TECHNOLOGY SYSTEMS

General Guidelines

A. A Technology System Plan and Specifications shall be prepared as part of the overall building design process before construction begins in accordance with the latest edition of the Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual (TDMM). It shall be designed and approved by a Registered Communications Distribution Designer (RCDD).

B. All work shall be performed in accordance with the latest revisions of the following standards and codes:
   1. Uniform Building Code
   2. Local Building Code
   3. Local Electrical Code
   4. National Electrical Code
   5. EIA/TIA-568 Commercial Building Wiring Standards
   6. EIA/TIA-569 Commercial Building Standard for Telecommunication Pathways and Spaces
   7. EIA/TIA J-STD-607-A Commercial Building Grounding/Bonding Requirements Standard

C. A Technology System Plan shall consist of the following minimum Telecommunications Drawings, as required:
   1. Campus or Site Plans, Exterior Pathways, and Inter-Building Backbones
      a. Shows physical and logical connections from the perspective of an entire campus - such as actual building locations, exterior pathways, inter-building backbone cabling on plan view drawings, and major system nodes and related connections on the logical system drawings.
   2. Layout of complete building per floor – Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways.
      a. The drawings should show the complete building layout per floor and indicate location of serving zones, communication equipment rooms, access points, pathways, and other systems that need to be viewed from the complete building perspective.
   3. Serving Zone Drawings – Drop Locations and Cable IDs
      a. The building is divided up by its serving zones. Drawings to indicate drop locations, communication equipment rooms, access points and detail callouts for communication equipment rooms and other congested areas.
   4. Communication Equipment Rooms – Plan Views – Tech and AMEP/Elevations – Racks and Wall Elevation
      a. Detailed look at communication equipment room. Drawings should indicate technology layout (racks, ladderacks, etc.), mechanical/ electrical layout, rack elevation, and backboard elevation.

D. The Technology Design shall include the following components:
   1. Mandatory Systems
      a. Telephone system
      b. Video distribution system
      c. Data / computer network system
      d. Central sound / public address system
      e. Gymnasium sound reinforcement system

f. High school student dining sound reinforcement system
g. Student dining sound reinforcement system
h. Music room sound reinforcement system

2. Optional Systems
   a. Security system

E. The Technology Designer should endeavor to reduce the quantity of Main Cross-Connect Rooms (MCs) by centralizing the MCs and/or using one MC to serve multiple floors or areas. For example, in a 3-story building, place the MC on the second floor and serve the 1st, 2nd, and 3rd floors from the same closet. The Technology Designer shall coordinate the quantity and size of MCs required with the Design Professional.

F. The Technology Designer should endeavor to centralize as many Technology and Control Systems as possible for the district into one school building or Network Operations Center (NOC), and interconnect the buildings and systems via fiber-optic cables whenever economically feasible. Consider using the savings from the centralization of the systems to offset the cost of the inter-building, fiber-optic cabling.

Wiring Standards

A. Media Standards

1. Unshielded twisted pair

a. The minimum standard for horizontal distribution wiring is six (6) cables of category 5e or higher, 4-pair, 24-gauge unshielded twisted pair (UTP) wiring, terminated in each classroom. The standard specifies 100-ohms impedance at one (1) megahertz, satisfying Integrated Services Digital Network (ISDN) and Institute of Electrical and Electronics Engineers (IEEE) 802.3 10BaseT requirements.

b. ***Note: wiring specifications are a minimum of category 5e. When bandwidth is expected to be above category 5e of 1 Gigabit per second (Gb/s or 100 Mhz) then category 6 for up to 10 Gigabit or 200+ Mhz should be used. From a future proofing perspective, it is always better to install the best cabling available. This is because it is so difficult to replace cabling inside walls, in ducts under floors and other difficult places to access. The rationale is that cabling will last at least 10 years and will support at least four to five generations of equipment during that time. If future equipment running at much higher data rates requires better cabling, it will be very expensive to pull out category 5e cabling at a later time to install category 6 cabling.***

2. Fiber optics

a. The media standard for both intra- and inter-building backbones is 62.5/125 micron graded-index multimode optical fiber cable. A minimum of ~~six~~ ten fiber strand cable should be installed for each cable run.

