drop at the display location

Display:

A single 16:9 aspect ratio large format flat panel LCD display with a minimum resolution of 1920 x 1080 will utilized for digital signage in the lounge areas. The exact location for each lounge area will be determined as the architectural in and interior design progresses.

Video Inputs:

None

Video Signal Routing and Processing:

The digital signage display will be setup to integrate with the future deployment of a digital signage system.

Audio:

If any audio is required for the digital signage, the displays built-in speakers will be used.

Control:

The digital signage display will be remotely controlled via a central control system to be automatically turned off based on schedule and space occupancy.

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

- Connection to the lighting control system
- Connection to the central audiovisual management system

Basis of Design Cost Estimate:

$2,500 for each digital signage display location for audiovisual equipment and installation. Consider a budget of $40,000 for the space.

9.2.14 LECTURE HALL

Description:

The lecture hall will be used primarily for lectures and class instruction however the room may also be used for other activities such as panel discussions and community events. The furniture in the lecture hall will be fixed. The pre-function are immediately outside the lecture hall will be used for pre/post-event gatherings as well as possible overflow space for the main lecture hall. There will be no fixed furniture in the pre-function area, but the design of audiovisual systems should accommodate a variety of possible layouts.

Capability Requirements:

- Audio and video content presentation
- Infrastructure to support audio and video lecture capture capability
- Audio reinforcement for a single presenter or multiple presenters simultaneously
- Remote control of presentations from control booth

Architectural and Interior Features:

- A portable lectern will be required to house audio and video source equipment such as a room PC, document camera and control touch panel.
- Structure will be required to support a ceiling mounted projection screens and the ceiling mounted projectors.
- Shades will be required to reduce outside light from entering the space.
- A control room will need to be provided to accommodate a single operator as well as the audiovisual equipment.

Infrastructure Requirements:

- Floor boxes will be located in the front of the room.
- Wall mounted back box located inside the room for a control touch panel.
- Cable raceway in control room.

Electrical Requirements:

- Power for all lecture hall audiovisual systems shall have an isolated ground
- Power required at each projection screen location.
- Power required at each projector location.
- Power required in each floor box.
- Power required in the control room for the equipment racks and control work surface area.

Mechanical Requirements:

- Supplemental cooling will be required in the audiovisual control room and projector enclosures.
- Diffusers should be located away from projections screens.

Lighting Space Requirements:

- Multiple lighting zones with presets will be required to accommodate the multiple uses of the space including general illumination and presentation lighting.

Wired IP Network Requirements:

- (4) Network drops located in the audiovisual control room
- (1) PoE network drop outside the room for room scheduling touch panel
- (1) PoE network drop at front of room for control touch panel
- (1) Network drop in each floor box for lectern connectivity

Display:

Two 16:10 aspect ratio projection screens and projectors with a minimum resolution of 1920 x 1200. Projectors and projection screens will be sized appropriately for the room size to ensure detailed viewing capability. The projectors shall not be located within the main lecture hall space but instead be located in an acoustically isolated projector enclosure located within the control room space. Removing the projectors from the instructional space reduces distracting fan noise and allows the projectors to have dedicated airflow.

Video Inputs:

Video inputs will be located at the main presentation lectern location and any additional floor box locations in the stage area of the lecture hall. Inputs will also be available in the audiovisual control room. In the pre-function area, video inputs will be made available for any presentations which may take place.

Video Signal Routing and Processing:

The main presentation lectern will have internal switching to provide a maximum of two video signals to the main matrix switch located in the main equipment rack. The matrix switch will route all video to each display in the space. Each display will have the capability to show unique content.

A video switching control will be provided in the audiovisual control room to allow presentations to be remotely controlled.

Audio:

A lectern mounted microphone will be provided in addition to four channels of wireless microphones. Additional hard-wired microphone inputs will be located in each floor box to accommodate alternate room configurations such as panel discussions.

Audio Signal Routing and Processing

An audio digital signal processor will be provided for routing, mixing and processing of audio signals. Lectures can be auto-mixed and the room has a digital mixing board that can also be used.

Audio Reinforcement:

Program and speech audio reinforcement will be via wall mounted loudspeakers flanking the main projection screen and be supplemented by overhead, distributed loudspeakers. In the pre-function area, reinforcement will be via overhead, distributed loudspeakers. Audio monitor speakers will also be provided in the control booth for the operators.

Audio Conferencing:

There is no audio conferencing planned for this space.

Video Conferencing:

There is no video conferencing planned for this space.

Control:

A touch panel will be provided as part of the main presentation lectern to control multiple aspects of the system including video and audio routing, volume and room systems such as lighting and shades. Additionally, a wall mounted control panel will be provided to control the space without the lectern being required.

In the control room a touch panel will be provided to control the systems on a higher technical level than the touch panels located on the lectern or in the lecture hall.

