District of Columbia Public Schools

"Schools Designed for Technology Supported Learning"

Technology Implementation Facilities Design Plan

June 3, 2002

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SECTION I
INTRODUCTION

A. Project Background

The Technology Implementation Facilities Design Plan development project was initiated as a joint effort between the District of Columbia Public Schools Department of Planning, Design, and Construction and the U. S. Army Corps of Engineers. Educational Systems Planning of Annapolis, Maryland developed the Technology Implementation Facilities Design Plan (hereafter referred to as the "Plan Document") in conjunction with Lukmire Grant Architects under a contract with the U.S. Army Corps of Engineers.

Educational Systems Planning (hereafter referred to as "ESP") would like to acknowledge the assistance of the staff of the Office of the Chief Technology Officer, the Office of the Chief Academic Officer, and the Department of Planning, Design and Construction for their assistance and valuable input into the development of the Plan Document.

The District of Columbia School District (hereafter referred to as "DCPS") has recently adapted a Facilities Master Plan, which calls for an extensive school building replacement and modernization program over the next decade.

This extensive school facilities program comes at a time of significant emphasis on changing the way students learn in school environments. This paradigm shift from an industrial learning model to an information learning model and the resulting desired learning environments is discussed in Section II, Preliminary Planning. With the magnitude of the school construction program defined in the Facilities Master Plan, it would be easy for DCPS to be caught-up in the "bricks & mortar" aspect and miss the opportunity to use this effort as a "widow of opportunity" for significant change in the instructional process. These new school facilities will have a defining and significant impact on the instructional process in DCPS for half a century. Consequently, it is important that the use of new instructional technology be appropriately and effectively planned for in these new facilities. The design of DCPS's new schools can become a significant change agent in this new paradigm shift. The real challenge is to develop a school design process which will focus on teaching and learning areas for today and tomorrow, and to design each school for its specific student target population, while maintaining district-wide technology implementation standards.

The focus of this document is both:

- Designing schools right from the beginning, and
- Doing what is right for children, not just doing right, which may not be right for kids.

The overall objective of the Plan Document is to provide to the architects who are hired to design new and renovated schools, guidelines and standards, which incorporate DCPS's desired uses of instructional and administrative technology. Briefly stated, the plan (1) identifies the impact of learning trends, technology trends, and the desired learning environments of facilities and communications infrastructure design; (2) documents DCPS's desired learning environments; (3) documents facilities design guidelines for technology of new, modernized, and the retrofit of existing schools, and defines detailed communications infrastructure standards (Division 17000).

The Plan Document is intended to be used in conjunction with and complement the following documents:

- The Facilities Master Plan, 2001/Final
- DCPS Design Guidelines, February 15, 2001
- DCPS Technology Plan "Beyond 2001 – Thinking Children" Draft May 15, 2001

B. Project Purpose and Use

The purpose of the Plan Document is to identify and delineate both the "process and product" of technology implementation and facilities design guidelines to be followed by architects in designing new and modernized schools. The Plan Document sets forth a procedure to be followed which will ensure that appropriate considerations are given to designing learning areas in schools that support the districts desired learning environments. New roles and responsibilities for the architects' design team components are identified and described. In addition, the Plan Document provides definitions and standards for technology communications infrastructures to facilitate these new learning environments. The document's emphasis is on "teaching and learning" the role technology can play in creating new learning environments, and the impact these new learning environments have on school design.

The Plan Document will assist the architect's design team in addressing:

- Technology and facilities planning activities
  - Instructional systems selection
  - Impact of technology utilization concepts on schematic design
- Facility requirements to support technology decisions
- Design and layout of learning areas and other technology spaces
- Standards for voice, video, and data communications infrastructure design
- Procedures for technology installation oversight

It is important to note that:

- The plan is not static; once approved, it will need to be reviewed and updated periodically to embrace the changing technology and its growing impact on facilities design.

- Section VI, Division 17000 is provided as a guideline for the development of school specific specifications that are to be included construction documents. It will require review and modification for individual school project and should not be routinely used.

C. Scope of Plan Document

The major considerations for technology and facilities planning included in the plan document are:

- Determination of specific instructional philosophies for the school project, such as: use distributed computing versus computer labs; specific use labs versus general use labs or open access labs; centralized media center functions, etc.
- Use of new and emerging technologies appropriate for specific school target population
- Methods of teacher and small group presentation techniques

The major considerations for facility requirements to support technology decisions are:

- Criteria for the determination of the number and location of telecommunication rooms (MDF and IDF's)
- Layout and design of telecommunication rooms
- Specification of equipment for telecommunication rooms
- Electrical requirements for telecommunication rooms
- Ventilation and air conditioning requirements for telecommunication rooms
- Specification scheme for Communications Network Outlets (CNOs)
- Criteria for the location and number of CNOs in classrooms and all other spaces
- Electrical requirements to support technology in classrooms, labs, media centers, science labs and all other spaces
- Specifications of equipment for telecommunication rooms
- Specifications and design layout of in-wall conduit to support CNO configuration scheme
- Specifications and design layout of surface mounted raceway to support CNO configuration scheme
- Specification of thru wall sleeves, vertical conduit chases, and in-floor conduit to support cable plant

The major considerations for standards for voice, video, and data communications infrastructure design included in the Plan Document are:

- New and emerging conceptual designs and topologies
- Emerging applications of wireless technology
- Development of building-wide 10/100-BASE-T computer network design
- Development of building-wide cable TV distribution system
- Specifications for CAD Communications Network Design drawings

The following school based systems were not intended for inclusion in this version of the Plan Document:

- Design of the DCPS wide area computer network (WAN); however, the Plan Document does include the design of equipment within each school necessary to connect with the WAN
- Voice intercom communications equipment
- Video surveillance
- Alarm security
- Fire and safety

SECTION II
PRELIMINARY PLANNING

The purpose of this section of the Plan Document is to provide the architect and design team consultants with a basic understanding of DCPS's objective of integrating technology utilization into the curriculum, student learning, and the very fabric of the instructional process. It is anticipated that, armed with this understanding, architects and educational designers will be better able to plan and design learning environments which will enhance and promote the effective use of technology in the educational process. A portion of this Section repeats and consolidates information contained in the District's Technology Plan "Beyond 2001 – Thinking Children" Draft dated May 15, 2001 and Facilities Guidelines Document dated February 15, 2001.

A. Statement of Guiding Principals

The District of Columbia Public Schools is committed to educating all students in a child-focused, supportive, heterogeneous, age-appropriate, dynamic classroom and school environment. This commitment is based on the belief that every student has the right to achieve his or her potential within society. At the foundation of the District's performance-based approach to curriculum design and delivery is a set of guiding principles that underscore the District's commitment to students. Those guiding principles are:

- All students are capable of learning, and there are no limits to learning.
- The dignity of the student and respect for his or her present circumstances and cultural and language diversity should always be affirmed.
- Each student learns in his or her own way and at an individual pace.
- Learning is both an individual and social process.
- Learning requires the active participation of the learner.
- Caring, sensitive, and respective adults heighten the student's desire for learning and create conditions for success.
- The school, community and family must act in collaboration to support the student's learning.

Embedded in these principals is the commitment that all students will achieve the same content standards and acquire the same foundational skill as described in the District's Curriculum Frameworks document. The infusion of technology into the curriculum, the placement of suitable and appropriate technology into the district's classrooms and other learning areas will play a major and strategic role in ensuring that student goals are achieved.

B. Technology Mission Statement

A technology mission statement is a clear, concise, and complete affirmation of the district's desired purpose of technology utilization. It is as much a statement of what "is desired" or to what the school aspires, as what "is today". It is clearly a statement of the future, which encapsulates the overall philosophy and strategy of how technology should be utilized to meet the district's instructional goals. The mission statement below was developed as a consolidation of thoughts obtained from the District's Technology Plan "Beyond 2001 – Thinking Children" Draft dated May 15, 2001. It is intended to reflect the thinking expressed in the district's Statement of Guiding Principles and enhance the statements of technology utilization beliefs to follow.

> "To prepare the district's young men and women for the challenges of tomorrow and to become productive citizens in an evolving world, the District of Columbia Public Schools will plan, design, implement and utilize technology to enhance the curriculum and improve instruction in classrooms and all other learning areas. Information technology will be used to assist students think, learn, and develop the ability to access, analyze, and communicate information. Technology should also increase the student's responsibility for his or her own learning and empower them to be agents for their own education, enhance cooperative learning and critical thinking while facilitating administrative tasks and classroom management. The district is committed to providing equitable student and staff access to technology and to the extensive staff support and development necessary to accomplish this mission."

C. Assumptions/Beliefs About Technology Utilization

Consolidation of staff philosophy, thoughts, and aspirations for technology applications is an important aspect of the technology planning process. The following assumptions about technology use were obtained from the District's Technology Plan "Beyond 2001 – Thinking Children" Draft dated May 15, 2001 or developed during the initial meetings with the district's technology staff and school based principals. It is important to note that no priority is intended by sequential statement of the assumptions. Addressing the following statements developed the list of beliefs:

> "Technology utilization should result in....."
> "The purpose of introducing new technologies should be....."
> "Technology should provide....."
> "The use of technology will facilitate....."

- Technology should support the desired student learning environment which is:
  - Learner centered
  - Project based curriculum
  - Active
  - Multi-sensory
  - Multimedia
  - Individualized/small group instruction

- Technology should support the desired learning environment where students can acquire the following skills:
  - Critical thinking
  - Problems solving
  - Team building
  - Use of and sharing information and ideas
  - Learning to learn

- Technology should support the desired learning environment where teachers can become:
  - Facilitators of instruction
  - Managers of instruction
  - Student coaches and mentors
  - Student motivators

- Technology should be used to facilitate teacher administrative tasks, which provides better time management and increases the instructional efficiency of teachers.

- Technology utilization will result in graduates having computer literacy skills, which will allow them to prepare for college entrance or the world of work and become effective and productive members of society.

- Technology should facilitate more active student learning, student autonomy, and individualization of instruction while increasing the student's' responsibility for his or her own learning.

- Technology utilization should provide increased student access to information, increase the student's skill in using technology, enhance the student's ability to evaluate information, and improve student achievement.

- The purpose of technology utilization is to enhance, not change, the curriculum and offer teachers the opportunity and framework to become more effective in developing and delivering dynamic curriculum. Technology should facilitate the process of change toward a learning environment in which the teacher is less a provider of information and more a facilitator of learning.

- Technology is a tool for students to use to foster creativity and critical thinking in a cooperative setting while encouraging individual growth.

- Technology utilization is based on the premise that it will result in increased multi-dimensional learning applications, enhanced student critical thinking skills, and provide a broader more integrated curriculum consistent with the school's mission statement and philosophy.

- Technology should provide an information-rich environment in which students are encouraged to access and manipulate information and which supports their creative decision-making processes. Access to information via technology needs to be equitable and easy with particular attention paid to confidentiality and security.

- Technology should facilitate individual student needs, promote dynamic inter-active learning, and provide students greater opportunities to construct informed conclusions.

- Technology should prepare students to live and work in a changing global society and expand their enthusiasm for life-long learning.

- Technology should provide tools to assist students to learn how to learn.

- Technology should be "transparently integrated" into the learning process in such a way that it provides a vehicle for greater use of critique, extrapolation, creative problem solving, and analysis.

- Technology should provide better communication (collaboration) among staff, students, and parents. Better communications is seen as greater, faster, and more responsive interaction while maintaining or increasing direct face-to-face contact.

- Technology will allow teachers to have access to a greater variety of learning strategies and on-line instructional materials to support a wider range of student learning styles.

- Technology will result in a greater strain on financial resources and physical facilities and must be supported through planning, staff development, parental, and technical support. Significant increases in the amount and type of teacher training will be required.

- The effective implementation of technology requires a significant change in teaching style and is dependent on a positive attitude toward change. Technology utilization will place greater demands on teachers.

D. Vision of Technology Utilization

How will things change for tomorrow? What are the technology trends that will make education different in the future? What impact will tomorrow's technology have on how we design schools and layout classrooms today? One does not have to be a futurist to visualize tomorrow's school environment. Most of the components can be found in today's society, a few even in today's classrooms. Many more technology components, however, are still in developmental stages. It is the responsibility of the architect and the educational technology design team consultants to design learning environments that make effective use of today's technology and provide a degree of affordable future proofing of the communications infrastructure for tomorrow's technology.

The following discussion addresses, for the architect's design team, the impact of future technologies in education and desired changes in learning styles and methods on facilities design. Some of the major considerations are:

- The existing classroom environment will continue, but with the teacher being supported by enhanced technological administrative and instructional systems. Technology will allow the learning environment to contain the following desirable features:
  - Small-group instruction
  - Individualized instruction

- "Non-paper" instructional materials
- Collaborative, multi-sensory instruction
- On-demand access to information and resources
- Exploratory, intuitive-based

- The general-purpose computer lab will become decreasingly necessary. Each classroom will have the capability of being or becoming a computer lab, as each student has his or her own small laptop or other type of individual computer device connected via wireless to the hard-wired school-wide data communications infrastructure.

- The design and layout of classrooms and all other learning areas must change to accommodate new teaching and learning environments.

- Technology intense (high band-width requirements) computer labs, such as technology education or media/information technology pathway labs, will continue to exist and contain high-end desktop computers "hard-wired" attached to the school-wide data communications network

- The media center (information resource center) will continue to function as the technology distribution center of the school, housing the main headend room for voice, video and data, large group presentation area(s), open access mini computer labs (electronic cafes), digital media production facilities, and student research and information access workstations.

- One-to-One E-Learning environments will be supported by a hybrid hard-wired and wireless communications infrastructure, utilizing a combination of traditional telecommunications room and fiber optic based "collapsed backbone" topology to provide each school with seamless data connectivity.

- The new educational environment will be characterized by greater parental involvement and responsibility in the teaching and learning provided to the children.

- Technology related instructional spaces in schools must be planned using the best possible direct access for community use during after school hours.

- Students and staff will work towards attaining a technology "comfort level" as technology becomes a "seamless and transparent" everyday part of the learning environment.

The technologies expected to play an important part in facilitating this new learning environment are:

- Large-screen wall presentation of video-display systems
- Individual laptop or other personal computer devices for all students
- Wireless network communications within the classroom
- Advanced interactive software
- Distance learning capabilities in multiple learning areas

The two major technology trends evolving in today's society that will have significant effects on instruction and learning are **wireless connectivity** and **digital video presentation and distribution systems.**

Wireless connectivity provides classrooms and other locations in the school with flexible and mobile access to resources beyond the classroom. It uses telecommunications principles, already so much a part of today's society, to enable teachers and students to communicate with people and resources within the school and around the world. Wireless connectivity, coupled with laptop or other individual computing devices for all students, will lead to extensive use of One-to-One Electronic Learning in classrooms and all other school spaces.

Integrated voice, video, and data building-wide communications networks are extending these benefits, as well as the instructional capabilities of media centers, computer labs, and TV studios to all classrooms and instructional spaces.

A classroom computer workstation or laptop located at the teaching station with building-wide network access will enable a teacher to:

- Connect directly to an information source;
- Present information to groups of students;
- Expand the classroom by communicating with other schools, cities, cultures, and countries.

Technology can link teachers to curriculum sources. Teachers can use a computer to access a central location to gather a list of resources and activities for the lesson being taught. They can join other creative teachers on a network to share and field-test lesson plans, adjusting them as necessary for their students. With these tools, teachers can create and present content lessons in a multi-media format designed to explore "what if..." questions.

In summary, the significance of these computer trends are that they allow teachers to: (1) better address higher order thinking skills; (2) meet the individual needs of a more diverse student population; and (3) change their role from an information dispenser to an instructional facilitator.

Most of this is possible because of the continuing trend towards the miniaturization of computers. The price/performance ratio will continue to decrease as their value/performance increases. Computers will be enhanced to include multi-sensory/multi-media capabilities. Digitized audio and video, graphics, and the storage of large volumes of data will become common features of most microcomputers and, thus, greatly enhance the usability of small notebook size computers. Voice recognition may replace the keyboard and mouse as the primary means of interfacing with the computer.