Telecommunication Room Wiring Guidelines

1. A telecommunication room (TR) is a local communications equipment room. This should be dedicated space providing a secure environment for the installation and termination of cable network electronics and other telecommunications equipment*, as specified in the ADE IT Security Policy (ITSP), 2B2.*
2. The main cross-connect (MC), the point where the backbones and horizontal distribution facilities intersect, should be located near the center of the area served, preferably in the building core area. Every effort should be made to secure as large an area as possible. When one MC is insufficient to cover a building, additional TRs must be established. The same parameters apply for both TRs and MCs.
3. Locate telecommunication rooms *away* from any sources of electromagnetic interference, such as electrical power-supply transformers, motors, and generators. There should be *no water sources* in this area.
4. There should be one telecommunications room for each 20,000 square feet zone/wing/building section. The recommended minimum closet size is 6 feet by 6 feet. The recommended minimum ceiling height is 8 feet, 6 inches. Closets should be designed with adequate conduit or openings through beams and other obstructions into the accessible ceiling space. Closets should be designed with controls to limit access to authorized personnel only, *as specified in the ADE IT Security Policy (ITSP), 2B2.*
5. The MC contains wiring terminations and communications equipment to serve a building. This equipment may include modular fiber distribution panels, wiring termination panels, telephone systems, concentrators/hubs that connect communication lines, routers that connect users on different networks, CATV (cable television) equipment, and equipment racks.

Telecommunication Room Wiring Standards: Interior Environment

1. **Telecommunication rooms require continuous climate control. Air conditioning should maintain temperature in the range of 65 to 75 degrees Fahrenheit, with relative humidity in the range of 40 to 55 percent. Telecommunication rooms require continuous climate control.**
2. **Carpet should *not* be installed in closets. Tile or sealed concrete floors will protect equipment from static electricity and dust.**
3. **The major components of the building electrical system should not be co-located in the telecommunications room.**

TECHNOLOGY SYSTEMS

Closet space should be dedicated to serving telecommunication needs only. **Electrical installations supporting telecommunication functions only should be located in the closet.**

Telecommunication Room Terminations

1. Each TR should contain at least one universal, self-supporting 19-inch data rack. Each rack should be securely mounted to the floor and braced to the wall using a section of cable tray. Racks must be grounded in accordance with National Electrical Code requirements.
2. If fiber optic cable is to be terminated in the closet, attach a fiber optic patch panel to the uppermost part of the data rack. Terminate the fiber optic cable with ST, SC, LC or pre-terminated high capacity MPO type connectors. The maximum optical attenuation for each mated connector pair must not exceed the connector manufacturer's specifications.
3. Terminate category 5e or higher cable on category 5e or higher RJ45 patch panels in all closet locations. All incoming cables should be routed on the tray and neatly dressed down to the patch panels. A cable management panel should be installed directly above and below each patch panel.

Building Wiring Guidelines

1. Student Workstation Wiring
   a. Each classroom should have *at least ~~two~~* four student workstation outlets. Consideration should be given to placing at least one student workstation outlet on each wall in every classroom. A duplex power outlet with ground should be in close proximity to the student workstation outlet. Run two cables of category 5e or higher, 4-pair, unshielded twisted pair from the outlet to the wiring patch panel located in the telecommunication room. The cables must be a *continuous run* and not spliced. The maximum cable length must not exceed 295 feet/90 meters as specified in the EIA/TIA-568 commercial building wiring standard. The maximum allowable horizontal cable distance is 90m of installed cabling, whether fiber or twisted-pair, with 100m of maximum total length including patch cords.
   b. Each outlet must consist of either flush-mounted or surface-mounted, high-quality category 5e or higher RJ45 modular jacks with IDC-style or 110-style wire T568A or B terminations. Consistency must be maintained throughout the installation. Jacks must meet EIA/TIA-568 recommendations for category 5e or higher connecting hardware.

c. Each outlet must be terminated with two individual cables. One outlet allows for voice and the remaining outlet allows for data. The color stripes on each cable should correspond with the color stripes on the edge connector. Faceplates must match the manufacturer for RJ45 outlets at all locations.