Lecture Capture:

Infrastructure to support the implementation of a lecture capture system will be provided in the design. All video and audio switching will be sized to accommodate the addition of lecture capture equipment in the future.

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

- Connection to the lighting control system
- Connection to the shade control system
- Connection to the HVAC system
- Connection to the central room scheduling system
- Connection to the central audiovisual management system

Basis of Design Cost Estimate:

$300,000 for audiovisual equipment and installation.

9.2.15 DIVISIBLE SEMINAR ROOM

Description:

The divisible seminar rooms will be used primarily for class instruction however the room may also be used for other activities such as small breakout group interactions and “hack-a-thon” collaborative sessions. The room is capable of being divided into two individual seminar rooms similar to the other seminar rooms in the project, or it can be combined into one large room for bigger events. The furniture in this space will be flexible and allow for a variety of setups to accommodate the various functions. The systems in these rooms will have the ability to be combined or act independently as described below.

Capability Requirements:

- Audio and video content presentation.
- Infrastructure to support audio and video lecture capture capability.
- Audio reinforcement for a single presenter or multiple presenters simultaneously.

Architectural and Interior Features:

- A portable lectern will be required to house audio and video source equipment such as a room PC, document camera and control touch panel.
- Blocking will be required for support in walls which will have an ancillary display.

- Structure will be required to support a ceiling mounted projection screen and the ceiling mounted projector.
- A location will be required to house the audiovisual equipment rack.

Infrastructure Requirements:

- Floor boxes will be located in the front of the room at the instructor desk location
- Additional floor box locations will be provided to accommodate room orientations towards the side walls when the rooms are combined.
- Wall mounted back box located inside the room for a control touch panel.
- Wall mounted specialty back box located at each ancillary display location.
- Flush mounted junction box located behind equipment rack location.

Electrical Requirements:

- Power required at each projection screen location.
- Power required at each projector location.
- Power required at each ancillary display location.
- Power required at teaching desk location which will also serve as the main equipment rack location.

Mechanical Requirements:

- Proper ventilation will be required at the main audiovisual equipment rack location.

Lighting Space Requirements:

- Multiple lighting zones with presets will be required to accommodate the multiple uses of the space including general illumination and presentation lighting.

Wired IP Network Requirements:

- (2) Network drops at the audiovisual equipment rack
- (1) Network drop in each floor box

Display:

In each of the rooms, two 16:10 aspect ratio projection screens and two ceiling mounted projectors with a minimum resolution of 1920 x 1200. Projectors and projection screens will be sized appropriately for the room size to provide detailed viewing capability.

Additionally, one flat panel will be located on the non-partition side wall in each room and one flat panel displays will be located at the back of each room to display additional video signals and to provide better viewing angles and

sightlines in alternate room configurations. These monitors can also be used for confidence monitors for presenters located in the front of the room.

Video Inputs:

Video inputs will be located at each floor box location to accommodate the presentation lectern connections.

Video Signal Routing and Processing:

A matrix switch will be located in the in the equipment rack and will route all video to each display in the space. Each display will have the capability to show unique content.

Audio:

A lectern mounted microphone will be provided in addition to two channels of wireless microphones. Ceiling microphones will be provided to be used for audio conferencing to pick-up audio from the audience. These microphones will also be used if the systems are upgraded to include lecture capture, distance learning or video conferencing.

Audio Signal Routing and Processing

An audio digital signal processor will be provided for routing, mixing and processing of audio signals.

Audio Reinforcement:

Program and speech audio reinforcement will be via overhead, distributed loudspeakers.

Audio Conferencing:

A VoIP based audio conferencing dialer will be integral to the audio digital signal processing unit.

Video Conferencing:

Infrastructure will be provided to accommodate videoconferencing for a distance learning application.

Control:

A touch panel will be provided as part of the main teaching desk/lectern to control multiple aspects the system including video and audio routing, volume and room systems such as lighting and shades. Additionally, a wall mounted control panel will be provided to control the space without the lectern being required.

Lecture Capture:

Infrastructure to support the implementation of a lecture capture system will be provided in the design. All video and audio switching will be sized to accommodate the addition of lecture capture equipment in the future.

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

- Connection to the lighting control system
- Connection to the HVAC system
- Connection to the central room scheduling system
- Connection to the central audiovisual management system
- Connection to shade control system

Basis of Design Cost Estimate:

$80,000 for audiovisual equipment and installation per room with an additional cost of $20,000 to add distance learning capabilities.

9.2.16 BOARDROOM

Description:

The boardroom will be used for two types of events: large meetings for faculty and staff and presentations. The furniture in this room will be fixed.