It is envisioned that each student will someday be assigned a personal notebook or other type of computing device to use both in school and at home. The computer will have: (1) wireless transmission capabilities for networking to local file servers; (2) the capability of attaching to any building-wide digitized two-way distributed video outlet; (3) a miniaturized CD-ROM type-high volume multi-media device; and (4) two-way voice recognition communications capabilities.

The student will carry his/her personal computing device from class to class and have the capability of wireless communication connectivity with any file server in the building. All file servers in the building will be physically connected via low cost high capacity copper/fiber cable. The student can use his/her computing device from a desk, small discussion group, the media center, other instructional support facilities, or home. The student can obtain (download) software or send (upload) performance data to the local classroom file server. By passing through the local file server, the student will have access to any other file server in the building, or with proper safeguards, access to file servers and mainframe computers elsewhere in the school or around the world. A single larger client server with mainframe architecture may become an effective alternative to the large number of smaller file servers.

E. Vision Of Potential Computer Uses

Today the majority of computer use is focused on a few classroom computers and the concentration of computers in labs. Trends towards a greater integration of computers into the classroom are beginning to develop due to less expensive desktop computers, laptops, and wireless developments. The trend is being pushed by the reduction in both the size and cost of microcomputer hardware, more advanced networking and wireless technologies, and the expanded development of hypertext based multi-media instructional software. It is believed that these latter developments, coupled with digitized video delivery systems, will have the single most significant technological impact to date on the learning process. This will take place in the classroom rather than the computer lab.

Classroom Uses

- Each classroom will utilize a multi-media **teaching and video presentation workstation**. This workstation will run interactive video and other multi-media software. In certain areas, such as music, the arts, science labs, and graphics classrooms, the teaching station includes interfaces specific to the subject at hand. The station has the capability to store and print documents and graphics and to communicate with school-based and off-site databases and electronic mail service. The stations can enlarge or project their images so a whole class of 28 students can view them comfortably.

- Each classroom will have a single desktop or laptop computer for use by the teacher and/or students for administrative support and instructional purposes.

- Each classroom will have the capability of becoming a full computer lab, as each student will have his/her own computing device.

- Students will have on-line access from the classroom to **research information** such as on-line encyclopedias, reference works, and collections of academic information.

- Students will have access to **subject-specific tools** such as music MIDI instruments, computer-aided design and drafting tools, desktop publishing tools, and high-level drawing and painting tools.

- Students will use a variety of computer **interfaces** in their **science laboratory** courses, including: temperature, pressure, electrical, light, and sound measuring devices; frequency counters and scales, all linked to a graphic display with an immediate printed output.

- Students will be provided with opportunities for distance learning opportunities.

Student Productivity

- Each student will have ready access, throughout the school day, to a standard set of **learning and production tools,** including: word processing, draw and paint tools, spreadsheet, and database, along with high-quality printing.

- Students will have access to **interactive multi-media** learning and production stations, where they can review material, conduct research, and prepare reports and presentations that combine text, graphic sound, music, motion video, and still images.

- Students will be able to access -- for review, practice, simulation, and complex problem-solving -- a wide range of **instructional programs** from any student or classroom workstation.

Teacher Productivity

- With appropriate security, teachers will access, from their classroom and work areas, appropriate **administrative data** such as grades, attendance, and student schedules, in a manner that facilitates their record keeping and information gathering.

- From the teaching station in their classroom, teachers will be able to access and run the most appropriate instructional software.

- From their classroom or work area, teachers will be able to search and retrieve library and research resources, both on and off-site through a variety of informational services.

- In their classrooms, teachers will have access to word-processing, desktop publishing, and desktop presentation tools to help them prepare teaching materials.

F. Implications For The Learning Environment

Much of what has been described above is possible today. In order for the technology of today and tomorrow to be effectively utilized, it must be fully integrated into the curriculum and made available when instructionally appropriate in the school environment. This will require a few fundamental changes in school system policies and standards of instructional practice.

First, technology must become an integral part of the curriculum and the physical environment, not an add-on.

Integrating technology into the curriculum means changing the process of institutionalized learning, which is basically the same today as it was 90 years ago: A teacher using text and reference materials to instruct a roomful of students. New computer and related technologies enable teachers to provide individualized instruction, where students make meaningful progress at their own pace. Integration of technology and curriculum implies a teacher-decision model that unifies curriculum strategies and technology-enhanced instruction and student learning.

Second, students must become more active educational participants in the restructured classroom of the future, not simply receivers of information.

The base of knowledge is expanding too quickly for students to be passive learners. They must become processors and appliers of facts and data. Success in the Information Age will be predicated on the continual application of information and skills to real world situations. Thus, learners will spend a greater percentage of time engaged in project-oriented activities and simulations of real work experiences.

A third significant shift must occur in the role of the teacher in the restructured classroom of the future.

The effective integration of technology will require that teachers no longer be trained to lecture and meet student-learning objectives primarily through textbooks and workbooks. Instead, they must be teachers who are managers of a complex educational environment, designers of an individualized learning program for each student, facilitators of learning, and caring coaches guiding students toward academic and personal goals.

Over the long term, technology has the potential of becoming the change agent for re-structuring education. Technology will help increase the percentage of time of a student's "mind-on-task." Many believe that motivation is the single most important element in learning. As students continue to be exposed to an ever-increasing technological world outside the school, it becomes increasingly difficult to motivate them in a low-tech learning environment.

Fourth, the layout and design of individual classrooms and other learning areas must reflect the integration of technology, the increased activity of students in their own learning, and the changing role of the teacher.

This fourth implication is the main purpose of the Plan Document. If the learning areas coming forth from the new school construction program are to truly reflect the districts desired learning environments, then the architect must place greater emphasis on:

- Ensuring that the educational specifications reflect the desired teaching and learning environments.
- Translating the impact of these teaching and learning environments on classroom and other learning area layout and design.
- Ensuring that all learning spaces meet the districts basic tenets for standard learning areas described in Section IV.

- Translating the impact of these teaching and learning environments on the schematic design of the building.

- Ensuring that the appropriate technology is selected from the districts' standards to match the specific schools' functions and student target population.

G. Critical Issues for Technology Utilization and Design

From discussions with DCPS staff and the experience of ESP, the following critical issues have been identified that, if not properly addressed, could significantly detract from the effective design for and utilization of technology in new and renovated schools. The following "inhibitors" or "critical issues" were identified and are highlighted to ensure their consideration in current and future planning. No priority is implied by the order presented. Several of the critical issues require little explanation. It should also be noted that many of the issues are interrelated, and addressing one can have a significant impact on others.

- **Initial and continuing budget allocations**

  The high cost of purchasing hardware, software, support and the other aspects of technology is a frequently cited inhibitor to integrating technology in the learning process. Too many districts make the mistake of budgeting only funds for hardware and software and not adequately providing funds for training and personnel support. The exploration of creative financing, coupled with a well conceived detailed technology plan and fund development program, can go a long way in providing initial and continuing financial support to technology implementation.

- **Time**

  DCPS is conscious of the fact that making the teaching and learning paradigm changes described herein, in classroom and other learning areas through the use of technology, takes time. At least initially, technology implementation is an "add on" to the normal instructional commitment of teachers. It is important to recognize that effective implementation will require planning time, time for staff development and training, and time to integrate technology's use into the traditional classroom environment. Support for additional time can be provided in various creative ways, from release time, reduced teaching loads, to shared responsibilities.

- **Staff development and training**

  A major issue in the successful implementation of technology is how to provide the staff development and training required to:

- Ensure that all teachers acquire basic computer utilization skills,
- Provide in-school facilitation support to encourage and increase the use of existing computer equipment and software, and
- Assist teachers to explore new and innovative applications of technology.

A major challenge in achieving technology's potential as a change agent for restructuring education is its implementation as an integral part of the classroom-learning environment; the success of which depends heavily on the teacher's ability-- both technical and educational-- to fully utilize the advantage of technology. Some teachers will acquire the basic level of technical skills on their own initiative and will encourage students to use available technology. Other teachers will require more training and encouragement. Staff development programs need to be tailored to the existing skills and experiences of individual teachers. A strong on-going staff development program is vital to successful technology implementation.

- **Teacher input and consensus**

The following is adapted from the May 1, 1996 issue of EDUCATIONAL WEEK and illustrates the importance of the teacher's role in the teaching and learning paradigm shift.

For teachers to integrate technologies into their curricula requires changes of huge magnitude in educational philosophy, classroom management, and curricular goals. Classroom teaching and learning will not improve automatically by the introduction of computers and communications techniques. For the technologies to be used optimally, teachers must be comfortable with a project-based, problem solving approach to learning; they must be willing to tolerate students progressing independently and at widely varying paces; they must trust students to know more than the teachers do about certain subjects and techniques, and to take on the role of expert teacher at various times; they must be comfortable about having control over what resources the student accesses or what the student learns, and they must be flexible enough to change directions when technical glitches occur.

Not everyone deals with change at the same pace. As noted above, the scope of change required to integrate new technologies is enormous. We are asking teachers to undergo profound belief and habit transformations. Technological change will never be as smooth as one would like.

- **Administrative and teacher commitment**

The commitment of administrative staff and teachers is both an initial and continuing factor in the effective implementation of technology. The full commitment of the principal and a small group of teaching staff is necessary to initiate the planning and use of technology. It is important that initial efforts be rewarded and capitalized on as the planning and installation of technology continues. If support is provided to this initial group, successful results will overflow to additional faculty as technology utilization increases. The foundation of technology use should be built on the work of those teachers who are most interested. Successful role models should be highlighted to the entire faculty.

Administrators can -- and should -- play a primary leadership role in helping overcome technology barriers, but they will need courage to confront the issues. Navigating into the 21st century with technology will require a new kind of leader -- one who can learn from the past to develop a new vision based on futurism, experimentalism, and a passion to explore the unknown.

- **Proper planning and decision making**

Integration of technology into the school culture requires long-term strategic planning. Those responsible for technology planning need to realize that such planning must be based on the premise that "the future will be different from the past" and that one must envision the future rather than merely extrapolate "the past into the future." Technology planning must be aggressive. The technology plan must be continually reviewed and updated to maintain currency of both technology and instructional applications.

The inability to make decisions or act on convictions is a serious inhibitor to technology implementation. Administrators and technology leaders can overcome their own hesitation by:

- *Getting involved NOW rather than later*. Overly conservative attitudes toward technology integration will not allow students to compete in the next decade and beyond.

- *Not waiting until the "new stuff" becomes available.* Educational technology changes are rapid with the shelf life of new technology products being three years or less. Leaders must plan far enough in advance to get the maximum benefit on the technology purchase while recognizing the need to continually upgrade both hardware and software.

- **Facilities and space**

DCPS feels strongly that the design and layout of classrooms and learning spaces in new and modernized schools must reflect the districts desired teaching and learning environments. Likewise, schematic designs reflecting learning space adjacencies must also reflect the integration of technology into classrooms and other learning spaces.

New and modernized schools need communications infrastructure, which can meet today's technology connectivity requirements and be robust and flexible enough to embrace future requirements.

- **Overcoming parental expectations of teaching style, i.e. teacher as a "coach."**

DCPS feels strongly that many of the issues discussed under "administrative and teacher commitment" also apply to parents. Commitment to many of the educational changes desired from teachers will need to be obtained from parents as well.

- **Staff technical support and maintenance**

Another major issue is how to provide the central and school based technical support needed to:

- Utilize the building-wide computer and video networks and computer equipment,
- Provide computer maintenance on an increasing number of computers, printers, and other equipment,
- Facilitate in-school familiarization with new software products and innovative applications of computers, and
- Facilitate in-school dissemination of software utilization procedures and suggestions of integration into the classroom.

The recent publication, The Connected School, Center for Technology in Learning, 2001, listed the following reasons why student-empowering uses of technology are not more common in public schools:

- Lack of technology infrastructure

- Lack of technical support

- Teacher discomfort with technology
- Scarcity of high-quality digital content in many subject areas
- The constraints of academic schedules and departmental structures

It is obvious that, while facilities and technology design of learning spaces is extremely important, there are numerous other people and material oriented criteria for success that also have significant impact on successful implementation of the districts technology supported desired learning environments.

SECTION III
TECHNOLOGY IMPLEMENTATION AND FACILITIES DESIGN: PROCESS

A. The Design Approach

If DCPS is to have facilities design become the vehicle which implements the teaching and learning paradigm shift discussed in the previous two sections, changes will be necessary in the composition of the architect's design team and the school design process. Past school design has seen space typically drive classroom layout, furnishings, and equipment; however, in a technology intense and learner-centered school, learning area layout, equipment, and furnishings should drive space and school design. If the learning areas coming forth from the school construction program are to truly reflect the districts desired learning environments, then the architect must place greater emphasis on:

- Ensuring that the educational specifications reflect the desired teaching and learning environments described in Section II.
- Translating the impact of these teaching and learning environments on classroom and other learning area layout and design.
- Translating the impact of these teaching and learning environments on the schematic design of the building.
- Ensuring that the appropriate technology is selected from the districts' standards to match the specific schools' functions and student target population.

To accomplish the above it is imperative that:

- The architects' design team consists of personnel knowledgeable and experienced in instructional practices that compose these desired learning environments.
- Greater and earlier emphasis is placed on the layout and design of classrooms and other learning spaces to effectively accommodate and encourage these desired learning environments.
- The architect have responsibility for the design, specification and selection of learning space furniture so that it may be integrated into the learning space design and layout.

- Schematic designs be developed after the layout and design of learning spaces and reflect the instructional decisions concerning technology applications.

- Open forum discussions, i.e. charettes with district and school staff be conducted at an early stage to customize, as appropriate, desired learning environments to the specific school.

The primary members of the architects' design team that must contribute to planning and design of technology support for teaching and learning spaces are the:

- Architect
- Educational technology consultant
- Electrical engineer
- Telecommunications consultant

It is important for the architects' design team to understand that the technological systems implemented in new/modernized schools are not just for student use. Community access to technology spaces should be a significant design consideration. As such, community involvement in the early planning process in important.

Schematic Design

Task 1 Instructional Planning

The architect and educational technology consultant will review the Educational Specifications for the specific school. The charettes process should be used as a key approach to introduce, debate, and determine specific goals of the educational approach for the school and formulate facility design and equipment requirements to support the desired teaching and learning environments. This process should involve DCPS curriculum specialists, school based instructional and administrative staff, architect and educational technology consultants in intense design sessions.

The charettes sessions should result in the development of typical classroom and other learning area layouts that support the DCPS teaching and learning methodology and desired learning environments. It is important to develop typical classroom layouts for each academic discipline at this early stage so that space sizes, number of students, furniture, and technology equipment configurations can be incorporated into the schematic design.

A significant part of the instructional planning process is to determine the desired classroom, science lab, media center, computer lab and other instructional uses of computer and video applications. The educational technology consultant should serve as the technology facilitator and

information source for the review and selection of computer and video technology systems. The consultant should provide information concerning:

- Basic levels of interactive video systems
- Characteristics of alternative school-wide computer network designs to support distributed classroom computing, computer labs, media center, multi-media, and administrative computing.
- Characteristics of alternate methods of teacher presentation to support multi-media utilization.

Task 2 Technology Space Allocation

The educational technology consultant should continue to assist the architect in the finalization of the schematic design by:

- "Tweaking" typical classroom layouts to fit into the schematic design so that they maintain the incorporation of technology supporting the desired learning environments.
- Determining the number, location, and space requirements of data communications wire closets.
- Developing technology space adjacencies that reflect the desired relationships and functions of the media center, technology labs, computer labs and other learning spaces and ensure that these adjacencies reflect the instructional philosophies of the school and district.

Task 2 Technology Descriptions

- Data network general description
  Brief narrative description of the communications infrastructure and computer network topology planned for the school.
- Video distribution system general description
  Brief narrative description of the video distribution cable plant and functionality of instruction video system including the type(s) of video projection system selected for the teachers workstation.
- Telephone cable plant general description
  Brief narrative description of the voice horizontal and riser cable plant planned to support the telephone system.