2. Teacher Workstation Wiring

a. Each classroom should have one teacher information outlet. A duplex power outlet with ground should be in close proximity to the information outlet.

b. Run two cables of category 5e or higher, 4-pair, unshielded twisted pair from the outlet to the wiring patch panel located in the telecommunication room. The cables must be a *continuous run* and not spliced. The maximum cable length must not exceed 295 feet/90 meters as specified in the EIATIA-568 Commercial Building Wiring Standard. The maximum allowable horizontal cable distance is 90m of installed cabling, whether fiber or twisted-pair, with 100m of maximum total length including patch cords.

c. Each outlet must consist of either flush-mounted or surface-mounted, high-quality category 5e or higher RJ45 modular jacks with IDC-style or 110-style wire T568A or B terminations. Consistency must be maintained throughout the installation. Jacks must meet EIA/TIA-568 recommendations for category 5e or higher connecting hardware.

d. Each outlet must be terminated with two individual cables. One outlet allows for voice and the remaining outlet allows for data. The color stripes on each cable must correspond with the color stripes on the edge connector. Faceplates must match the manufacturer for RJ45 outlets at all locations.

3. Administrative Workstation Wiring

a. Each outlet must be terminated with two individual cables. One outlet allows for voice and the remaining outlet allows for data. The color stripes on each cable must correspond with the color stripes on the edge connector. Faceplates must match the manufacturer for RJ45 outlets at all locations.

D. Campus Backbone Wiring

1. Fiber optic cabling shall be the standard for interconnecting buildings in a campus environment. The fiber optic cable shall contain a minimum of ~~six~~ ten fiber strands and be placed in conduit. The cable must meet or exceed FDDI ANSI Standard X3T9.5 requirements for ~~100 Mbps~~ 1 Gbps transmission.

Telephone System Standards

A. The telephone system should provide TDM or IP-based voice communications both internally and externally throughout the building and the district.

B. The PABX should be a fully digital, IP-Enabled PABX or an all-IP-Based PABX. The all-IP-Based system should maintain the same

high level of functionality, redundancy, and programmable features as originally specified. Any all-IP system should employ standards-based signaling and instrument powering. All PABX systems should fully support an E911 system.

C. A school telephone system shall be as follows:

1. Provide a 4-pair, minimum Category 5e, CM (CMP where required), UTP cable to all telephone, fax, alarm, elevator, and ancillary voice connections. Provide Multi-Pair, minimum Category 3, CM (CMP where required), UTP, trunk-cables between Telecommunications Rooms and the Main Cross-connect (MC), and between the MC and the Telecommunications Service Entrance Facility (aka DEMARC).

2. The PABX telephone system should provide the capability for a fully digital, non-blocking, voice communications link between all classrooms and offices within the building. A telephone set is not required in each classroom; however, the necessary wiring infrastructure should be installed so as to provide access to the telephone system on an as-needed basis.

3. The PABX telephone system should be capable of inter-operating on a district-wide basis using T-1, PRI, or VOIP trunking between buildings. The PABX system should be connected in order to provide a unified system throughout the district. Trunking should be designed on a P=0.01 basis.

4. Provide telephone jacks and telephones in classrooms, offices, media center, teacher prep areas, workrooms, conference rooms, secretarial areas, telecommunication rooms, elevators, etc., as determined by the district's program needs.

5. Provide fully digital, full-duplex, digital display speakerphones with a minimum of eight (8) programmable function keys in each area where access to the telephone system is needed.

6. Provide a minimum of one fully digital, full-duplex, speakerphone attendant console with multiple programmable function keys and one-touch button calling for all extensions within the building. The attendant console should be located in the main administrative reception area.

7. Provide centralized PABX and phone instrument power with a minimum of four (4) busy-hour standby capabilities for all PABX equipment. IP-based systems should also be provided with four (4) busy-hour standby capabilities for all powered switches or patch panels located in each telecommunications room. Connect the central power supplies to building emergency power when available. All IP instruments and power sources should be IEEE 802.3af compliant.

Telephone System Guidelines

A. Provide personalized programming for each system within the district.
B. Provide personalized training for all users within the district.
C. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607 specifications.

Video Distribution System Standards

A. The video delivery system should include a 750 MHz broadband, coaxial-based system for distributing centrally-located RF video programming sources such as CATV, satellite dish programming, etc.