Capability Requirements:

- Audio and video content presentation
- Audio reinforcement for a single presenter or multiple presenters simultaneously
- Audio conferencing
- Video conferencing
- Web conferencing

Architectural and Interior Features:

- Structure will be required to support a ceiling mounted projection screen and the ceiling mounted projector.
- A location will be required to house the audiovisual equipment rack.
- Table boxes will be required to conceal the technology system connections and help manage cables.
- Shades will be required to reduce outside light from entering the space.
- A neutral wall finish for video conferencing.

Infrastructure Requirements:

- Floor boxes will be located under the table location for connection of microphone cables, audio/video connections and wired network connections.
- Wall mounted back box located inside the room for a control touch panel.
- Wall mounted back box located outside room for scheduling touch panel.
- Flush mounted junction box located behind equipment rack location.
- Wall mounted specialty back box located at each ancillary display location.
- Wall mounted back box located in the rear of the room for an alternate video conferencing camera position.

Electrical Requirements:

- Power required at the projection screen location.
- Power required at the projector location.
- Power required at each display location.
- Power required in each floor box.
- Power required at the main equipment rack location.

Mechanical Requirements:

- Supplemental cooling will be required at the main audiovisual equipment rack location.
- Diffusers should be located away from projections screens.

Lighting Space Requirements:

- Multiple lighting zones with presets will be required to accommodate the multiple uses of the space including general illumination, videoconferencing illumination and presentation lighting.

Wired IP Network Requirements:

- (2) Network drops at the audiovisual equipment rack
- (1) PoE network drop outside the room for room scheduling touch panel
- (1) Network drop in each floor box

Display:

A single 16:10 aspect ratio projection screen and ceiling mounted projector with a minimum resolution of 1920 x 1200. Projector and projection screen will be sized appropriately for the room size to provide detailed viewing capability.

Video Inputs:

Video inputs will also be located at the table to accommodate laptop and other portable video sources.

Video Signal Routing and Processing:

A main matrix switch located in the main equipment rack will route all video to the main displays in the room and the far end of the video conference.

Audio:

Two channels of wireless microphones will be provided. Ceiling mounted microphones will be used for audio and video and web conferencing. Additionally the microphones will be used to provide voice lift within the room to help all participants can hear conversations in the space.

Audio Signal Routing and Processing:

An audio digital signal processor will be provided for routing, mixing and processing of audio signals.

Audio Reinforcement:

Program audio reinforcement will be via wall mounted loudspeakers flanking the main projection screen and be supplemented by overhead, distributed loudspeakers. Speech reinforcement will be reinforced only by the distributed, overhead loudspeakers.

Audio Conferencing:

A VoIP based audio conferencing dialer will be integral to the audio digital signal processing unit and utilize the room's integrated microphones and speakers.

Video Conferencing:

A high-definition video conferencing codec will be provided in this space. Pan, tilt and zoom cameras will be located at the front and rear of the room to capture those seated at the table and a presenter located at the front of the room. Due to the large size of the room and the requirement to use a projector to get a large enough image for adequate viewing in the room, the video conferencing experience will not be as ideal as it would be in a smaller purpose built video conferencing room.

Control:

A touch panel will be provided at the table location to control multiple aspects the system including video and audio routing, volume and room systems such as lighting and shades. Additionally, a wall mounted control touch panel will be provided to control the space.

Lecture Capture:

A lecture capture system is currently not planned for this space, however the cameras and microphones which are part of the video conferencing system could be utilized by a lecture capture system in the future. All video and audio switching will be sized to accommodate the addition of lecture capture equipment in the future.

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

- Connection to the lighting control system
- Connection to the shade control system
- Connection to the HVAC system
- Connection to the central room scheduling system
- Connection to the central audiovisual management system

Basis of Design Cost Estimate:

$150,000 for audiovisual equipment and installation.

9.2.17 MULTIPURPOSE ROOM

Description:

The multipurpose room will be used various types of events including basketball games, game room, movie room, presentations and group meetings. It was desired that the furniture in this space be flexible.

Capability Requirements:

- Audio and video content presentation
- Audio reinforcement for a single presenter or multiple presenters simultaneously

Architectural and Interior Features:

- Structure will be required to support a ceiling mounted projection screen and the ceiling mounted projector.
- A location will be required to house the audiovisual equipment rack.
- Wall mounted video input location for connection of a presenters laptop or other video source.
- Shades will be required to reduce outside light from entering the space.

Infrastructure Requirements:

- Wall box located in the front of the room for connection of a presentation lectern.

- Wall mounted back box located inside the room for a control touch panel.
- Wall mounted back box located outside room for scheduling touch panel.
- Flush mounted junction box located behind equipment rack location.

Electrical Requirements:

- Power required at the projection screen location.
- Power required at the projector location.
- Power required adjacent to the wall video input location.
- Power required at the main equipment rack location.

Mechanical Requirements:

- Supplemental cooling will be required at the main audiovisual equipment rack location.
- Diffusers should be located away from projections screens.