The above components of the schematic design (classroom/learning area design and technology adjacencies) are critical to ensure that the final school design reflects the instructional philosophies and desired teaching and learning environments of DCPS. This is critical Because once the Design Development and Construction Document Phase has begun, there is little opportunity to effect these critical aspects of the design. Any significant design changes beyond the schematic design are expensive and time consuming.

Design Development

The educational technology consultant should either develop or provide significant assistance to the architect in the layout and design of:

- Typical classroom
- Computer labs
- Media center
- Science labs, and
- Other technology spaces

The educational technology consultant should provide the architect with the "Statement of Facilities Requirements for Technology" which is intended to provide the electrical/mechanical engineer(s) with the necessary information for them to proceed with detailed design required in the design development phase. The "Statement of Facilities Requirements for Technology" should contain the following information:

- Voice, video and data narratives developed in the schematic design phase.

- Communications Network Outlet (CNO) Symbol Set
  Detailed description of each CNO type shown on the 1/8" Information Technology (IT) drawings. The description should include faceplate, number and type of voice, video, and data connection jacks, conduit and device box requirements, and the number and type of cables serving the CNO.

- General electrical requirements to support technology in:
  - Classrooms
  - Technology labs
  - Library
  - Technology distribution center and all equipment rooms
  - Science labs, and
  - All other technology spaces

- Electrical grounding requirements of communications infrastructure equipment rooms.

- 1/8" Information Technology (IT) drawings showing the location of data, voice and TV network outlets (Communication Network Outlets-CNOs) in classrooms, labs, offices, and support areas. Drawings should include:
  - Voice riser diagram
  - Data connection diagrams
  - Equipment rack elevations
  - Detailed equipment room layouts
  - Video headend details
  - Video schematic diagram

- Specifications of size and location of all in-wall vertical and above door horizontal conduit required supporting horizontal voice, video, and data cabling for CNOs.

- Location and specification of through-floor conduit and chases to support riser equipment room interconnect voice, video, and data cable plant

Construction Documents

It is DCPS's intent that the architect will be responsible for the completion of the voice cable plant and telephone system, an operational video distribution system, and an operational data communications infrastructure as defined in the detailed design guidelines provided in Section IV. The educational technology consultant and/or the telecommunication consultant will complete the detailed design and specification of voice, video, & data communications infrastructures to include:

- Development of the school-wide 10/100-BASE-T computer network design,
  - Cable for all sub-networks and the backbone network
  - Network outlet wall faceplate configurations and identification scheme
  - Distribution and riser cable paths
  - Installation procedures
  - Wire closet layout and patch panel specifications, and
  - Wire closet switch and router equipment.

- Develop building-wide cable TV distribution design to include specifications for:
  - Cable
  - TV outlet wall faceplate configurations and identification scheme
  - Cable distribution paths and installation requirements, and

- Specification of head-end equipment.

- The final products of the design activity will be:

  - A set of computer network Infrastructure Technology (IT) design drawings containing CNO locations, voice and data cable layout, wire closet equipment plans, and network interconnect diagrams for installation of the computer network from faceplate to equipment room.

  - Division 17000 Communications Infrastructure-Data Specifications to be used in conjunction with the network design drawings for the installation of the computer network.

  - A set of network Infrastructure Technology (IT) design drawings containing video outlet locations and cable layout, head end equipment plans, and interconnect diagrams for installation for the school-wide cable TV distribution system.

  - Division 17000 Communications Infrastructure-Video Specifications to be used in conjunction with the cable TV network design drawings to procure the installation of coax cable and head end equipment.

Construction Administration

The educational technology consultant and/or the telecommunication consultant will provide the following services during the construction phase:

- Review working drawings, equipment specifications and samples provided by contractor for approval of "as equivalent" and respond to Requests For Information (RFI's).

- Conduct site visits and inspections to ensure quality and workmanship of cable and wire closet equipment installation.

- Prepare final punch list of yet-to-be-completed tasks for cable installation.

- Supervise contractor testing of completed cable system.

B. The Implementation Approach

It is DCPS's intent to have the complete voice, video and data communications infrastructure installed and made operational by the general contractor. With the possible exception of data electronic communications equipment (routers and

switches) for telecommunications equipment rooms, the general contractor is to provide and install all voice, video and data communications systems. This is to include, but not necessarily be limited to:

- All low voltage cable pathways, which will include but not necessarily be limited to:
  - Cable trays in corridors
  - Horizontal sleeves through walls over doorways etc.
  - Vertical riser chases
- Complete equipment room (wire closet) build-out
- Electrical grounding systems for equipment rooms
- Communications Network Outlets (CNOs) as shown on IT drawings
- Horizontal cable plant for voice, video and data
- Riser cable plant for voice and data
- Installation of complete video headend system
- Installation of complete data electronics equipment in telecommunications rooms (actual switch equipment may be provided by owner but installed by contractor)

SECTION IV
TECHNOLOGY IMPLEMENTATION AND FACILITIES DESIGN GUIDELINES: PRODUCT – NEW AND MODERNIZED SCHOOLS

A. Desired Learning Environments

The purpose of Paragraph A is to provide generic description of the learning environments that DCPS desires to have designed into classrooms, labs, and other learning spaces. This Paragraph will provide a starting point for learning components that should be included in Paragraph B, Typical Learning Area Layouts and Paragraph C, Communications Network Outlet (CNO) Requirements. The contents of this Paragraph draws heavily on information concerning "basic tenets of the standard learning area design" contained in the Design Specifications for the Ballou HS Science Laboratory Project, as documented in Memo to Mary Gill dated January 26, 2001.

Basic Components of Classroom/Learning Areas

Each classroom, laboratory, and other types of learning areas should have the following basic components:

- A teacher presentation area where the teacher can project from his/her computer to either a high mounted video monitor or a cart/ceiling/demonstration table mounted digital LCD projector.
- Student workstations with data connectivity.
- Student collaborative and project work areas with data connectivity via wireless.
- A technology/learning center or corner with data connectivity for specialized equipment.
- A student presentation area where a small group of students can project from their computer to a low video monitor (optional).
- Flexible furniture that will allow multiple classroom layouts to accommodate traditional classroom layout, chevron, auditoriumas well as small group and team project work areas.
- Space for display of student projects.
- Capacity to support English as a Second Language (ESL) activities.
- Writable walls.

Fast Internet Connectivity

The basic premise of this requirement is a communications infrastructure design which provides each learning area with individual teacher and student connectivity to the building-wide data network which in turn has connectivity to the DCPS wide area network and internet service provider.

Typical Classroom Data Connectivity

- The ”Teacher CNO” at the teaching station at the front of the classroom will provide one hard-wired data connection for the teacher’s computer access to the building-wide network.
- The “Student CNO(s)” in the classroom is to provide connectivity for multiple students to have hard-wired access to the building-wide network. The architect is to provide multiple (up to four) locations in each classroom for in-wall conduit to service student connectivity.
- A hard-wired data outlet in the ceiling will provide wireless connectivity for those students working at collaboration and project tables without access to hard-wired data outlets.
- A minimum of two hard-wired data outlets is to be located at the technology center for network printer and other peripherals.

Typical Computer/Technology Laboratory Data Connectivity

- The ”Teacher CNO” at the teaching station at the front of the classroom or demonstration table will provide one hard-wired data connection for the teacher’s computer access to the building-wide network.
- The “Student CNO(s)” in the lab to provide data connectivity each student station via hard-wired access to the building-wide network.
- A hard-wired data outlet in the ceiling to provide wireless connectivity for those students working at collaboration and project tables without access to hard-wired data outlets.
- A minimum of four hard-wired data outlets is to be located at the technology center for network printers and other peripherals.

Video Connectivity

Each school will have a traditional broadband coaxial video distribution system which will operate over the 5 to 750 MHz range with a sub-split spectrum. The network design shall use 1000 MHz CATV equipment and installation techniques. The network design shall permit simultaneous transmission of data, audio and video information. All communications circuits shall be full duplex without the use of multiple cables. All devices attached to the network will be considered "drops", except the devices that will send information in the "reverse" direction to the head-end and receive information in the "forward" direction from the head-end.

Typical Classroom Video Connectivity

- Teacher presentation will be to either a high/low mounted video monitor or to a ceiling/cart mounted digital LCD projector. The “teacher CNO” at the teaching station will provide low video connectivity from the teachers computer to project to either a high wall mounted TV monitor or a cart or ceiling mounted digital LCD projector. The Teachers CNO should be located near the teaching station in the front of the classroom near exterior walls with windows in order to minimize student glare.

- A “Monitor CNO” for video connectivity should be located high (48” AFF for cabinet mounting or 84” for wall mounting) for receiving video distribution to monitor. In addition, video connectivity should be included in the Teachers CNO for broadcast connectivity from a video camera.

Typical Science/Computer/Technology Lab Video Connectivity

- Teacher presentation will be to a table or cart mounted digital LCD projector. The “teacher CNO” at the teaching station will provide low video connectivity from the teachers computer to project from the digital LCD projector. The Teachers CNO should be located near the teaching station in the front of the lab or in the demonstration table.

- A video outlet should be included in the Teachers CNO for broadcast connectivity from a video camera. For science labs, the video outlet is in the demonstration table.

- A video outlet should be located at one science lab student station for broadcast connectivity from a video camera.

- A video outlet should be located at one student station location in each computer or technology lab for broadcast connectivity from a video camera.

Video Connectivity for Other Learning Areas

- The media center should have a large group presentation area with projection capabilities to either a high/low mounted video monitor or to a cart or ceiling mounted digital LCD projector.

- In small group resource and seminar rooms teacher presentation should be to a high/low mounted video monitor. The "teacher CNO" at the teaching station will provide low video connectivity from the teachers computer to project to the high mounted TV monitor. The Teachers CNO should be located near the teaching station in the front of the room near exterior walls with windows in order to minimize student glare. A video outlet should be included in the Teachers CNO for broadcast connectivity from a video camera.

B. Communications Network Outlet Recommendations

COMMUNICATIONS NETWORK OUTLET (CNO) SYMBOL SCHEME

TM	Teacher CNO located at teaching station at 18" AFF connecting to high video monitor at 84" AFF or at cabinet top level of 48" AFF. Low "T" component to contain: 1 data jack, 1 voice jack, 1 video connector with audio/video harness to high mounted video monitor. "M" component to contain 1video F/G connector and audio/video (AV) harness from the Teachers "T" low component. See separate specification for each AV harness.
TMP	TMP Teacher CNO located at teaching station at 18" AFF connecting to high video monitor at 48" AFF. Low "T" component to contain: 1 data jack, 1 voice jack, 1 video connector with AV harness to high mounted video monitor. "M" component to contain 1video F/G connector and AV harness from the Teachers "T" low component. See separate specification for each AV harness. "P" indicates a separate conduit and AV harness to a ceiling mounted digital projector.
V	Monitor CNO at 84" AFF containing: 1 video F/G connector with cable from head-end.

F	Termination location for 6-strand multimode “dark” fiber optic cable in wall mounted remote equipment box.
AV	Administrator’s CNO containing: 1 data jack, 1 voice jack, and 1 video F/G connector with cable from head-end
AVT	Audio Visual CNO containing: 1 data jack, 1 voice jack, and 1 video F/G connector with cable from head-end located in the demonstration table to be used for audio-visual connectivity to cart mounted digital projector.
D	Student Double CNO containing: 2 data jacks. “D” CNO is usually contained in in-wall conduit but may also be located in surface mounted split channel raceway.
T1	Student Triple CNO containing: 3 data jacks
T1F	Student Triple CNO containing: 3 data jacks located in floor.
Q	Student Quad CNO containing: 4 data jacks.
QF	Student Quad CNO containing: 4 data jacks located in floor.
A	Administrator’s CNO containing: 1 data jack and 1 voice jack
W	Wireless connectivity: One Category 5e cable attached to the ceiling structure for connection of an access point for wireless connectivity. Terminate and test.
G	Gym CNO containing: 1 data jack, 1 voice jack and 1 video F/G connector with cable from head-end. G CNO to be located at 84” AFF and be protected with wire cage.
C	Cafeteria CNO containing: 1 data jack, 1 voice jack and 1 video F/G connector with cable from head-end located at 84” AFF.
P	Ceiling mounted LCD digital projector with video harness to TMP CNO.

CNO Recommendations for Senior High Schools

Location Type: Academic Core Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Project Lab (Resource)	1-TMP, 1-P, 6-D, 1-W, 1-F	15	1	2	1
Technology Lab	1-TMP, 1-P, 8-D, 1-W, 1-F	18	1	2	1
Small Group Rooms	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Science Classroom/Lab	1-TM, 1-AVT, 3-D, 1-W, 1-F	9	2	3	1
Science/ Project Lab	1-TM, 1-AVT, 6-D, 1-W, 1-F	15	2	3	1
Science Prep	1-AV, W*	1	1	1	0
Chemical Storage	Blank	0	0	0	0
Greenhouse	1-AV, 2-D, W*	5	1	1	0
Resource Classroom (Teacher Center)	1-AV, 1-A (for each additional teacher's workstation), W*	2-5	2-5	1	0
Conference Room	1-TM, 2-D, W*	5	1	2	
Workroom/Copy Center	1-A, 1-D, W*	3	1	0	0
Reception Area	1-AV, W*	1	1	1	0
Dept Head/Asst Principal	1-AV, W*	1	1	1	0
Student Personnel	1-AV, 1-A (for each additional staff), W*	2-3	2-3	1	0
Storage (Sq Ft >100)	1-A, W*	1	1	0	0
Spec Needs Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Self Contained Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Daily Living/Laundry	1-A, W*	1	1	0	0
Office	1-A, W*	1	1	0	0
Distance Learning Lab	1-TM, 10-D, 1-W, 1-F	22	1	2	1
Alt Attendance Area	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Publications Workroom	1-AV, 1-D, W*	3	1	1	0
School Store	1-AV, W*	1	1	1	0
Language Lab	1-TMP, 14-D, 1-W, 1-F, 1-P	30	1	2	1

Location Type: Media Center Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Reading/Stacks	1-TM, 10-D, 1-W, 1-F	12	1	2	1
Circulation	1-AV, 1-D, W*	2	1	1	0
Media Production Area	1-TM, 10-D, 1-W, 1-F	22	1	2	1
Computer Research Area	1-TMP, 14-D, 1-W, 1-F, 1-P	30	1	2	1
Office	1-AV, W*	1	1	1	0
Workroom	1-A, W*	1	1	0	0
Small Group Conf Room	1-AV, 1-A, W*	2	2	1	0
Periodical Storage	1-A, W*	1	1	0	0
Equipment Storage	1-A, W*	1	1	0	0
Technology Distribution Center	1-A, 1-Q, W*	5	1	0	0

Location Type: Visual Arts Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
2-D Studio	1-TM, 10-D, 1-W, 1-F	22	1	2	1
3-D Studio	1-TM, 8-D, 1-W, 1-F	18	1	2	1
Kiln Room	1-A, W*	1	1	0	0
Storage (Sq Ft >100)	1-A	1	1	0	0
Office	1-AV	1	1	1	0

Location Type: Performing Arts	Typical CNO Type & Number	Data	Voice	Video	Fiber
Auditorium Seating	1-AV, 2-W	3	1	1	0
Stage	2-AV, 1-W, 1-F	3	2	2	1
Ticket Booth/Box Off	1-AV, W*	1	1	1	0
Sound &Light Control Room	2-AV, 1-W, 1-F	3	2	2	1
Chair/Piano Storage	1-A, W*	1	1	0	0
Scene Shop	1-AV, 2-D, W*	3	1	1	0
Costume/Prop Room	1-A, W*	1	1	0	0
Scene Shop Storage	1-A, W*	1	1	0	0
Make-up/Dressing Room	1-V, W*	0	0	1	0
Multipurpose Music Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Uniform Storage	1-A, W*	1	1	0	0
Practice Room	1-D, W*				
Drama Room	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Band/Orchestra Room	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Instrument Storage	1-A, W*	1	1	0	0
Uniform Storage	1-A, W*	1	1	0	0
Practice Room	1-D, W*	1	0	0	0
Choral Room	1-TM, 3-D, 1-W, 1-F	8	1	2	0
Choral Practice Room	1-D, W*	1	0	0	0
Music Library	1-AV, W*	1	1	1	0
Office Suite	1-AV, 1-A, W*	2	2	1	0