B. The system should provide an extension of the CATV service from the service provider's demarc to the main cross-connect.

C. The system should allow for remote broadband origination of programming via a RF broadband or an MPEG IP connection.

Data / Computer Network System Standards

A. The data network should provide a "high speed" ethernet local area network to all buildings within the district, providing a minimum of 100/1000 Mbps switched ethernet connectivity between all computer devices, such as file servers, printers, etc. The backbone should consist of gigabit ethernet links between the telecommunication rooms and the main cross-connect. Inter-building links should consist of a minimum of two (2) parallel gigabit ethernet circuits arranged in a load-sharing, ethernet trunk with properly programmed VLAN and QoS support.

B. The data network shall consist of the following:

1. A 4-pair, minimum category 5e compliant, CM-rated (CMP where required), UTP horizontal cabling infrastructure, terminated and tested with a level-III cable certification unit, and provided with a manufacturer's 20 year (minimum) lifetime performance-based warranty.

2. A fiber optic-based backbone cabling infrastructure equipped with multi-mode and single-mode fibers between the telecommunication rooms and the main cross-connect. The multi-mode fibers shall be terminated with fusion-spliced, factory-polished, SC pigtails. The single-mode fibers shall be terminated with fusion-spliced, factory-polished, SC pigtails capable of 10 Gbps operation.

3. A minimum of six (6), 4-pair, minimum category 5e compliant, CM (CMP where required) rated, UTP cables from the service entrance facility to the main cross-connect for the extension of special circuits (T-1, PRI, etc.) that are provided by the service provider.

4. A 100-pair, minimum category 3 compliant, CM (CMP where required) rated, multi-pair telecommunications UTP cable from the service entrance facility to the main cross-connect to be used for the extension of voice, fax, and alarm circuits that are provided by the service-provider. Investigate the possibility of making a single process communication cabling "utility" through the building and/or campus. The result will be a design methodology that allows a standardized cabling system to serve all communications needs throughout the process areas.

5. A minimum of six (6), 4-pair, minimum category 5e compliant, CM (CMP where required) rated, UTP cables from the main cross-connect to each telecommunications room for special data circuits.

6. A minimum of one (1), 100-pair, minimum category 3 compliant, CM (CMP where required), UTP cable from the main cross-connect to each telecommunications room for voice circuits. Trunk cables must be sized to accommodate all telephone system requirements.

7. Review the building design and place data faceplates, equipped with a single minimum category 5e compliant, CM (CMP where required) rated, UTP cable from the associated telecommunications room, below ceilings to support the deployment, by the Owner of 802.11a/b/g/n wireless ethernet access points and associated wireless network switching devices and phones. Provide proper spacing for adequate coverage of entire facility. Consult with Owner and consider coverage of selected external areas, playgrounds, entrances, parking lots, commons areas, etc. (via externally mounted antennas). Wireless design shall be based on centralized, IEEE 802.3af compliant power sources.

C. The system should include all jacks, patch panels, patch cords, connectors, labels, designation strips, and equipment cabinets or racks (with associated fans, grounding/bonding, wire-managers, labels, power strips, etc.)

D. The system should include all inter- and intra-building network electronics, including user layer-2 workgroup switches, layer-3 gigabit backbone switches, wireless switches, routers, and file servers.

E. As a minimum, the network may be used to support the following applications on a local and wide area basis:

1. Data networking
2. VoIP telecommunications
3. Wireless access points
4. Video conferencing
5. Video streaming/media retrieval
6. Automation systems
7. Control systems
8. Security systems

F. The network system should also include un-interruptible power supplies (UPS) for all primary components. Provide an SNMP management interface in all UPS units. Provide a minimum of 30 minute (4 hours when used for voice support or security system support) standby power for all network electronics. Connect the UPS units to the building emergency generator when available.

G. Provide all required integration services to setup and program the network (IP addresses, VLANs, routing, wireless surveys, etc.).

H. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA J-STD-607-A specifications.

Central Sound System / Public Address System Standards

A. Provide a building-wide central sound (public address/paging) system providing communications used for "all call" and emergency announcements. This system shall incorporate a master program clock/bell system used to generate tone signals for class change. This system shall be connected to the voice

communication (telephone) system. If telephone sets are not installed in all classrooms, the central sound system shall provide two-way communication with the school administrative office.