Lighting Space Requirements:

- Multiple lighting zones with presets will be required to accommodate the multiple uses of the space including general illumination and presentation lighting.

Wired IP Network Requirements:

- (2) Network drops at the audiovisual equipment rack
- (1) PoE network drop outside the room for room scheduling touch panel
- (1) PoE network drop inside the room for control touch panel

Display:

A single 16:10 aspect ratio projection screen and ceiling mounted projector with a minimum resolution of 1920 x 1200. Projector and projection screen will be sized appropriately for the room size to provide detailed viewing capability.

Video Inputs:

Video inputs will be located at the main presentation location.

Video Signal Routing and Processing:

A video switch located in the main AV equipment rack will route all video to the main display.

Audio:

A portable wired microphone will be provided in addition to two channels of wireless microphones. The microphones will be used to provide voice lift within the room to help all participants can hear any conversations in the space.

Audio Signal Routing and Processing:

An audio digital signal processor will be provided for routing, mixing and processing of audio signals.

Audio Reinforcement:

Program and speech audio reinforcement will be via overhead, distributed loudspeakers.

Audio Conferencing:

There is no audio conferencing functionality in this space.

Video Conferencing:

There is no video conferencing functionality in this space

Control:

a wall mounted control touch panel will be provided to control multiple aspects the system including video and audio routing, volume and room systems such as lighting and shades.

Lecture Capture:

A lecture capture system is currently not planned for this space,

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

- Connection to the lighting control system
- Connection to the shade control system
- Connection to the HVAC system
- Connection to the central room scheduling system
- Connection to the central audiovisual management system

Basis of Design Cost Estimate:

$60,000 for audiovisual equipment and installation per room.

9.2.18 CAFÉ

Description:

The café has a large seating area for dinning. While the seating area will mostly be used by patrons of the café, its large open area makes it an ideal location to hold large presentations and meetings.

Capability Requirements:

- Audio and video content presentation
- Audio reinforcement for a single presenter or multiple presenters simultaneously

Architectural and Interior Features:

- Structure will be required to support ceiling mounted projection screens and ceiling mounted projectors.
- A location will be required to house the audiovisual equipment rack.
- Shades will be required to reduce outside light from entering the space

Infrastructure Requirements:

- Wall mounted back boxes for audio and video inputs.
- Wall mounted back box located at strategic locations for control touch panels.
- Wall mounted back boxes at audiovisual equipment rack location.

Electrical Requirements:

- Power required at projection screen location.
- Power required at projector location.
- Power required at each ancillary display location.
- Power required audiovisual equipment rack location.

Mechanical Requirements:

- Supplemental cooling will be required in the audiovisual equipment rack location.
- Diffusers should be located away from projections screens.

Lighting Space Requirements:

- Multiple lighting zones with presets will be required to accommodate the multiple uses of the space including general illumination and presentation.

Wired IP Network Requirements:

- (2) Network drops located at the audiovisual equipment rack location.
- (1) Network drop adjacent to audio and video input locations

Display:

Three 16:10 aspect ratio projection screens and ceiling mounted projectors with a minimum resolution of 1920 x 1200. The projectors and projection screens will be sized appropriately for the room size to achieve coverage in the main presentation area.

Video Inputs:

Video inputs will be located at the main presentation location in the café seating area.

Video Signal Routing and Processing:

A matrix switch will be located in the main equipment rack. The matrix switch will route all video to each display in the space. Each projector will have the capability to show unique content.

Audio:

A lectern mounted microphone will be provided in addition to two channels of wireless microphones. Additional hard-wired microphone inputs will be located at the main presentation location to accommodate alternate presentation configurations such as panel discussions.

Audio Signal Routing and Processing

An audio digital signal processor will be provided for routing, mixing and processing of audio signals.

Audio Reinforcement:

Program and speech audio reinforcement will be via overhead, distributed loudspeakers.

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Control:

A touch panel will be provided to control multiple all aspects of the system including video and audio routing, volume and room systems such as lighting and shades. The touch panel can be password protected to deter misuse of the space.

Connectivity:

The following connection from the audiovisual systems in these spaces will be required:

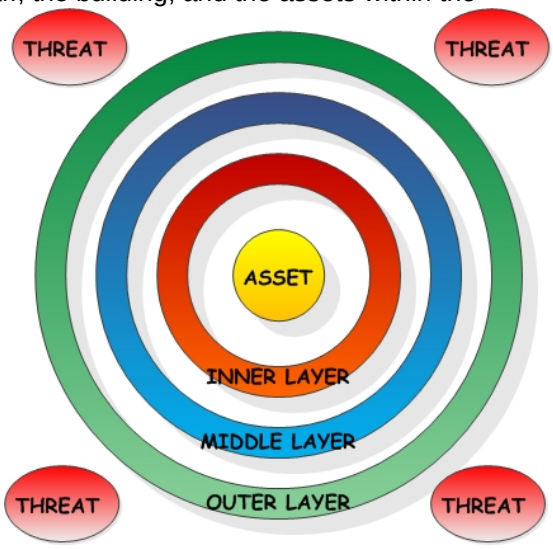
- Connection to the lighting control system
- Connection to the shade control system
- Connection to the HVAC system
- Connection to the central room scheduling system
- Connection to the central audiovisual management system

Basis of Design Cost Estimate:

$125,000 for audiovisual equipment and installation.