Location Type: Junior ROTC Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Learning Center	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Supply Storage Area	1-A, W*	1	1	0	0
Office Center	1-AV, 1-A (for each workstation), W*	1-3	1-3	1	0

Location Type: Physical Ed/Health	Typical CNO Type & Number	Data	Voice	Video	Fiber
Multi Purpose PE	2-AV, 1-W	5	2	2	0
Gymnasium	2-AV, 1-W	5	2	2	0
Auxiliary Gymnasium	2-AV, 1-W	5	2	2	0
Fitness Room	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Dance/Aerobics/Wrestling Room	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Health Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Health Lab	1-A, W*	1	1	0	0
Department Head Office	1-AV, W*	1	1	1	0
Teacher Center / Workroom	1-AV, 1-A, W* (for each additional teacher's workstation)	2-5	2-5	1	0
Storage (Sq Ft >100)	1-A, W*	1	1	0	0
Concession	1-A, W*	1	1	0	0
Training Room	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Laundry	1-A, W*	1	1	0	0

Location Type: Technology Education Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Tech Teaching Lab	1-TMP, 1-P, 15-D, 1-W, 1-F	33	1	2	1
Technical Storage	1-A, W*	1	1	0	0
Teacher Workroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Career Office	1-AV, 1-D, W*	3	1	1	0

Location Type: Administrative Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Entrance Lobby	1-V, W*	0	0	1	0
Waiting/Reception Area	1-V, W*	0	0	1	0
Principal's Office	1-AV, W*	1	1	1	0
Assistant Principal	1-AV, W*	1	1	1	0
Admin Assistants Office	1-AV, W*	1	1	1	0
Data Entry Office	1-A, 1-D, W*	3	1	0	0
Clerical Office	1-A, W*	1	1	0	0
Administrative Workroom	1-AV, 1-D, W*	3	1	1	0
Admin Storage Room	1-A, W*	1	1	0	0
Mail Room	1-A, W*	1	1	0	0
Conference Room	1-TM, 1-D, W*	3	1	2	0
Records Room	1-A, W*	1	1	0	0
Attendance/Clerical Office	1-A (for each desk), W*	1-3	1-3	0	0
Security Center	2-AV, W*	2	2	2	0
Book Storage	1-A, W*	1	1	0	0
Supply Storage	1-A, W*	1	1	0	0
Staff Break Room	1-AV, 1-D, W*	3	1	1	0
Parent/Volunteer Resource Center	1-AV, 1-D, W*	3	1	1	0
Telecom Head End Room	1-A, W*	1	1	0	0
Health Reception	1-A, W*	1	1	0	0
Office	1-A, W*	1	1	0	0
Treatment Area	1-A, W*	1	1	0	0
Health Storage	W*	0	0	0	0

Location Type: Guidance and Student Svc Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Reception/Wk Area	1-AV, W*	1	1	1	0
Career Center	1-AV, 1-D, W*	3	1	1	0
Student Services Office	1-AV, W*	1	1	1	0
Conference Room	1-TM, 1-D, W*	3	1	2	0
Storage/Work Area (Sq Ft >100)	1-A, W*	1	1	0	0

Location Type: Student Dining & Food Svc Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Cafeteria/Commons	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Stage	2-AV, 1-F, W*	2	2	2	1
Ticket Booth/Box Off	1-AV, W*	1	1	1	0
Sound Control Room	2-AV, 1-V, W*	2	2	3	0
Chair/Table Storage	1-A, W*	1	1	0	0
Office	1-A, W*	1	1	0	0

Location Type: Engineering & Custodial Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Receiving	1-A, W*	1	1	0	0
Custodial Shop	1-A, W*	1	1	0	0
Custodial Office	1-A, W*	1	1	0	0
Engineering Shop	1-A, W*	1	1	0	0
Engineers Office	1-AV, W*	1	1	1	0

Location Type: Building Services	Typical CNO Type & Number	Data	Voice	Video	Fiber
Telecommunication Rooms	1-A, W*	1	1	0	0
Mech/Elect Rooms	1-A, W*	1	1	0	0
Central Storage Area	1-A, W*	1	1	0	0

* **Wireless connectivity to be provided from nearby Access Point.**

Additional Notes:

1. The Language Lab will also require one (1) Enhanced Category 5 cable installed from each student workstation to the teacher's desk for the connection to the special language lab rack panel patch unit provided by the installer of the language lab equipment.

2. The Distance Learning Lab will require special in-wall and floor conduit for video cameras and monitors.

CNO Recommendations for Middle/Junior High Schools

Location Type: Academic Core Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Science Classroom	1-TM, 1-AVT, 8-D, 1-W, 1-F	19	2	3	1
Science Prep/Storage	1-AV, W*	1	1	1	0
Team Teaching/Resource	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Commons Activity Area	1-TM, 2-D, 1-W, 1-F	6	1	1	1
Workroom	1-A, W*	1	1	0	0
Technology Lab	1-TMP, 1-P, 14-D, 1-W, 1-F	31	1	2	1
Technology Storage	1-A, W*	1	1	0	0
Resource Classroom	1-TM, 5-D, 1-W, 1-F	12	1	2	1
Student Services Office	1-AV, 1-A, W*	2	2	1	0
Spec Programs Classroom	1-TM, 4-D, 1-W, 1-F	10	1	2	1
Kitchen/Laundry	1-A, W*	1	1	0	0
Speech, Occupational & Physical Therapy	1-TM, 4-D, 1-W, 1-F	10	1	2	1
Occupational & Physical Therapy Storage	1-A, W*	1	1	0	0

Location Type: Media Center Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Reading/Learning	1-TM, 10-D, 1-W, 1-F	22	1	2	1
Circulation	1-A, 1-D, W*	3	1	0	0
Media Production Area	1-TM, 10-D, 1-W, 1-F	22	1	2	1
Computer Resource Area	1-TMP, 1-P, 13-D, 1-W, 1-F	29	1	2	1
Office	1-AV, W*	1	1	1	0
Storage	1-A, W*	1	1	0	0
Workroom	1-A, W*	1	1	0	0
Technology Distribution Center	1-A, 1-Q,W*	5	1	0	0

Location Type: Visual Arts Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Art Lab	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Art Storage/Office	1-AV, W*	1	1	1	0
Kiln Room	1-A, W*	1	1	0	0

Location Type: Performing Arts	Typical CNO Type & Number	Data	Voice	Video	Fiber
Auditorium Seating	1-AV, 2-W	3	1	1	0
Stage	2-AV, 1-W, 1-F	3	2	2	1
Workroom/Storage	1-A, W*	1	1	0	0
Control Room	2-AV, W*, 1-F	2	2	2	1
Chair Storage	W*	0	0	0	0
Instrumental Room	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Inst/Uniform Storage	1-A, *W*	1	1	0	0
Choral Room	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Choral Storage	1-A, W*	1	1	0	0
Music Library	1-AV, W*	1	1	1	0
Practice Room	1-D, W*	2	0	0	0
Piano Practice/ Ensemble Room	1-A, W*	1	1	0	0

Location Type: Physical Ed/Health	Typical CNO Type & Number	Data	Voice	Video	Fiber
Multi Purpose/Gym	2-G, 1-W	3	2	2	0
Fitness Room	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Health Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Office	1-A, W*	1	1	0	0
Equipment Storage	1-A, W*	1	1	0	0
Laundry	1-A, W*	1	1	0	0
Uniform Storage	1-A, W*	1	1	0	0
Training Room	1-TM, 2-D, 1-W, 1-F	6	1	2	1

Location Type: Admin Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Entrance Lobby	1-V, W*	0	0	1	0
Welcome Center	1-AV, W*	1	1	1	0
Security Area	2-AV, W*	2	2	2	0
Conference Room	1-TM, 1-D, W*	3	2	2	0
Principal's Office	1-AV, W*	1	1	1	0
Assistant Principal	1-AV, W*	1	1	1	0
Data Entry Office	1-A, 1-D, W*	3	1	0	0
Admin Workroom	1-AV, 1-D, W*	3	1	1	0
Mail Room	1-A, W*	1	1	0	0
Records Room	1-A, W*	1	1	0	0
Telecommunication Room	1-A, W*	1	1	0	0
Parent Resource Center	1-AV, 1-D, W*	3	1	1	0
Counselor's Office	1-AV, W*	1	1	1	0
Student Svc Conf	1-AV, 1-D, W*	3	1	1	0
Health Office	1-A, W*	1	1	0	0
Treatment Area	1-A, W*	1	1	0	0
Before/After School Office	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Supply Storage	1-A, W*	1	1	0	0
Book Storage	1-A, W*	1	1	0	0
Staff Lounge	1-AV, 1-D, W*	3	1	1	0

Location Type: Student Dining & Food Svc Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Student Dining Area/Multipurpose Room	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Chair/Table Storage	W*	0	0	0	0
Stage	2-AV, W*	2	2	2	0
Kitchen	W*	0	0	0	0
Food Service Office	1-A, W*	1	1	0	0
Serving Lines (Ends)	1-A, W*	1	1	0	0

Location Type: Engineering & Custodial Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Receiving	1-A, W*	1	1	0	0
Custodial Office	1-A, W*	1	1	0	0

Location Type: Building Services	Typical CNO Type & Number	Data	Voice	Video	Fiber
Custodial Closet	1-A, W*	1	1	0	0
Telecommunication Rooms	1-A, W*	1	1	0	0
Mech/Elect Rooms	1-A, W*	1	1	0	0
Central Storage Area	1-A, W*	1	1	0	0

*** Wireless connectivity to be provided from nearby Access Point.**

CNO Recommendations for Elementary Schools

Location Type: Academic Core Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Pre-K Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Kindergarten Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Commons Activity Area	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Resource Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Student Services	1-AV, 1-D, W*	3	1	1	0
Speech Room	1-AV, 1-D, W*	3	1	1	0
Spec Needs Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Kitchen/Laundry	1-A, W*	1	1	0	0
Storage (>100 Sq Ft)	1-A, W*	1	1	0	0
Workroom/Teachers Off	1-AV plus 1-A per Teacher, W*	2-5	2-5	1	0
Head Start Classroom	1-TM, 3-D, 1-W, 1-F	8	1	2	1
Early Childhood	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Project/Science Lab	1-TM,1-P, 3-D, 1-W, 1-F	9	1	2	1
Family Room	1-AV, W*	1	1	1	0

Location Type: Media Center Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Reading/Learning	1-TM, 2-D, 1-W	6	1	2	0
Circulation	1-A, 1-D, W*	3	1	0	0
Media Production	1-TM, 6-D, 1-W, 1-F	14	1	2	1
Computer Project Lab	1-TMP, 1-P, 15-D, 1-W, 1-F	32	1	3	1
Office	1-AV, W*	1	1	1	0
Technology Distribution Center	1-A, 1-Q,W*	5	1	0	0
Workroom/Storage	1-A, W*	1	1	0	0

Location Type: Visual Arts Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Art Lab	1-TM, 2-DD, 1-W, 1-F	6	1	2	1
Art Storage	1-A, W*	1	1	0	0
Kiln Room	1-A, W*	1	1	0	0

Location Type: Music Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
General Music	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Music Storage	W*	0	0	0	0
Instrumental Music	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Instrumental Storage	W*	0	0	0	0

Location Type: Physical Ed Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Gymnasium	2-AV (one at 84” AFF), 1-W	2	2	2	1
PE Office	1-A, W*	1	1	0	0
Stage	2-AV, W*	2	2	2	0

Location Type: Administrative Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Welcome Center	1-AV, W*	1	1	1	0
Security Area	1-AV, W*	1	1	1	0
Conference Room	1-TM, 1-D, W*	3	1	2	0
Principal's Office	1-AV, W*	1	1	1	0
Assistant Principal	1-AV, W*	1	1	1	0
Data Entry Office	1-A, 1-D, W*	3	1	0	0
Administrative Workroom	1-AV, 1-A, W*	2	2	1	0
Mail Room	1-A, W*	1	1	0	0
Records Room	1-A, W*	1	1	0	0
Parent Resource Center	1-AV, 1-D, W*	3	1	1	0
Counselor's Office	1-AV, W*	1	1	1	0
Student Services Conf	1-AV, 1-A, W*	2	2	1	0
Health Office	1-AV, W*	1	1	1	0
Treatment Area	1-A, W*	1	1	0	0
Before/After School Office	1-A, W*	1	1	0	0
Staff Lounge	1-AV, 1-D, W*	3	1	1	0

Location Type: Student Dining & Food Svc Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Student Dining	1-TM, 2-D, 1-W, 1-F	6	1	2	1
Multipurpose Room	1-TM, 2-D, 1-W, 1-F (can be combined with Student Dining above)	6	1	2	1
Kitchen	1-A, W*	1	1	0	0
Food Svc Office	1-A, W*	1	1	0	0
Serving Line (Ends)	1-A, W*	1	1	0	0

Location Type: Building Services	Typical CNO Type & Number	Data	Voice	Video	Fiber
Telecommunication Rooms	1-A, W*	1	1	0	0
Mech/Elect Room	1-A, W*	1	1	0	0
Central Storage Area	1-A, W*	1	1	0	0

Location Type: Engineering & Custodial Spaces	Typical CNO Type & Number	Data	Voice	Video	Fiber
Receiving	1-A, W*	1	1	0	0
Custodial Office	1-A, W*	1	1	0	0

*** Wireless connectivity to be provided from nearby Access Point.**

C. Overview of Design Approach

The purpose of this section is to provide an introduction to the components of the building-wide computer network that will allow the document user to more fully understand the details provided in later sections. These guidelines adhere to the general cabling industry practice of using a "universal cabling system" (UCS). A universal cabling system attempts to wire a building for information needs without knowing specifically what equipment will be utilized. The intent is to provide for the maximum possible long-term stability and flexibility and is based on the idea of wiring a building for the maximum possible useful life. The main components of a universal cabling system are:

- Common Media – unshielded twisted pair (UTP) and fiber optic cables capable of supporting voice, video, and data communications.

- Star Topology – Media (cable) is distributed only from designated frames within the system in a configuration similar to a star rather than a ring or bus.

- Cross connects – Cross connects and patch panels provide the system with flexibility to make changes to the service quickly and easily using jumper wires and modular jacks.

- Universal outlet – Common universal outlets provide a standard interface that permits devices to connect to any service by changing the connection to the outlet and not the outlet itself.

The communications infrastructure distribution system will consist of three major components, a Technology Distribution Center (TDC), Telecommunications Room (TR), and Communications Network Outlets (CNOs). The Technology Distribution Center should contain the central or prime distribution equipment for all communications systems: voice, video, and data. Ideally, the TDC should contain the video head-end equipment, the central data (MDF) intelligent switch equipment, and the telephone service entrance. The Technology Distribution Center also functions as the demarcation point for external systems such as the telephone company lines or the cable television system connection and should contain terminations for these systems. The TDC may also house file servers and be the point were servers would be connected to the backbone cabling system. The room should also be the source for delivery of data communications to other buildings – either hard wired to buildings in a campus environment or through a wide area network (WAN). One Technology Distribution Center is required for each school or building facility. Telecommunications Rooms represent the physical locations elsewhere in the school, which connect cabling from

Communication Network Outlets in individual classrooms or locations to the Technology Distribution Center.

A typical small elementary school may have only a Technology Distribution Center with cable from classroom Communication Network Outlets routed directly to it without the requirement of an intermediate Telecommunications Room. A larger elementary school may have a TDC and one TR. Middle schools may have a TDC and two-four TRs while a high school could require as many as six-ten TRs. The major criteria for the requirement of Telecommunications Rooms is that the maximum distance of UTP Enhanced Category 5 copper cable from the CNO to a patch panel in either a TDC or TR should be no greater than 290 feet.

Communications Network Outlets (CNOs) are usually wall or floor mounted connector boxes located in classrooms or other user sites. Cables from either the TDC or TR are terminated at the CNO. Computers and other network devices are connected to the network via patch cables running from the device to the cable connector in the CNO. CNOs can terminate multiple cables and cable types for voice, video, and data. Floor mounted connector boxes should be avoided in all cases where the floor surface is subjected to cleaning with any solvents that could damage the cable or box. In limited cases, where carpet is used, floor boxes may be an acceptable alternative.