B. Provide surge-protected, weatherproof exterior horns protected with wire guards/cages, as required, on the outside of the building at playground and bus drop-off/pick-up locations. Consider easily accessible, internally-mounted volume controls for all external paging horns.

C. Provide wall-mounted type horns protected with wire guards/cages, as required, in gymnasiums, auxiliary gymnasiums, and locker rooms. Non-protected, wall-mounted type horns shall be provided in high school student dining areas, technology production labs, vocal rooms, instrumental rooms, mechanical decks, or other spaces with high ambient noise levels.

D. Instructional spaces shall have speakers recessed in ceiling pads in suspended ceilings. Supply wall-mounted volume controls as required.

Gymnasium Sound Reinforcement System Guidelines

A. Provide a separate sound system in gymnasiums for use during instruction periods, student assemblies, public assemblies, and sporting events.

B. Locate main equipment cabinet directly accessible from the gymnasium for ease of adjusting sound levels.

C. Provide a minimum of 2 combination XLR microphone/auxiliary jacks at opposite ends of space.

D. In buildings where announcements or broadcasts are to be made from bleachers, provide a single microphone and an auxiliary jack in a junction box attached to the bleachers. Provide protective cover plates.

E. Provide a wireless microphone system.

F. Loudspeakers pointed at the bleachers shall provide a maximum 3 decibels difference in sound level across the entire bleacher seating area and 25 decibels over the highest ambient noise level.

G. Provide a feedback elimination system.

H. Provide a portable console/cabinet containing a CD, cassette, and MP3 player unit, mic mixer, mic inputs, and associated audio cables for attaching to the permanently mounted microphone and auxiliary input faceplates.

I. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607 specifications.

High School Student Dining Area Sound Reinforcement System Guidelines

A. Provide a separate sound system in high school student dining areas for use during media productions, stage productions, student assemblies, or public assemblies.

B. The system shall be designed for a high degree of intelligibility and a full range of stereo music capabilities.

C. Locate the main equipment cabinet in the main high school student dining area control room. Provide a sound reinforcement mixing station in the control room and at the back of the high school student dining area.

D. Locate the main sound reinforcement speakers in a space so all seats are provided with a high degree of intelligibility for both stereo music and speech. Intelligibility shall be a maximum of 3 decibels over the entire seating area and 25 decibels over the highest ambient noise level.
E. Provide a minimum of 2 microphone outlets at locations in the seating area. Locate a microphone patch panel housing XLR microphone/auxiliary inputs on the stage to serve various microphone stands on stage. Provide for on-stage, monitor speakers connected to central amplifier.
F. Provide separate wireless sound systems for both performers and for attendees requiring assistive listening. The assistive listening system shall conform to the Americans with Disabilities Act guidelines.
G. Install speakers used for monitoring this sound system in ready (green) rooms so performers know when to go on stage. Such rooms may include dressing rooms, music rooms, and instrumental rooms. Consider video monitor jack for video monitoring.
H. Provide a wireless stage manager communication system dedicated for use by sound, lighting, and stage manager personnel.
I. Provide a feedback elimination system.
J. When equipped with an FM tuner, connect to an FM antenna mounted externally to the building.
K. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607 specifications.

Student Dining Sound Reinforcement System Guidelines (Cafetoriums only)

A. Provide a separate sound system in the student dining area for use during student assemblies or public assemblies.
B. This system shall be comprised of a permanently mounted cabinet or rack (based on space architecture) for housing production and amplification equipment connected to either ceiling- or wall-mounted speakers conforming to the architecture of the space.
C. Provide a minimum of 2 XLR hanging microphone/auxiliary jacks at opposite ends of space for use.
D. Provide a wireless microphone system located in the rack/cabinet system.
E. Provide a feedback elimination system.
F. When equipped with an FM tuner, connect to an FM antenna mounted externally to the building.
G. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607 specifications.

Music Room Sound Reinforcement System Guidelines

A. Provide single (shared) portable sound equipment for the playing and recording of music in the high school instrumental, vocal, and ensemble rooms.
B. Provide the instrumental, vocal, and ensemble rooms with wall-mounted speakers and a minimum of 3 XLR wall-mounted microphone jacks distributed throughout the rooms. Provide a minimum of 2 XLR hanging microphone jacks located on the ceilings.
C. The equipment rack shall be mobile housing amplification equipment.