9.3 SECURITY

The First Academic Building will utilize a combination of staff and electronic security for the protection of the students, faculty, staff, the building, and the assets within the building (both physical and intellectual property). The Electronic Security System (ESS) consist of access control, video surveillance, and visitor management. The layout of the ESS field components (i.e. card readers, cameras, etc.) is critical in providing an optimal level of security for FAB. The approach taken to securing FAB is a layered approach, which is developed from the outer most part (i.e. perimeter of building) inwards to its more secure locations. .



1) Physical Security – Campus

   Campus ground will be manned by security guards, walking the grounds to ensure a safe and secure campus environment. The cost of this physical security item is planned to be shared amongst other building operators of the Cornell NYCTech Phase 1 campus.

2) Physical Security – First Academic Building

   The main reception desk for the FAB building will have security functionality as well, allowing staff at the desk the ability to view the security systems. The main desk will be staffed with a security guard 24/7.

The electronic access control system for the FAB will utilize a compatible system with that in operation at Cornell's campus in Ithaca. Compatibility will occur at the head-end level as well as the peripheral device level. The intent of this level of compatibility is to allow the use and exchange of information with the main access control system database in Ithaca, as well as only require an individual to carry a single Cornell electronic credential (ID card) for use at both the Ithaca campus as well as the NYCTech location. The other Cornell spaces at NYCTech will be controlled from the centralized server/database located at FAB, allowing individuals to be enrolled into a single system for use of the Cornell spaces.

The outer layer of security for the building will be the monitoring and control of its perimeter doors. The building will have the ability to allow free access through designated doors during normal operating hours, to allow public use of the café, while monitoring and controlling other doors that lead directly into non-public areas. During non-business hours, the building will be secured and will require an individual to use a card reader to gain access into the building.

The middle layer will consists of control points between the perimeter at grade and the non-public Cornell spaces on the other floors. These control points will take the form primarily of turnstiles near the main reception/security desk. The turnstiles will be in use continuously, both during normal business hours and non-business hours.
The inner layer would be any further controlled separation internally to Cornell, such as after-hour demarcation points between students working towards their master's degree and those working towards their doctorate.

9.3.1 SECURITY FIELD DEVICE LAYOUT

1) Access Control:

   Electronic access control, card readers, will be located at entry points into the following areas:

   a. Lecture Hall
   b. Seminar Rooms (all)
   c. Master Studio
   d. Conference Rooms (all)
   e. Mail Room
   f. Elevators
   g. IT/Tel Rooms (all)
   h. Convenient Stair (between 1st and 2nd floor)
   i. Egress Stairs (entering floor from 2nd floor and up)
   j. Showers

   Mechanical access control (brass key), lock and key, will be located at entry points into the following area:

   a. Mechanical Rooms (all)
   b. Electrical Rooms (all)
   c. Service Rooms (all)

2) Video Surveillance:

   Cameras will be located at the following locations:

   a. All entry and exit points

      - Storage for video cameras will be short term and will be defined in the next phase.

3) Security desk

   a. Responsible for regulating where groups can gain access to.

      - Room B0070 in the cellar will be designated as the Security Equipment room.

9.3.2 SECURITY HEAD-END EQUIPMENT

1) The FAB head-end (main processing components) for the access control and video surveillance system will be co-located along with IT equipment

   Access Control Head-End

   a. The access control system will utilize the Lenel OnGaurd software and hardware
   b. The following equipment will be located within a lockable Remote Processor Cabinet (RCP): (control panel, network interface, fire alarm system connection and 12V/24V power supplies).
   c. For door devices which require 120V at the device, the power supply will 77be located at the door.
   d. The RPC will be provided with a dedicated 110VAC circuit powered from emergency circuits. The RPC(s) will be wall mounted.

   CVMS Head-End

   a. Video surveillance system for the FAB will be IP-based.
   b. The head-end devices require a network equipment environment.
   c. Cameras without special power requirements (i.e. heater/blowers for exterior cameras, motors for pan/tilt/zoom cameras) will be Power-over-Ethernet (PoE).
   d. The head-end equipment for video surveillance (switches, recorders, and storage devices) will be rack mounted.

   Visitor Management Head-End

   a. The visitor management system will integrate with the access control system
   b. The head-end devices will be located at the front security desk
   c. The operator will have the ability to schedule visits, register and track visitors, take pictures and print temporary badges at the front desk which will be readable by the bar code reader at the turnstiles.