Communication cables selected for new and existing schools must support current network requirements, such as 10/100 BASE-T Ethernet and allow for the maximum flexibility to support evolving high bandwidth topologies like Gigabyte Ethernet. Communications cables consist of horizontal and backbone wiring. Horizontal cabling is the wiring from the Communications Network Outlet back to either a Telecommunications Room or the Technology Distribution Center and is Unshielded Twisted Pair (UTP) Enhanced Category 5 and/or Category 6 cable.

Data backbone or riser cable is the wiring that connects the Technology Distribution Center with the one or more Telecommunications Rooms and is fiber optic cable. Backbone cable may also refer to the cable that connects one or more buildings in a campus environment. Inter-building cable consists of 12 strands of multimode and 6 strands of single mode for wire closet interconnect data backbone cable. Backbone data cable may also consist of 6 strands of multi mode fiber from TDC to Remote Equipment Boxes located in individual learning areas.

Detailed documentation of the installed wiring distribution system must be provided and maintained to facilitate system administrations, system maintenance, and future system changes. System documentation must include as-built-drawings, detailed cable drawings with all cables and

terminations identified, bill of materials of all installed equipment and wiring, rack or backboard equipment layouts showing placement of support equipment, specifications with appropriate approvals for connectors and cables and model and serial numbers of installed equipment. No changes or modifications can be made without making appropriate changes in system documentation.

D. Data Infrastructure Topology Design

Topology Descriptions

The fundamental concept for the data infrastructure topology is that each school will be hard-wired with specific numbers of teacher and student drops in learning areas, as defined in Paragraph C of this section, and have building-wide wireless ready connectivity. Wireless ready means that after installation of the wireless drops the installing contractor will be responsible for performing the site survey, identifying necessary network access points (NAP) and installation of the NAP's. In addition, each learning area will be provided with six strands of "dark" multimode fiber from the IDF for future use. Only in schools with a collapsed backbone topology will this fiber be used.

In the past network designer have embraced a "traditional" data network cabling topology for most schools. However, conditions are being predicted and designed for in new and renovation school construction that call for the consideration of a more robust and resilient cabling topology.

Higher computer-to-student ratios and the increased use of technology in the classroom call for greater speed across networks and greater reliability on that network's integrity. Several modified cabling structures, or topologies, exist that can help in both of these areas. Other technologies, such as wireless networking and "convergence", may quickly reach a point of usefulness in the K-12 environment, and should be taken into consideration for all current and future projects.

<u>The Traditional Model</u>

The central point in the traditional topology is the Technology Distribution Center (MDF) in or adjacent to the media center. This room, at a minimum, is 100 square feet, and could be several times that size, depending upon the school size and computer-to-student ratio. Housed within the room are the racks, cabinets, wallboards, termination equipment, and other equipment necessary to provide connectivity to/from the outside world. The MDF also provides service to all data and voice communication network outlets within a 290 foot radius through Category 5e copper UTP cables. Unfortunately, the size of most schools causes cable lengths to extend this maximum distance,

necessitating one or more additional telecommunication rooms at strategic locations throughout the school. The purpose of these additional TRs is to reach any workstation within the school by copper cable runs of less than 290 feet. To allow for data to be quickly and efficiently passed between any two points in the network, the telecommunication rooms are connected back to the MDF by fiber optic cables, in a "Star" configuration.

Each TR has size and structural requirements similar to the TDC. Sometimes, due to the smaller coverage area, all of the necessary equipment can be contained in a wall-mounted cabinet or rack, allowing for minimal impact on other uses of the room. As a standard, though, 80 feet is the minimum requirement for interior dimensions of the room. Wallboards are installed on at least one wall, for the termination of phone and video equipment. Plumbing and electrical panels should be excluded from any of these TRs.

The "Zone-Cabling" or "Collapsed Backbone" Model

Recently, a different approach has been taken to increase the speed of networks, and to reduce the space requirements of a telecommunications system. The zone-cabling model includes a MDF that performs the same function as in the traditional model. However, the MDF houses more equipment aimed at passing information along fiber optic cables, and less copper cable equipment.

The fiber optic cables originating from the MDF are run to different "zones" of the building. The zones may be individual or groups of rooms. The cables may be terminated in shallow closets, special cabinets actually mounted in the suspended ceiling, or wall-mounted cabinets in classrooms. These zones, unlike the traditional method, are not determined strictly by area or length of the copper cable runs. Instead, the number of cables that may be terminated in the horizontal cross-connect dictates how many and where these fiber optic cables are terminated. As a general rule, the size of the "zone cabling" zone is smaller than the zone covered by the TRs in the traditional mode and can, in fact, be a single classroom. This allows for average copper cable runs of less than 100 feet, and increases the bandwidth out to each zone or classroom. The feature that allows this to be a viable option with minimal cost impact is a significant reduction in Cat 5e UTP cable lengths. The savings in copper when the port density is beyond 20 data outlets per classroom offsets the cost of the fiber.

The Hybrid Model

Another alternative is to combine the use of telecommunication rooms and "zone cabling" cabinets. This would allow for rooms with a lower population of communication network outlets to be serviced by a TR in the area (within 290 feet). Other rooms, such as the media center and computer labs, could be serviced as individual zones and have a cross-connect cabling located immediately in that location.

Recommended Topology By School Type

Elementary: In most cases, elementary school classrooms are anticipated to utilize a minimum number of data ports per classroom (4-6). This number is sufficiently small to recommend the traditional topology. Telecommunication rooms should be able to accommodate an area encompassing between 8-12 classrooms, offices, and special-use rooms, allowing minimal size requirements and cost for TRs. It is anticipated that the typical elementary school will utilize the "traditional MDF/IDF model."

Middle School: The nature of a middle school is to prepare the student for the responsibility of a high school education. As a data topology, the middle school will most likely use the "hybrid model" with fiber runs directly to computer labs and other high-density computer areas.

High School: Most high schools are steadily increasing the number of data outlets in their classrooms. Add to this increased demand for flexibility in classroom configurations, "wireless-ready" rooms, and "1-to-1 student learning", and the data outlet count jumps dramatically. The District would recommend a "fiber to the classroom" or "zone cabling" topology for high schools with high data port counts and a "hybrid model" for all others.

E. Video Infrastructure Topology Design

General Description

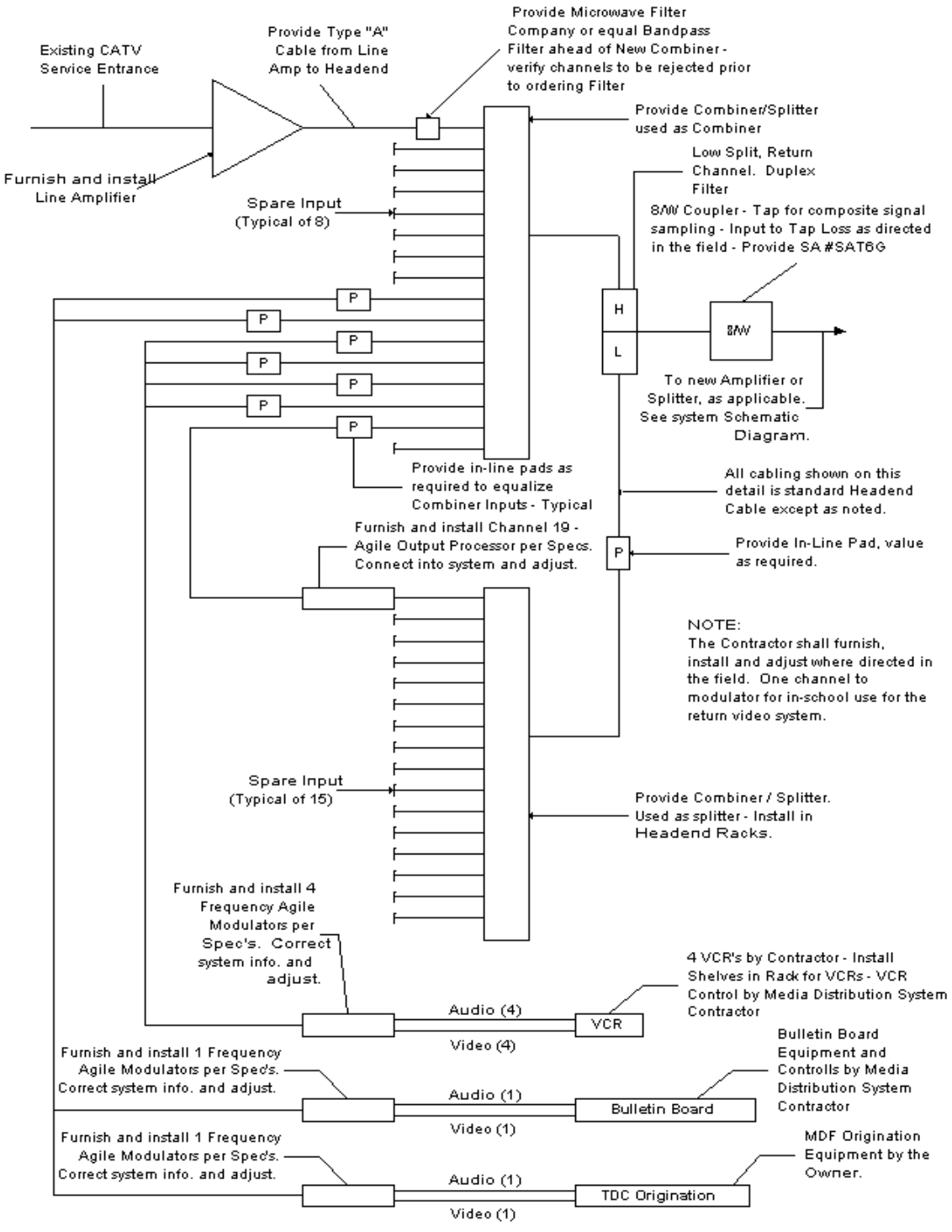
The broadband coaxial video distribution system shall operate over the 5 to 750 MHz range with a sub-split spectrum. The network design shall use 1000 MHz CATV equipment and installation techniques. The network design shall permit simultaneous transmission of data, audio and video information. All communications circuits shall be full duplex without the use of multiple cables. All devices attached to the network will be considered "drops", except the devices that will send information in the "reverse" direction to the head-end and receive information in the "forward" direction from the head-end. Teacher presentation will be to either a high/low mounted video monitor or to a ceiling/table mounted digital projector.

Headend Equipment

Video headend equipment is to be installed in the Technology Distribution Center located in or adjacent to the Media Center with only necessary amplifiers located in telecommunication rooms. The premises video system shall be capable of receiving multiple video programming signals from a variety of outside sources at the TDC and distributing these signals on multiple broadband channels to each video outlet in the school. Outside programming sources may include cable television (CATV) from the local provider, master antenna television (MATV), satellite downlink (C and/or KU-band), microwave and/or instructional television fixed service (ITFS) depending on available service.

The video system shall also have the capability of distributing local programming generated on-site from centralized sources such as VCR's, laserdisc, DVD's, computers, video cameras or video file servers. However, it is anticipated that each learning area will be equipped with a 27-30" video monitor and separate VCR.

The typical video headend depicted below for an elementary school is provided not as recommended design but rather as a representative generic design and an example of the required specificity and detail of the design.



TYPICAL ELEMENTARY SCHOOL VIDEO HEADEND DETAIL
NOT TO SCALE

Cable Plant

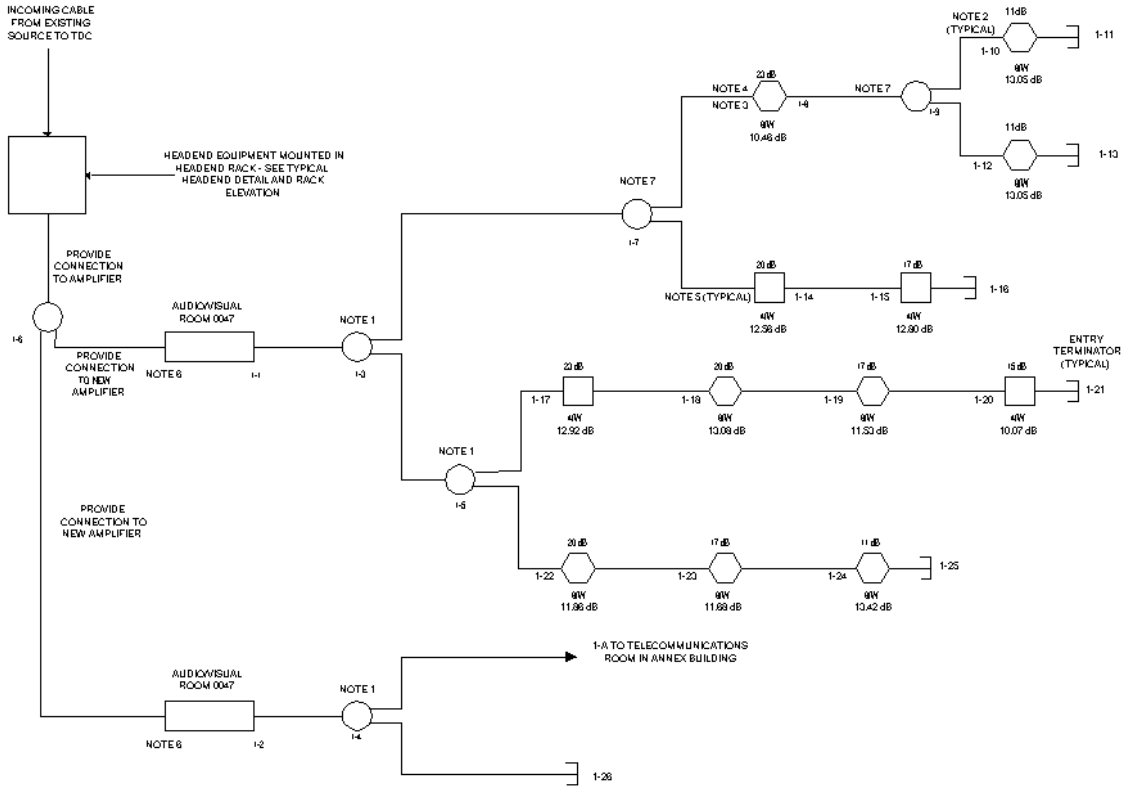
Most building-wide video distribution is implemented over either coaxial or UTP cable infrastructures.

At this time, coaxial systems are the most common and typically the most cost-effective implementation and that recommended for DCPS. Coax based cable distribution systems are based on time-proven technology and, properly designed and installed, can provide reliable long-term service. The two types of coax cable plant designs are tap and drop and home run systems. The home-run model provides video coax cable runs from CNOs to nearest TDC/IDF while the tap and drop provides taps in corridors connected by video trunk cable and horizontal coax cables routed from the tap to CNOs. The recommended coax cable plant design for DCPS is the tap and drop system utilizing RG-6 horizontal cable from taps to classrooms etc. and trunk coax cable as appropriate and defined in Division 17000. The video cable plant can utilize the same cable trays and other low voltage pathways as voice and data cabling.

UTP video distribution systems are now available and are undergoing rapid improvement. They typically involve a star-wired topology utilizing Category 5e wiring, have a “plug and play” ease of installation and use, are very easy to modify and troubleshoot, and promise a large bandwidth capability. However, at this time, the most successful systems tend to use proprietary equipment and standards and are not recommended by DCPS. Such systems require pre-design approval by the Office of the Chief Technology Officer prior to consideration.

VIDEO SYSTEM SCHEMATIC DIAGRAM

The video system schematic diagram depicted below is provided not as recommended design but rather as a representative generic design and an example of the required specificity and detail of the design.