D. Provide a feedback elimination system.
E. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607 specifications.

Security Systems Guidelines *(optional)*

A. Within the building security system allowance designated in Chapter 1, provide as many of the following provisions as possible. The following recommendations represent a reasonable expectation of protection within budget constraints and security needs of the district. The Design Professional should specify the priority security systems to fit the site/building conditions.
    1. The primary security system will be the access control system; consisting of a CPU, software, control modules, wiring, readers, and strikes/locks for selected exterior doors. The remainder of the exterior doors should be equipped with fire panic hardware making them available for emergency exit but not for entry. Remove exterior hardware.
    2. Burglar alarms: Every exterior door is contacted and backup up by motion detection in the corridors to protect the facility from after-hours intrusion and to summon authorities in an emergency situation. Install motion detectors on all floors of the facility in corridors and all rooms with outside access. The alarm system shall be integrated with the building lighting system and shall activate the corridor lights and other selected areas in the event of alarm activation.
    3. CCTV: Provide exterior cameras and adequate cameras in the corridors, plus the head end equipment (digital recorder, monitors, multiplexer, and power).
    4. Pan zoom tilt (PZT) should be considered for external cameras. Mount external cameras in appropriate environmentally controlled enclosure. Mount internal cameras in smoked-dome enclosures.
B. Provide security screens for windows if warranted by the specific project location and exposure.
C. Every system shall be UL approved and monitoring shall be provided at UL approved central station.
D. Every alarm system shall communicate over a dedicated telephone data line.
    1. Alarm system shall have a battery backup (UPS system) for power of at least 4 hours. Provide SNMP management on UPS system and connect to network.
    2. Connect the UPS units to building emergency generator when available.
    3. System shall be programmed to accept individual alarm access codes from authorized employees. Codes are not to be shared.
    4. Each keypad will have a distress code.
    5. The systems will be supervised, i.e., power failure, line cut, and communication failure will signal the monitoring station of the problem.
    6. Every door, hatch or other port of entry will be fitted with an alarm contact.
    7. Each entry point will be backed up by motion detectors.
    8. Panic buttons will be installed at reception areas.

9. An exterior horn and strobe light that signals an alarm break will be part of this system.
10. If equipped, the fire system flow and tamper switches will be tied to an alarm point.
11. The alarm company will provide monthly reports detailing alarm system use, including opening, closing, and alarm conditions.
12. Consideration shall be given to centralizing and integrating the system on a district-wide basis via the wide area network, where available.

E. Minimum Standard: Closed Circuit Television Systems

1. Cameras: All cameras will be color, CCD chip technology. They may be stationary or they may be pan, tilt, or zoom. Those abilities will be designated at the design phase and based on need. All cameras will be equipped with an automatic iris to control light. Compatible lenses specific to each placement and required field of view will be used. Cameras with integral motion detectors are acceptable. Limit internal camera spacing to 150 feet maximum. Provide a dedicated camera for each building entrance. Use appropriate lenses for application.
2. All cameras shall be capable of being viewed and digitally recorded at the same time.
3. Controllers: Should the design call for cameras that can pan, tilt, and zoom, they will require a controller that can move the cameras. The system shall have a battery backup (UPS system) for power of at least 4 hours. Provide SNMP management on UPS system and connect to network. Provide for graceful shutdown of equipment. The controller shall be IP connected to the network and shall permit viewing and control over the network, via PCs. A separate security VLAN shall be established. Connect the central UPS to building emergency generator when available.
4. Recorder: Each recorder shall be digital and provide for up to 60 days of storage. Each recording system shall be equipped with provisions for extracting digital images and transferring to a CD. The recordings shall contain a digitally encoded date and time for each camera. Each recorder shall be equipped with digital image enhancement capabilities. The recorder shall be network connected and shall be capable of being viewed and controlled remotely from a PC workstation over the data network.
5. Motion Detectors: The camera system should be equipped with motion detectors for changing the frame per second recording rate, depending on system set up.
6. Camera Power: All cameras will be powered by low voltage wire and transformers connected to central UPS power with a minimum of 4 hours standby. The wire will be run with the copper video transmission cable. Category 5e, IP, or Baseband video systems are acceptable. In-line or parallel power is acceptable. Cable runs exceeding 500 feet may require the use of fiber optic cable. Exterior installations can have the cable above or below ground. The wire must be tied to a support cable if run above the ground, and every camera should be grounded with surge suppressors for lightning strikes. The lightning protectors shall be properly grounded in accordance with NEC and EIA/TIA-607 and connected to the associated telecommunications grounding bus (TGB).