9.4 SMART BUILDINGS

The FAB building is to set precedent for the CNY Tech campus, as well as to establish an aspirational benchmark for building design and technology integration. The intention of the Smart Building scope is to empower the project team to achieve these goals and to capture the full value of the capital investment for the university.

9.4.1 Smart Building Qualifiers, Drivers, and Goals

In order to determine the validity of an approach, technology, or integration within or between systems, the following ***qualifiers*** were developed by the design and project team to help ensure that the design approach met the following requirements:

1. All systems and data need to be able to be utilized for future curriculum, research, and product development
2. The approach and design needs to set new precedents for CU, CNY Tech, and make a great story
3. A holistic, cross-discipline approach is required which breaks down silos
4. All energy-consuming systems need to be able to respond dynamically to human presence
5. Adaptability for future updates and upgrades are a requirement and in order to facilitate these needs, open standards and protocols need to be leveraged wherever possible
6. The validity needs to be investigated taking into account first cost as well as a twenty year life cycle analysis
7. In order to facilitate the future requirements, systems need to leverage an IP-based, converged network approach
8. Systems should allow data to be captured, normalized, and leveraged
9. Integration within and between systems should be explored for added value and functionality
10. Presence data should be able to be leveraged from multiple sources in order to create the best conditional logic and unified sequence of operations
11. Approaches should be compared to best practices, standards, and precedents from the Ithaca campus

Through discussions and collaboration, the following were determined to be the primary ***drivers*** for the Smart Building design and integration efforts:

1. The building, systems, and data should be able to be a teaching tool which empowers the future curriculum
2. The data generated by all of the building systems should be able to be utilized for research
3. The students and curriculum should be able to leverage the building systems and data for product development and growing the incubator businesses

With the qualifiers and drivers in mind, all of the Smart Building elements and integration should achieve the following ***goals***:

1. *Transform the user experience in the built environment*
2. *Reduce the cost of operations through smart building integration*
3. *Reduce the energy consumption for efficiency and sustainability*

9.4.2 Basis of Design Decisions for Design Development Reference

Through the DD phase of the project, a few key design decisions were agreed upon by the entire team which will direct the project team's path for the rest of the design process. The following decisions were made that will be adhered to through the finalization of the design and approach:

1. The project shall utilize a converged IP network which will serve both the traditional user requirements (internet and CIT network access) as well the building systems. The exact topology and data segregation will be determined in the next phase to insure data security and system "up time" will be maintained.
2. With a converged IP network, all of the building systems will leverage an IP-based data exchange wherever possible and cost-effective. Further, the platform choices for the major systems will need to have a robust, enterprise scale server / software approach to allow for future growth as well as to achieve the overall goals for the building.
3. The building automation control system (BACS), lighting control system, AV control system, and security system will capitalize on open standards and interoperability. This clarification and direction should not impact first cost.
4. Custom middleware / programming will be avoided wherever possible – and – off-the-shelf functionality will be leveraged for all systems and integration. This will also save on an impact to first cost as well as improving life cycle costs as well.
5. In order to fulfill the primary drivers listed above, the data that is available from all of the integrated systems should be stored in a "normalized" format (i.e. a web services-type of architecture) so that the building, its systems, and the data may be leveraged for curriculum, research and experimentation, as well as product development. The exact requirements and architecture of this system will be determined in the next design phase once the foundation building systems are better understood.

9.4.3 Determination of Smart Building System Integration "Required Outcomes" and Specification Requirements

Most of the systems that will be integrated in the project are already being procured: the BACS, the lighting control system, the AV control systems, the occupant calendar system, the security system, etc

All of the specified systems have myriad capabilities that typically are underutilized. The smart building scope strives to capture the full value out of

the systems through a better design of the systems as well as how they integrate together.