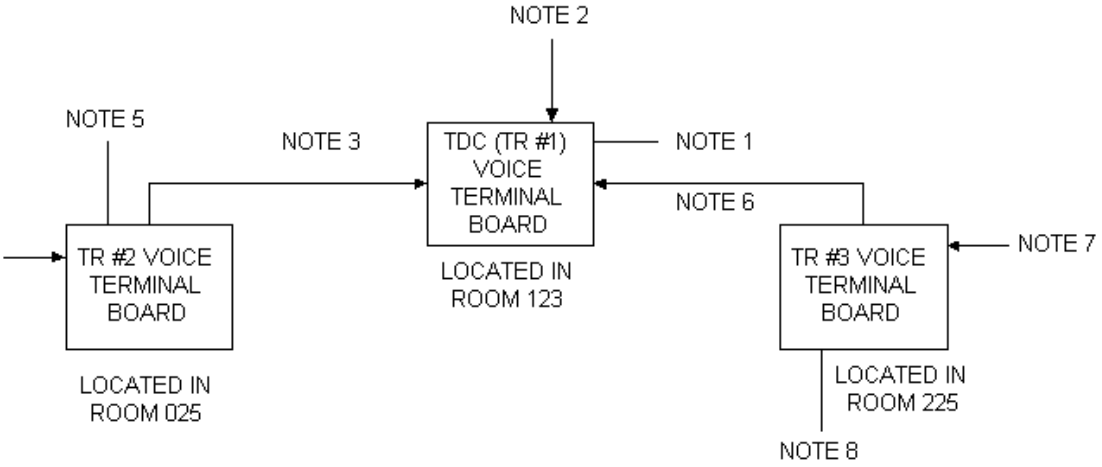


VIDEO SYSTEM SCHEMATIC DIAGRAM

1. 2/W SPLITTER LOCATED ON THE TELEVISION DISTRIBUTION BOARD AT THE HEADEND RACI WIRE CLOSET LOCATION.
2. DENOTES NUMBER OF OUTPUT PORTS OF TAP DEVICE (TYPICAL).
3. NUMBER REPRESENTS DESIGN TAP LEVEL IN dBmV AT 750 MHz AT ADJACENT PORT OF TAP DEVICE (TYPICAL).
4. NUMBERS ABOVE 2/W, 4/W AND 8/W TAPS DENOTES NOMINAL TAP LOSS TO ALL PORTS OF T DEVICE (TYPICAL).
5. NUMBERS ADJACENT TO ITEMS OF EQUIPMENT CORRESPONDS TO NUMBERS ON FLOOR F ADJACENT TO SAME ITEMS OF EQUIPMENT.
6. NEW BIDIRECTION AL AMPLIFIER - MOUNT AT HEADEND SEE SPECIFICATIONS OUTPUT LEVELS T BE 47 Db at 750 MHz AND 41 Db at 150 MHz.
7. 2/W SPLITTER LOCATED IN THE ACCESSIBLE CEILING SPACE.

F. Voice Infrastructure Topology Design

The voice cable plant will consist of Category 5e horizontal cable from the phone jack in the CNO to with IDF and the appropriate number of Category 3 tie cables from the IDF to the TDC as per sample voice riser diagram provided below:



"SAMPLE " ELEMENTARY SCHOOL
VOICE RISER DIAGRAM
NO SCALE

VOICE RISER DIAGRAM NOTES

1. 4' WIDE BY 8' HIGH PLYWOOD SHEET FURNISHED AND INSTALLED UNDER THIS CONTRACT AND BOLTED TO WALL. ALL HORIZONTAL AND TIE CABLES ENTERING THIS TELECOMMUNICATIONS ROOM TO BE TERMINATED IN 110 BLOCKS MOUNTED ON THIS BOARD
2. ENHANCED CATEGORY 5 CABLES FROM VOICE OUTLETS IN TELECOMMUNICATIONS ROOM SERVICE AREA
3. 25 PAIR CATEGORY 5 CABLES VOICE TIE CABLES FROM EXISTING TR#2 VOICE TERMINAL BOARD TO TDC. TERMINATE ON 110 BLOCKS AT BOTH ENDS.
4. ENHANCED CATEGORY 5 CABLES FROM VOICE OUTLETS IN TELECOMMUNICATIONS ROOM SERVICE AREA.
5. 4' WIDE BY 8' HIGH PLYWOOD SHEET FURNISHED AND INSTALLED UNDER THIS CONTRACT AND BOLTED TO WALL. ALL HORIZONTAL AND TIE CABLES ENTERING THIS TELECOMMUNICATIONS ROOM TO BE TERMINATED IN 110 BLOCKS MOUNTED ON THIS BOARD
6. 25 PAIR CATEGORY 5 CABLES VOICE TIE CABLES FROM EXISTING TR#3 VOICE TERMINAL BOARD TO TDC. TERMINATE ON 110 BLOCKS AT BOTH ENDS
7. 4' WIDE BY 8' HIGH PLYWOOD SHEET FURNISHED AND INSTALLED UNDER THIS CONTRACT AND BOLTED TO WALL. ALL HORIZONTAL AND T IE CABLES ENTERING THIS TELECOMMUNICATIONS ROOM TO BE TERMINATED IN 110 BLOCKS MOUNTED ON THIS BOARD

It is anticipated that voice switch equipment (PBX) or other point of demarcation equipment will be located in the TDC.

G. Telecommunication Pathways

Introduction

This section addresses the specific requirements, codes, and standards concerning telecommunication pathways. Pathways are used to distribute and support horizontal and backbone voice, video and data cable and connecting hardware between the work area outlet and the telecommunications room. These pathways and spaces represent the routing and are the "container" for the horizontal and backbone cabling.

Horizontal Pathways

Horizontal pathway systems consist of structures that conceal, protect, support and provide access to horizontal cables, which transport telecommunication signals, between the telecommunications outlet/connector in the work area and the horizontal cross-connect in the telecommunications room. The horizontal pathway system must be designed to handle all types of telecommunications – low voltage – voice, video and data cable. The following considerations must be given to the design of horizontal pathways:

- Design to meet current cable counts and allow for growth.
- Conduit or other enclosed pathways such as surface mounted raceways or telecommunications poles are to be provided from all CNOs to the space above suspended ceilings in room or corridor.
- Conduit or other enclosed pathways are to be used in all spaces without suspended ceilings and areas where required by applicable electrical codes.
- Conduit will be sized not to exceed data listed in Table 4.4-1 of the ANSI/EIA/TIA Standard or Table 4.10 of the 2000 BICSI TDM Manual.
- Conduit pathways shall meet all standards of Chapter 4, Section 1 of the 2000 BICSI TDM Manual.

Cable Trays

- Cable trays and raceway requirements
    - Wall or ceiling mounted open cable tray should be used in high cable volume areas such as corridors, around Computer Labs, near and around the TDC, and TRs. In all spaces except

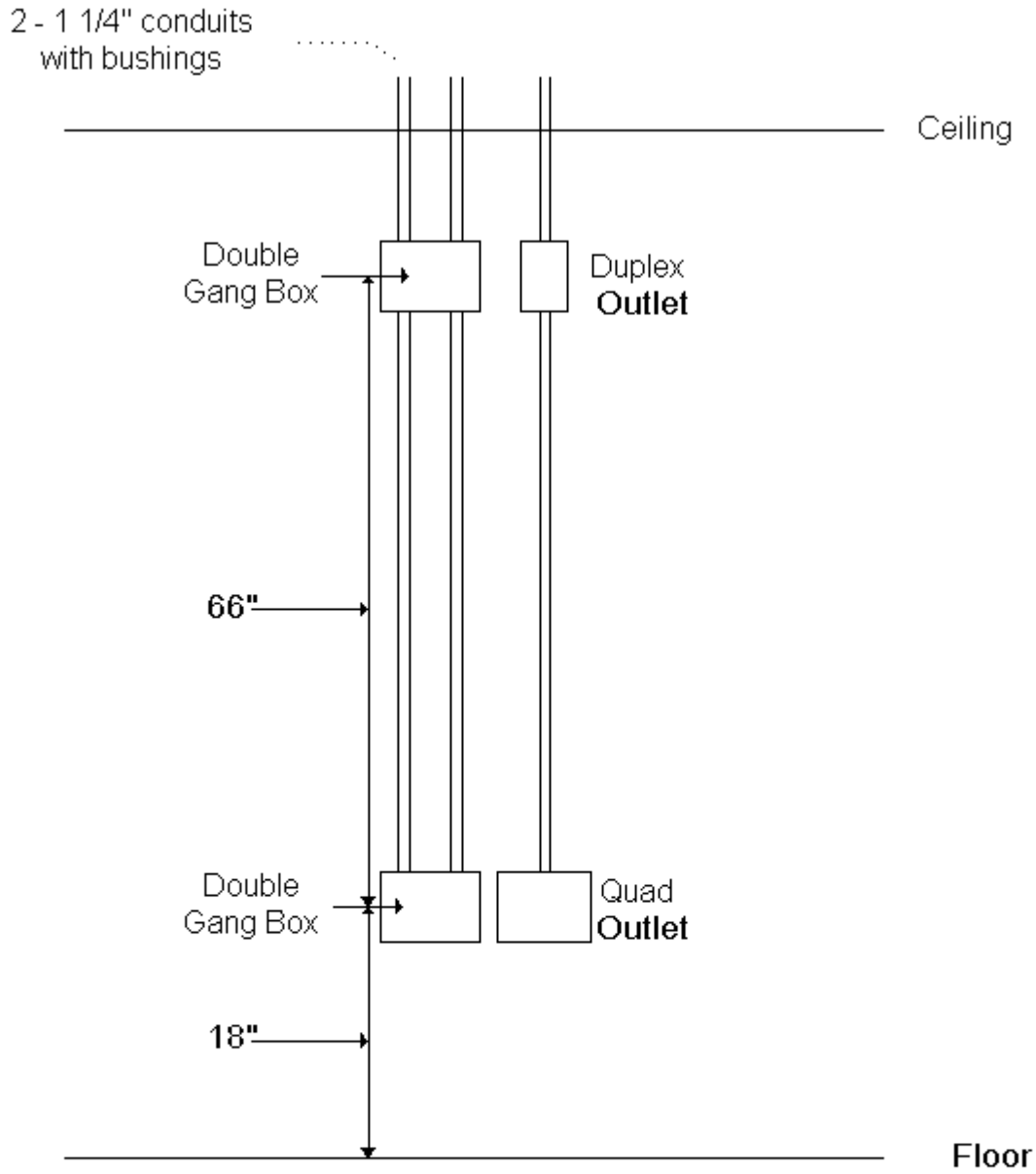
telecommunications rooms, cable trays are to be above suspended ceilings.

- Access to Cable trays shall not be restricted by other building components.
- Cable trays should carry low voltage cables only unless engineered to carry both high and low voltage cables.

In-Wall Conduit

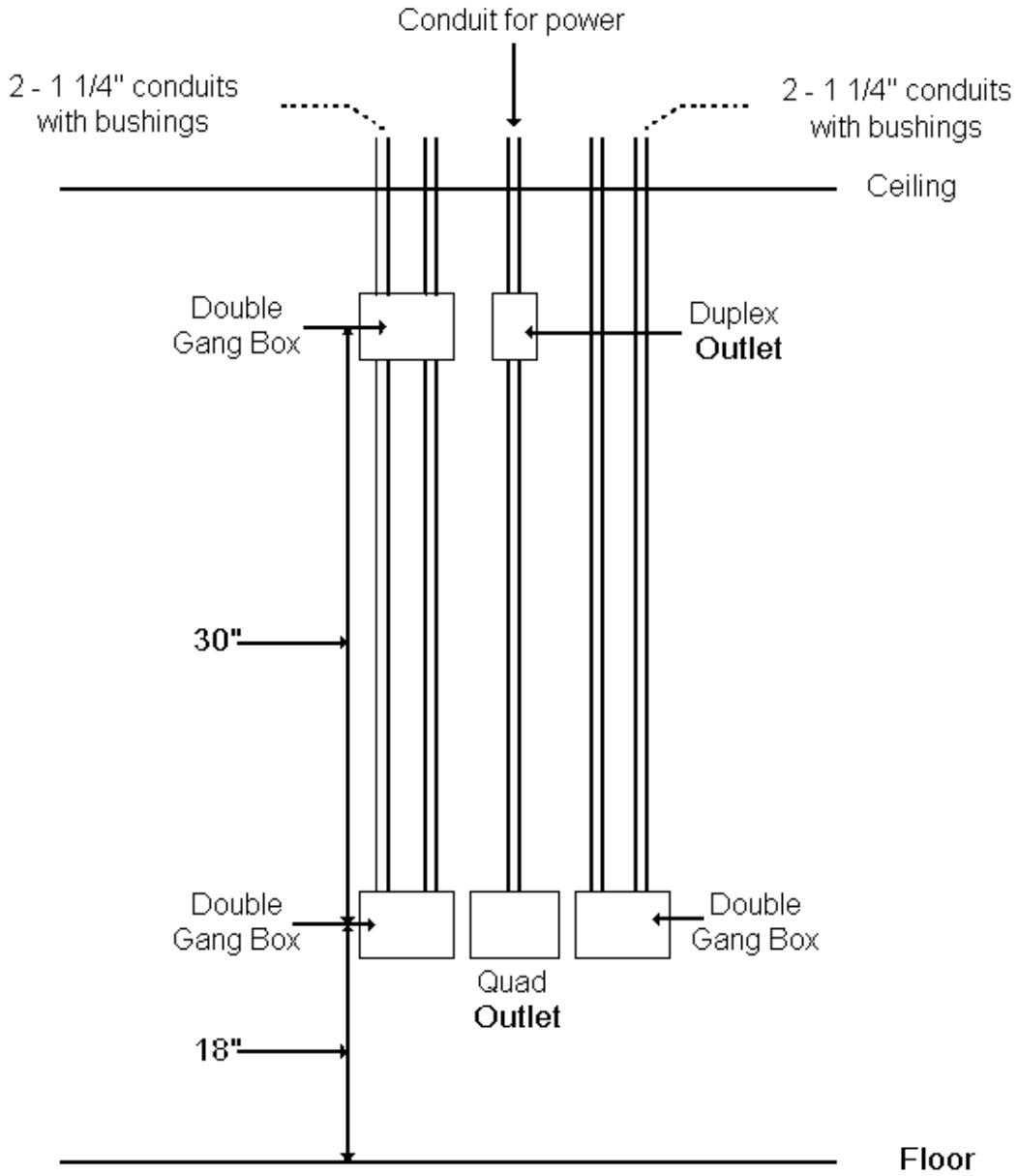
- Conduit requirements

  - Consider conduit sizing when specifying conduit. A 40% fill ratio is recommended
  - Communication Network Outlet drawing follow on next page.