7. Exterior Housings: Exterior cameras will be placed in climate-controlled and vandal-resistant housings. Exterior cameras will be placed no more than 1,000 feet apart. Exterior camera housings shall be grounded in accordance with NEC and EIA/TIA-607.
8. Monitors: Systems with 4 or fewer cameras will be monitored with a 13-inch (minimum) color monitor. Systems of 5 cameras or more will be monitored with 20-inch color monitors. An additional 20-inch (minimum) color monitor should be mounted on the ceiling at the public entrance to show that cameras are being used in the public areas.
9. Consideration shall be given to integrating the system on district-wide basis via the wide area network.

F. Minimum Standard: Access Control Systems

1. All access control systems should be a minimum of Windows 2000 based or compatible. The system should have the ability to integrate alarms and video signals into one centralized system. The number of doors on the System will vary from building to building; however, a minimum number of doors should be selected for access control devices. All other exterior doors should be equipped with fire panic devices to prevent entry while allowing exit. The system shall have a battery backup (UPS system) for power of at least 4 hours. Provide SNMP management on UPS system and connect to network. Provide for graceful shutdown of equipment. The controller shall be IP-connected to the network and shall permit viewing and control over the network, via PCs. Connect the central power supplies to building emergency power, when available.
2. Card readers should be proximity or biometric readers. Doors protected by access control will open for exit by using a crash bar release. Each of these doors will be monitored via the door alarm contact for being propped or stuck open. In an emergency, the protected doors can be seized allowing exit only.
3. The system will be on a programmed schedule that automatically unlocks the doors for admittance at the start of the day, locks doors (except the main entrance) during class hours, and locks all doors at the close of the day. This will funnel visitors to the front door where they can be observed and controlled.
4. The head-end equipment for the access control system will, ideally, integrate both alarm and video signals. Consideration shall be given to integrating the system on a district-wide basis via the wide area network.

Interactive Classroom Design Guidelines *(optional)*

Videoconferencing classrooms require special attention to ensure that the highest quality sound and visual signals are transmitted and received by participants. The following are recommendations on the building of interactive videoconferencing rooms.

A. Location: A quiet, convenient and central location is best. It should be isolated or separated from the sources of loud outside noise. This minimizes the need for sound isolation treatment. The room should be near an area that allows for direct and indirect supervision of the class

(for monitoring students, security and liability reasons). Access should be suitable for a person with a physical disability. A ground floor location is preferable. Areas to avoid are those that are located near high traffic areas, lifts, plumbing, workshops, and plant rooms. Care should be taken to diminish the sounds from the air conditioning ducts, the gymnasium, band room, shop, or cafeteria.

B. Classroom Size: Classroom size depends on the maximum number of participants you hope to have in your room. We suggest planning for a minimum of 20 participants, but ideally be prepared to accommodate at least 25, with tables and chairs. The space should be approximately 24 feet wide by 30 feet long, with a ceiling of 9 feet minimum, to accommodate compressed interactive equipment along with 20 students, or a majority of the faculty for staff development. For teaching seminar groups involving 100 or more, the system should be placed in a lecture theatre setting. Consideration shall be given for appropriate acoustics.

C. Classroom Shape: To reduce acoustic effects, square rooms should be avoided, if possible. An oblong or irregular shaped room is a better shape, as it does not encourage standing waves (and thus echoes).

D. Physical Layout: Room layout will depend on the number of participants, the available space and the purpose of the room. Layout is a compromise between clear audio, the best viewing of monitors, interaction, and the space available.