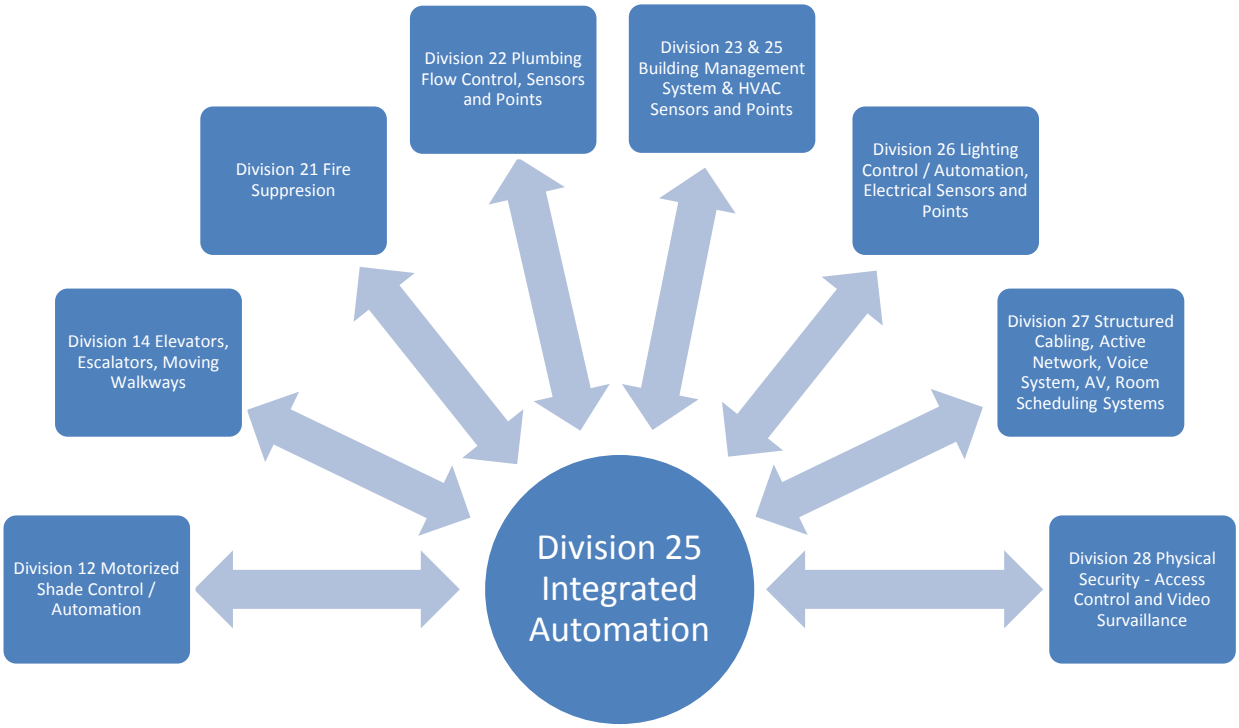
The result of the smart building integrated design process is a list of system functions that are termed as “required outcomes”. The required outcomes typically need cross-discipline design by the design team, and cross-contractor integration during construction.

Crucial to the success of all of the systems is a close collaboration with the university’s IT group as all of the systems and the integration will be based upon a converged IP network. As such, many of the responsibilities identified in the required outcomes include tasks that are the responsibility of the university’s IT group.

The required outcomes have been finalizes and the responsibilities of the contractors and the owner’s IT group have been clearly described and documented in the CSI Division 25.00.00 Integrated Automation section of the specifications.

All of the other relevant sections have been cross-referenced to 25.00.00, clearly stating that additional contractor requirements need to be adhered to and cannot be discounted.

Below is a diagram that shows the different specification sections that will most likely be leveraged in the final specifications.



9.4.4 Building Automation and End User Applications

The building and collaboration systems for the project will have the ability to automate many common tasks, requiring less interaction between occupants and control interfaces. Lighting, motorized shades, HVAC, and AV systems will be able to work together based upon time of day, day of the year, microclimate, scheduled events, and automation rules developed by the project team. The majority of actions will be based around human "presence".

Presence will be determined and cross-referenced from a number of different system sources. The following systems are anticipated to be leveraged for "presence" data:

- Occupancy sensors via the lighting control system
- Badge swipes from the security system
- Wireless Local Area Network (WLAN) BYOD device presence
- Wired network device presence
- VoIP phone system use
- Active Directory / Windows / Outlook log-on presence

All of the automation that is scheduled will be able to be overridden by users in spaces to suit their needs.

All of the different user groups in the building will require applications through which they will interact with all of the different building systems. Below is a summary of the applications that will be utilized for the project as well as the source from which the application will be acquired; i.e. is the software part of the project first cost, or will it be from acquired and put into production outside of the project.

Application	User Group	Server On Site / Virtual	Contractor Provided	Client Provided
BACS	Building Engineering / Facility Management	On Site, Virtual	Software	Server meeting requirements
Lighting Control	Building Engineering / Facility Management	On Site, Virtual	Software	Server meeting requirements
Shade Control	Building Engineering / Facility Management	On Site, TBD	Software	Server meeting requirements
Security Access Control and	Security / Administration	On Site, Virtual	Software	Server meeting requirements

Application	User Group	Server On Site / Virtual	Contractor Provided	Client Provided
Video Surveillance				
AV Management	AV / IT Management	On Site, Virtual	Software	Server meeting requirements
IT Network Administration	IT Management	Off Site, Virtual	Software	Server meeting requirements
VoIP Administration	IT Management	Off Site, Virtual	Software	TBD
Facility Management	Facility Management / Administration	Off site, Virtual	Existing License	Existing System
Room Scheduling Calendar	All	Off Site, Virtual		Existing System
Room Scheduling Display Administration	AV / IT Management	On Site, Virtual	Software	Server meeting requirements
Email	All	Off Site, Virtual		Existing System
End User Building Dashboard	All	Off Site, Virtual	TBD	TBD

9.4.5 Management and Support Models for Design Consideration

There are four key operations models that have been taken into consideration for the design and integration of building systems with user applications. The project team has developed a memo of operational assumptions the design utilized for the CD level documentation. This assumption memo was the basis of the design and is fully incorporated into the specifications in Division 25.00.00, Section 3.