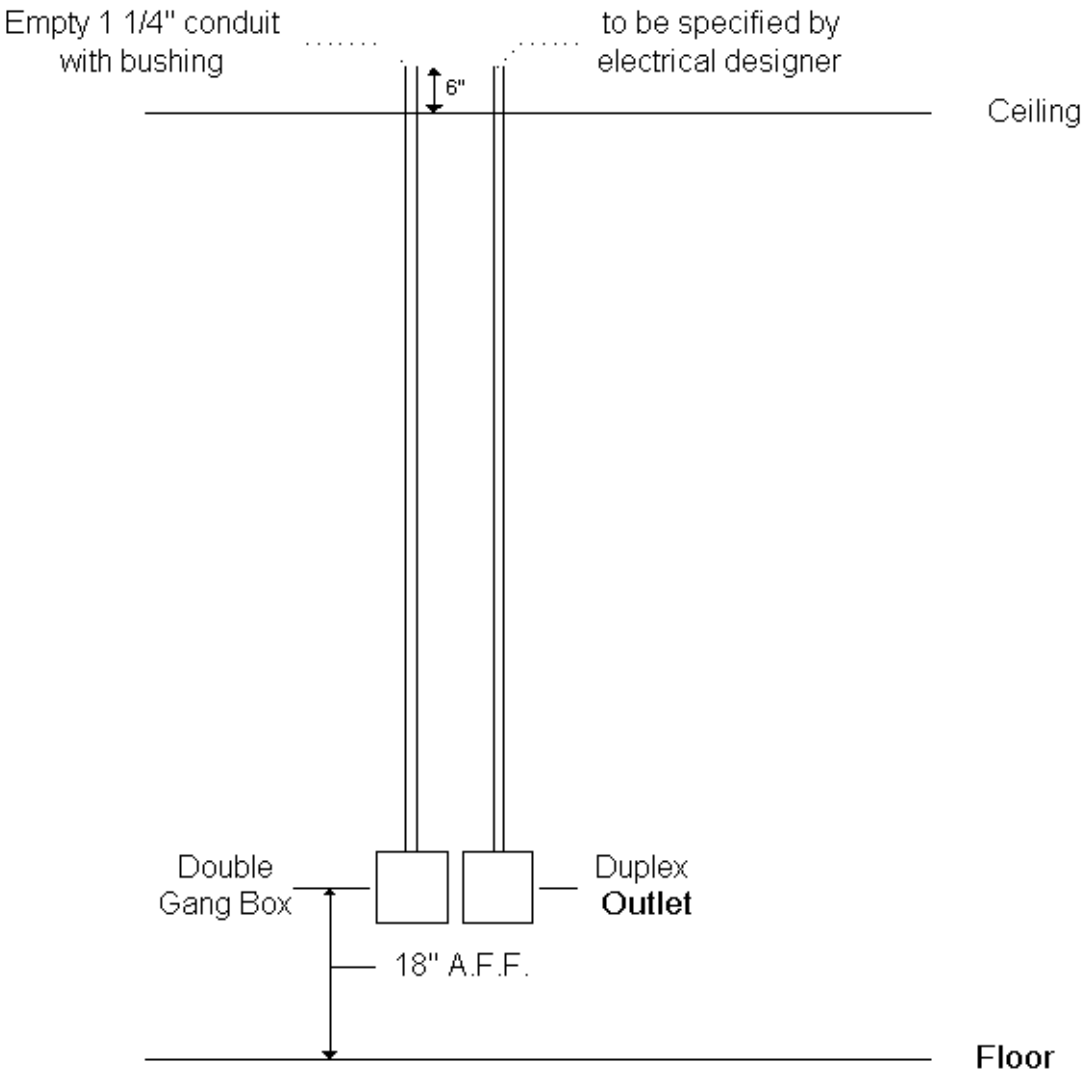
TM

CONDUIT DETAIL
TEACHER/MONITOR
CNO
Not to Scale



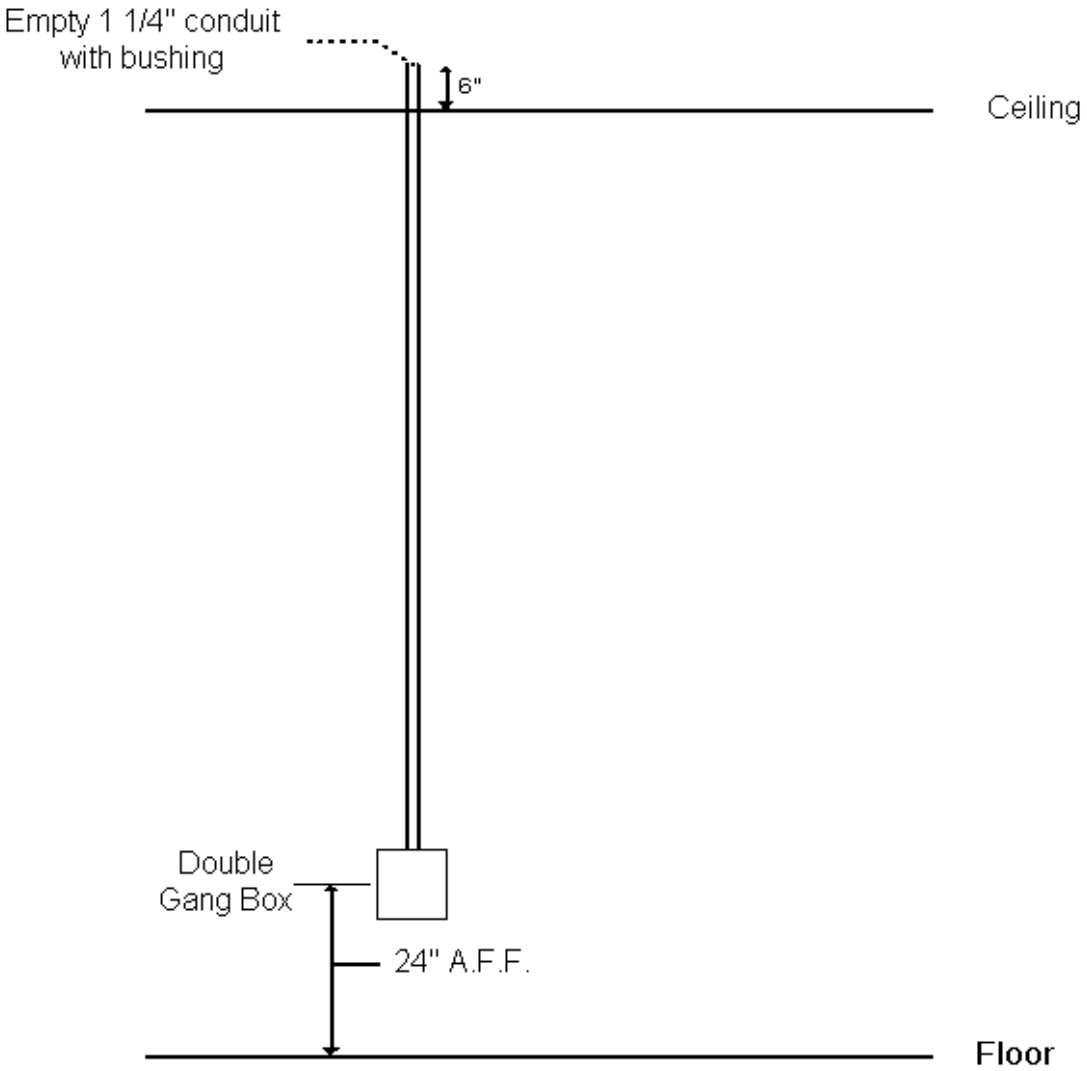
TMP

CONDUIT DETAIL
TEACHER/MONITOR/PROJECTOR
CNO
Not to Scale



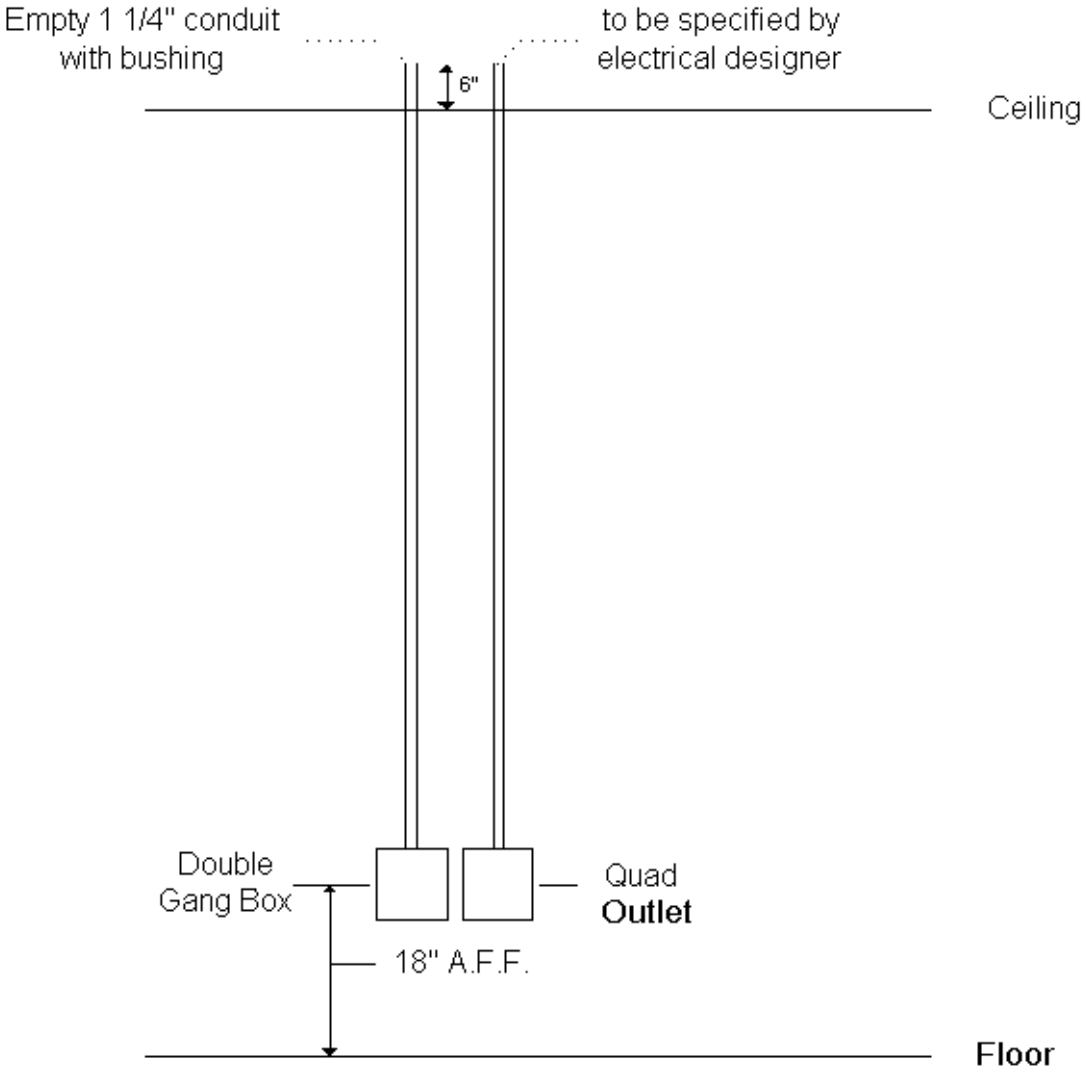
A/AV

CONDUIT DETAIL
ADMINISTRATIVE CNO
Not to Scale



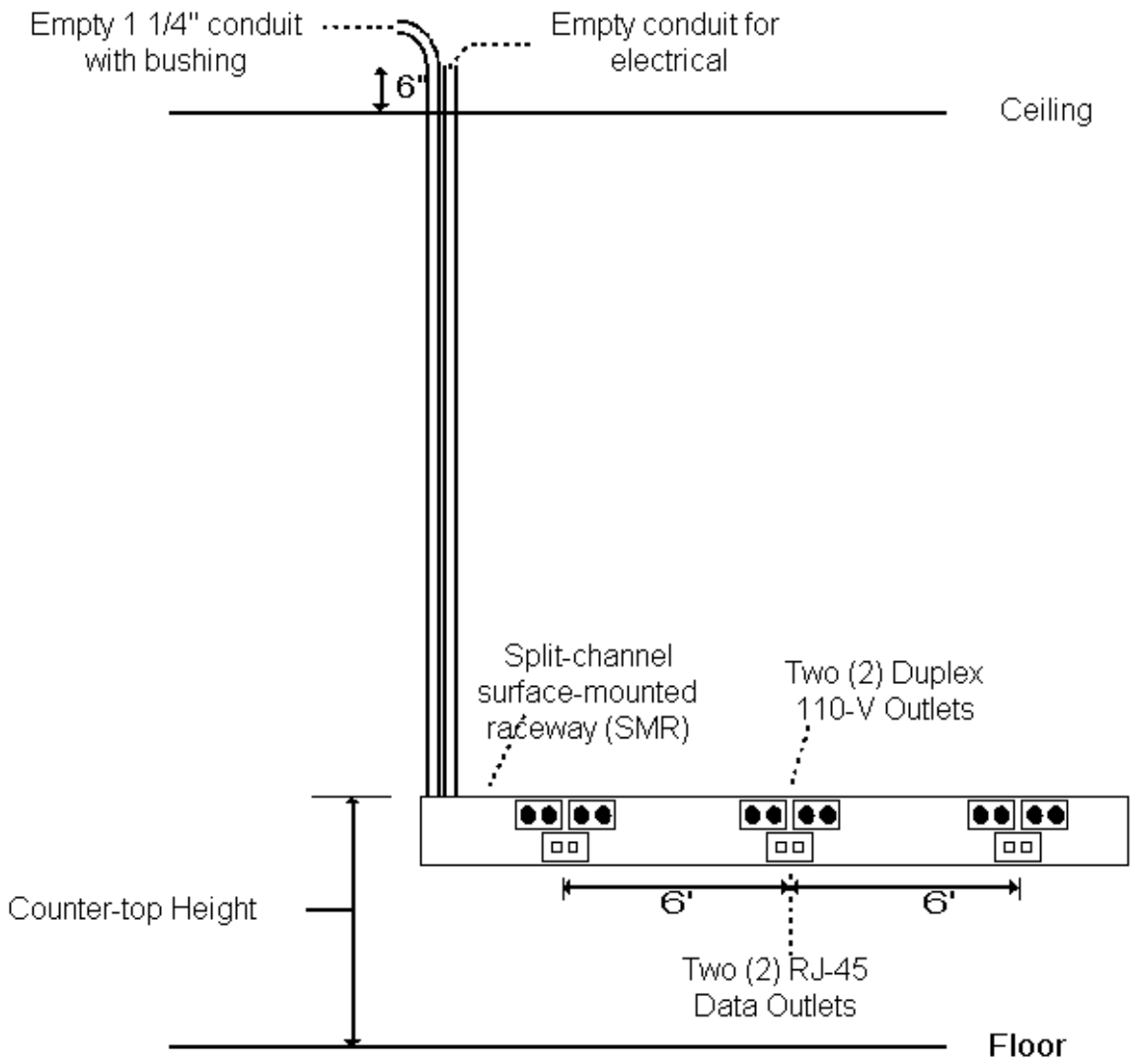
F

CONDUIT DETAIL
FIBER CNO
Not to Scale



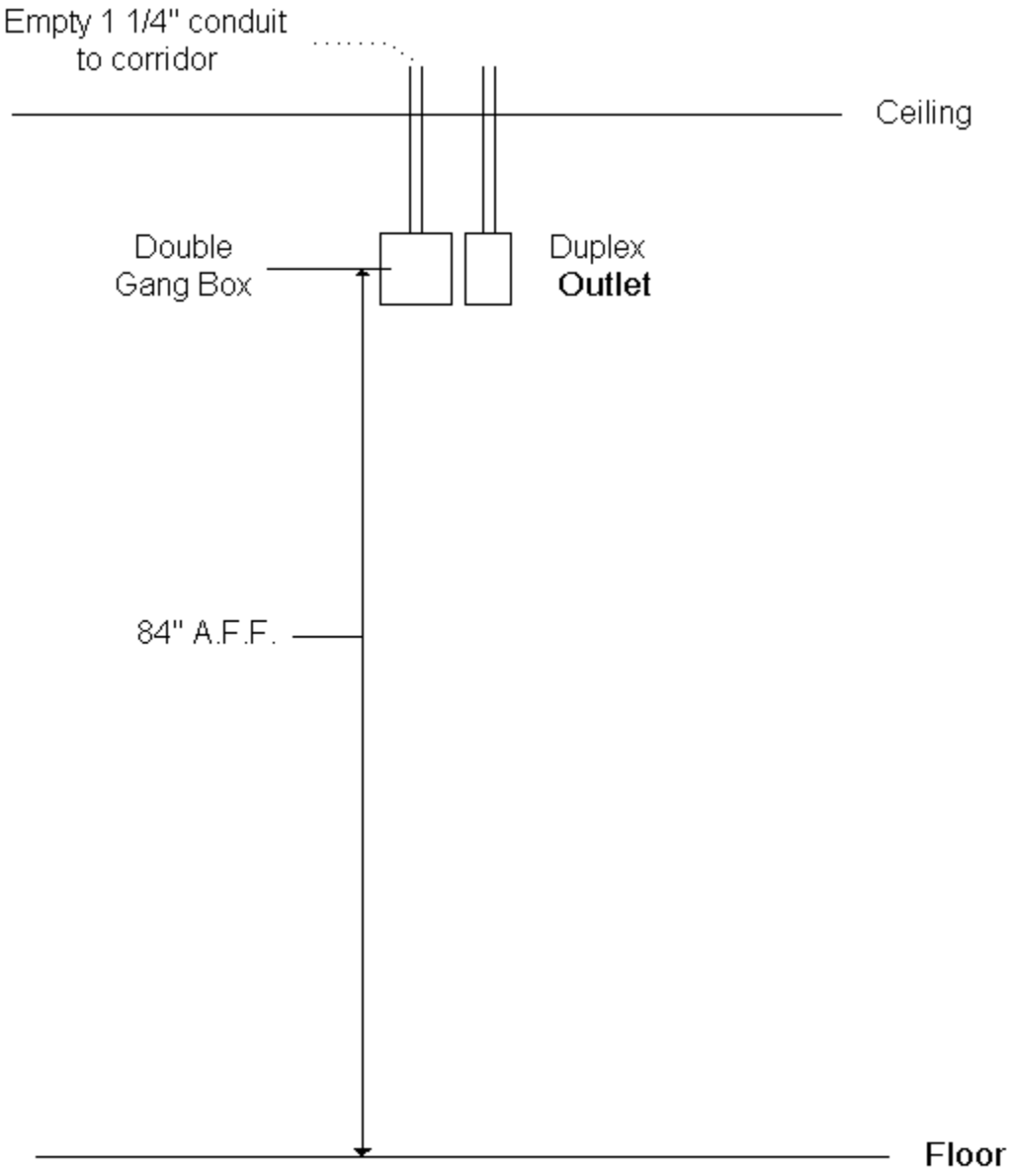
D

CONDUIT DETAIL
DOUBLE CNO
Not to Scale



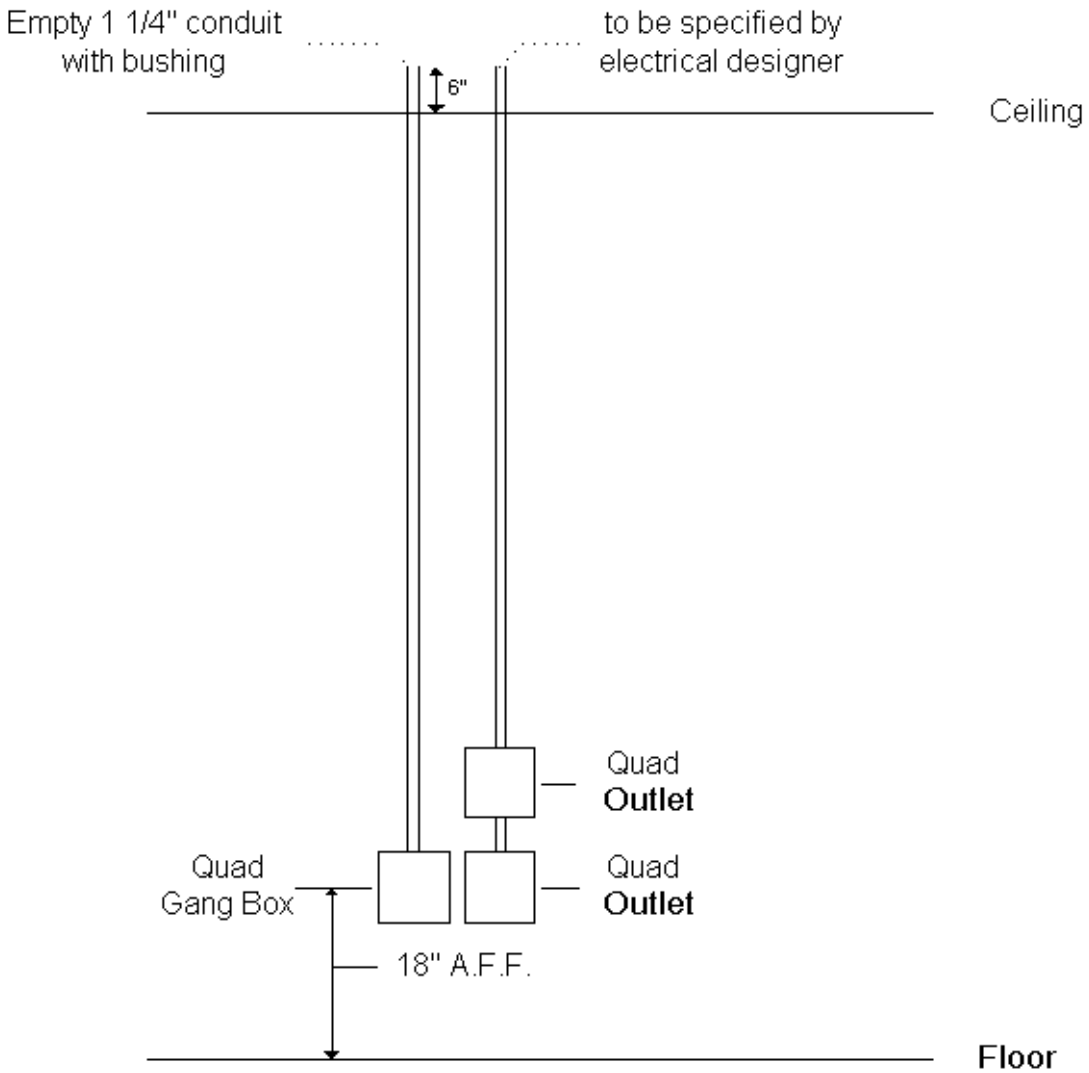
Surface Mounted Split Channel Raceway
(3 "D" CNO's)

Not to Scale



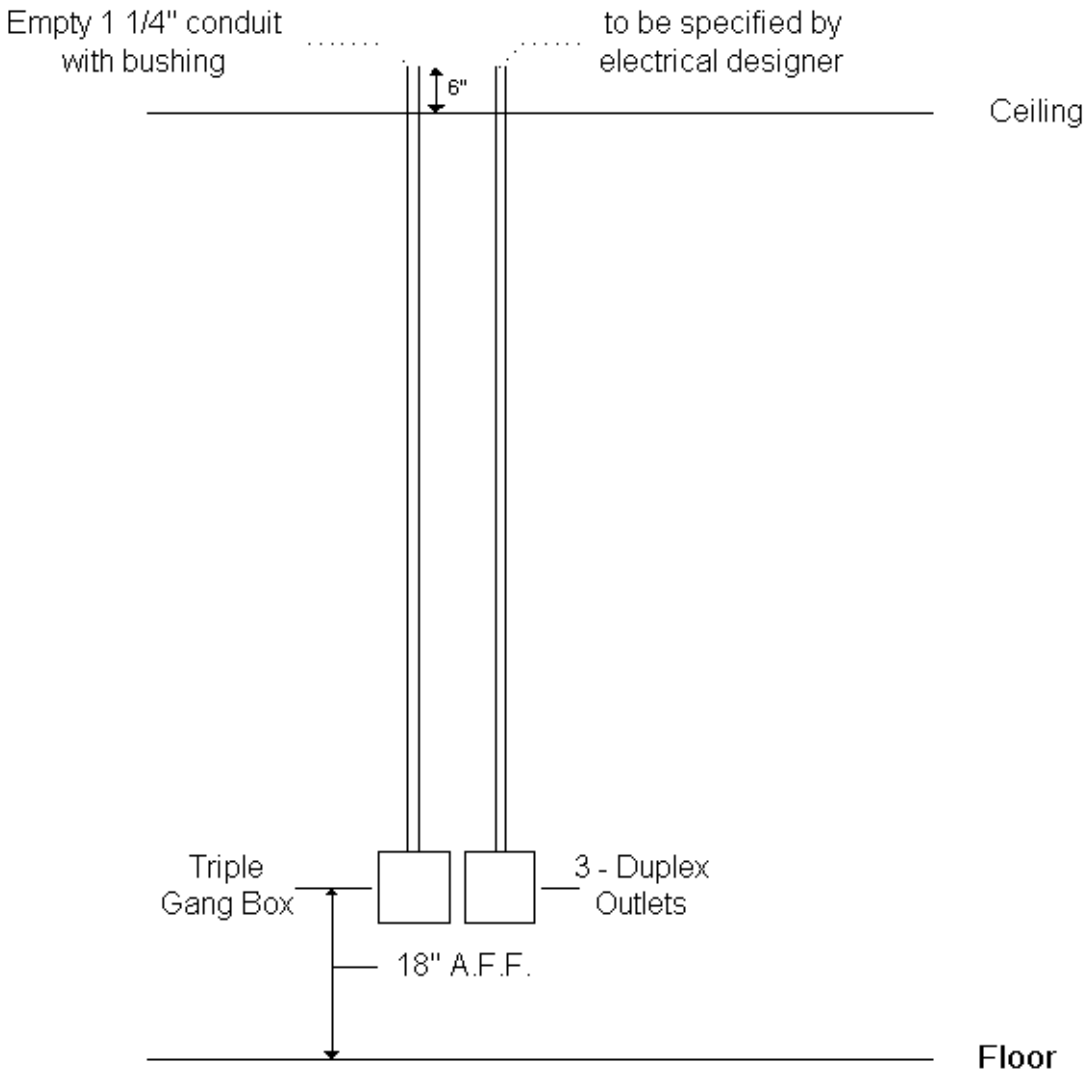
G

CONDUIT DETAIL
GYMNASIUM CNO
Not to Scale



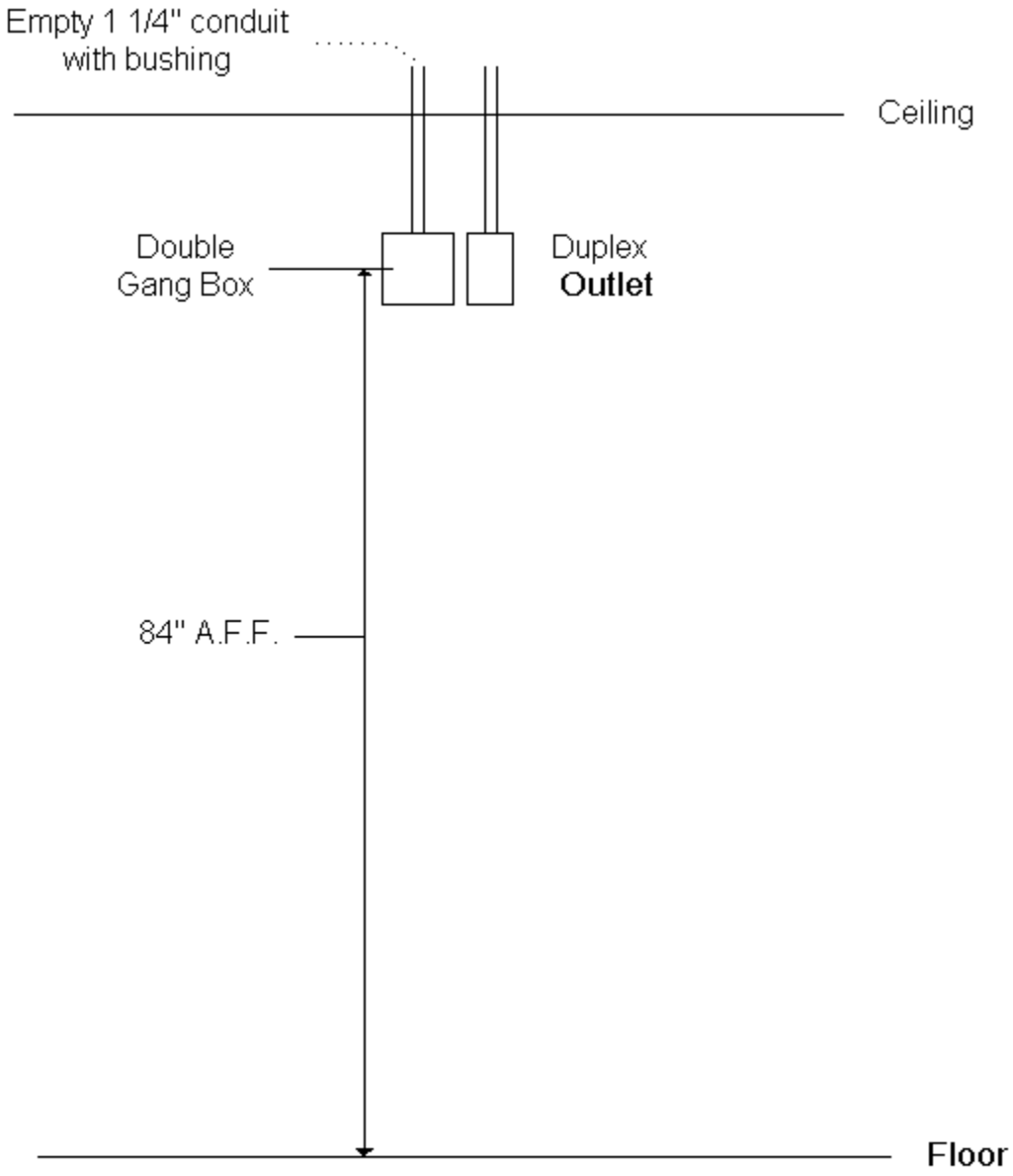
Q

CONDUIT DETAIL
QUAD CNO
Not to Scale



T1

CONDUIT DETAIL
TRIPLE CNO
Not to Scale



V

CONDUIT DETAIL
VIDEO CNO
Not to Scale

Surface Mounted Raceway

The use of split channel surface mounted raceway in new and renovated schools should be kept to a minimum. However, there are situations where its use is appropriate. For example, for a series of student CNOs spaced along a wall under windows where it is difficult to install in-wall conduit or around walls in a computer or science lab. Whenever used, the vertical routing of power and low voltage cables should be within in-wall conduit and only the horizontal routing of cables within surface mounted raceway.

Within Casework

Voice, video and data cable may be routed within casework such as science lab or demonstration tables from in-wall conduit to CNOs installed in the same casework. Cabling installed in exposed area with possibility of damage must be installed within fixed for flexible conduit.

Exposed Conduit

- Low voltage voice, video and data cable routed in areas without suspended ceiling must be in appropriately sized conduit or other surface mounted raceway. Examples of such locations are:
  - Boiler rooms
  - Stage areas
  - Gymnasium

Suspended Ceiling

- Ceiling Distribution Requirements
  - Low voltage voice, video and data cable may be supported above suspended ceilings by “J” hooks attached directly to the roof support structure.
  - Ceilings must be accessible in all areas.
  - Cable shall not be laid directly on ceiling tiles or suspension parts.