E. Acoustics: Audio quality is one of the most critical technical elements in a successful videoconference, and it has implications for the selection and placing of the room, as well as for its construction and treatment. The participants and presenters must hear each other clearly, both locally and remotely, without strain. Some factors influence the quality of the sound in a videoconference; namely, ambient noise, room acoustics and reverberation, and equipment configuration.

1. Acoustic treatment of rooms will need to be executed with materials that satisfy the relevant building regulations, so it is essential that this work be supervised by qualified staff.
2. The internal acoustics of a room are very important. Too much reverberation (echoes in a closed room) will present problems. Rooms should not be too absorbent, as this will present an unnatural and uncomfortable environment for the participants. A room that suffers badly from echoes should have the acoustic treatment applied to the adjacent walls rather than the two opposite ones. This will allow standing waves to be reduced in two dimensions (lengthwise and widthwise).
3. Hard blank walls can be deadened by heavy curtains, which have the added bonus of improving the décor. Carpets and other soft furnishings will improve the acoustics and will generally be more cost-effective than acoustic ceiling tile.

F. Windows: The ideal room has NO windows. Windows always cause problems for television cameras due to the changing light levels. Window Treatments: If windows are unavoidable, heavy curtains or drapes should be applied to improve acoustics.

G. Entrances**:** Entrance at rear of the room is the best option. Access should be suitable for a person with a physical disability.

H. Flooring: There should be carpet on the floor. Carpets and other soft furnishings will improve the acoustics and will generally be more cost-effective than acoustic ceiling tile.

I. Lighting: Fluorescent lighting is the most realistic choice for these rooms. Normal office lighting levels will be adequate, i.e., 500 Lux, and an intermediate or warm fluorescent tube color (equivalent color temperature 3200-4000 Kelvin). There should not be a buzzing sound projected from the lights in the classroom.

1. Install lighting at the front of the room but ensure that it is on a separate switch from the rest of the room lights. As a general practice, it is advised that classroom lighting, even in traditional classrooms, be "zoned" into rows of separately switched lights. These rows should run across the width of the room, not down its length. In this way the front of a room, beside the projection screen, can be darkened to give better contrast to the projected images, but still retain a good level of light over the participant's desks**.**

1.2 Recommend using high efficiency T-8 lamps and electronic ballast along with the use of occupancy light sensors to prevent energy waste in unoccupied areas and/or buildings, along with copy/work rooms, rest rooms, etc.

J. HVAC: The HVAC should be seen – not heard in the classroom. Microphones are sensitive to moving air. The microphone amplifies normal air conditioning and can cause a large amount of background noise in a videoconference. Air conditioning/handling equipment will also require installation by experienced staff to ensure the quality of air is adequate and the temperature, humidity, etc. are of an acceptable standard.

K. Communication: There should be a dedicated phone line and phone in the videoconference room. It is also recommended that there be a FAX line in the room. It is suggested that you have at least one phone and an additional phone line, or jack, in the room for a FAX line or expansion in the future.

L. Computer: Videoconference rooms should have a minimum of four areas to access a computer and the Internet.

M. Electrical: Electrical installations need to comply with current National Electrical Code (NEC) wiring regulations and should be carried out by competent and qualified staff. The equipment used for videoconferencing should be powered from a clean main supply to avoid electrical interference. It should not be on a circuit that is shared by large electrical loads such as plant motors, lifts, workshops, etc.

N. Wiring: To minimize hum pickup, signal cables (i.e. sound and vision) should not be run parallel to main supply cables; this is especially important for microphone cables. Also, do not run over or parallel to lighting ballasts.

1. Several cables should be run from the control desk to the picture monitors and loudspeaker/audio mixer and also to the CODEC, wherever these are situated. Some provision must be made for small ducting or conduit to protect these cables.
2. When cable runs across floor spaces cannot be avoided, some form of protection must be provided. Special rubber cable protectors are available that protect the cables and minimize the risk of tripping.

O. Room Color: Generally high contrast color is desired. Light Blue or light gray is commonly used. Stay away from dark and vivid colors. One recommendation is Periwinkle Blue, or Slate Gray.

P. Furniture**:** Individual sites will have their own preferences for the type of furniture to be installed. Try to avoid bright, reflective surfaces that may cause unwanted highlights in the picture and distract the viewer from the main subject matter.