1. Facilities Management / Building Engineering – CNY Tech will field initial user needs with an outsourced facility management and engineer provider with a 24 hour operations center and super chief engineer that is completely familiar with the building and systems
2. Security Operations – 24/7 hour staff, most likely from a managed service provider.

3. IT Support Model – a combination of CIT and a managed service provider.
4. AV / Media Management – a combination of the managed service provider as well as the local integrator providing warranty and maintenance support.

9.4.6 User Groups for Design Consideration

The following user groups have been identified that need to be taken into consideration for the design and integration process. Each identified user group's anticipated user interface devices and applications are presented:

User Group	Group Applications	User Interfaces
Students	Email, calendar, class content portal, building dashboard	Smartphone, tablet, PC, room interfaces
Instructors	Email, calendar, class content portal, building dashboard	Smartphone, tablet, PC, room interfaces
Administration	Email, calendar, class content portal, building dashboard	Smartphone, tablet, PC, room interfaces
Visitors / Guests	Building dashboard	TBD
Facility Managers	BACS / Lighting / Shade Administration, Facility Management, Email, calendar, class content portal, building dashboard	Smartphone, tablet, PC, room interfaces
Building Engineering	BACS / Lighting / Shade Administration, Facility Management, Email, calendar, class content portal, building dashboard	Smartphone, tablet, PC, room interfaces
AV / IT Management	IP Network Administration / VoIP Administration /AV system administration / room scheduling administration, Email, Calendar	Smartphone, tablet, PC, room interfaces
Security	Security Software, Email, Calendar	Smartphone, tablet, PC

9.4.7 The User Experience in the Built Environment

The user groups identified above all have unique needs and requirements which the design team is taking into consideration. There are three primary ways in which individuals will interact with the building:

1. Passive Interaction: by simply "being" in the building, the various systems will react to one's presence. This passive interaction is differentiated by an individual not needing to use an interface to have the systems respond to presence; i.e. one does not have to use a switch, touchpanel, tablet, smartphone, etc. to get the systems to respond to he or she being in a space. For this passive interaction, automation will be leveraged in intuitive ways and can be divided into two main categories:
    a. Reactive Automation: systems respond to changes in human presence. Some examples of reactive automation that may be utilized:
        i. Occupancy sensors turning lights on / off
        ii. Occupancy sensors turning AV systems off when not in use
        iii. Occupancy sensors triggering small temperature set-point changes in the HVAC system
        iv. Occupancy sensors triggering the scheduling calendar when rooms are occupied and unoccupied, improving room utilization
        v. Occupancy sensors triggering Class Session Lecture Capture – Automatically recording classes if the instructor schedules the system initially to preform automatically
        vi. Additional examples will be more fully documented in CD
    b. Proactive Automation: systems are programmed to work in a manner that anticipates human presence. Some examples of proactive automation that may be utilized:
        i. Lowering a space's HVAC set point in anticipation of a large incoming heat load. An example would be lowering the tiered classroom's set point two or three degrees over thirty minutes prior to class so that when the students and instructors enter the room balances to the desired set point, rather that overheating and the HVAC system working reactively to the additional heat load.
        ii. Turning on the power over ethernet (POE) to the VoIP phone system in the early morning prior to administration staff arrival so the phones are up and running prior to individuals getting to their desks. [The concept being that POE to the VoIP system would be turned off overnight if no users were working in the various open office areas.]
2. Active Interaction: This category describes occupants interacting with various user interfaces to control the building systems. It is hoped that the majority of building systems would simply work in a passive automation model as identified above; however, all building occupants should be able to easily override the passive automation and modify the space to suit their given needs. Examples of active interaction include:
    a. Turning on and off lights via switches or control panels

b. Changing set points on thermostats for selected areas (most likely done by building engineering)

c. Control AV systems for volume, presentations, setting up videoconference calls, etc.

d. Motorized shade control

3. Management Interaction: This is where end users can implement, modify, or remove aspects of the automation, as well as interact and control the various systems on a building-wide level. It is envisioned that the various building systems will exchange data to improve the operational efficiency of the university and the facility. This interaction is mostly computer browser-based use of the various applications listed above. These systems would include:

   a. BACS and sub systems

   b. Lighting Control system

   c. Shade Control system

   d. AV systems

   e. Facility Management system

   f. IP Network Management system