  - Provide “J-Hook” supports where cable bundles require support.
  - Cable to be bundled in not more than 50 cables, not tied, and supported every 60” by a “J” hook.

Horizontal Sleeves

- Sleeve Requirements

- Conduit sleeves are required for all wall penetrations. For example, a size – 3" conduit will allow for up to 41 cables.
- Conduit sleeves for classrooms, offices, etc. should be located over doors.
- Sleeves shall be fire stopped where required by code.

BACKBONE PATHWAYS

A building backbone system is the part of a premises distribution system that provides connection between equipment rooms, telecommunication rooms, and telecommunication service entrance facilities. Fiber optic cable from the Technology Distribution Center or a Telecommunications Room to a remote equipment box located in a learning area is considered to be part of the backbone pathway requirement.

Interduct

- Interduct Requirements
  - All fiber optic cable used for backbone cabling are to be run in interduct sized appropriately for 40% fill.

Backbone Cable Pathways

- Backbone Cable Pathway Requirements
  - Backbone pathways shall be capable of accommodating all telecommunications media recognized in ANSI/EIA/TIA-568A, including 100Ohm Unshielded Twisted Pair (UTP), 62.5/125 um optical fiber, single-mode optical-fiber cable and 50-Ohm coaxial cable.

- Capacity
  - Pathways shall be sized to accommodate the anticipated size, type, and quantity of cables, and provide capacity for future growth. Provide additional empty conduits, trays, sleeves, etc., where as may be necessary to add additional capacity without causing significant disruption to the facility.

- Firestopping
  - All pathway penetrations through fire-rated construction assemblies are to be fire stopped in accordance with applicable codes.

H. Telecommunications Cabling Standards

The purpose of this section is to establish minimum standards for cabling types, pathways, and installation practices. It will also suggest practices to better enable maintenance and upgrades to the cabling system.

General Requirements

1. Industry Standards – Cabling Systems should conform to the requirements of EIA/TIA-568-A, *Commercial Building Telecommunications Cabling Standard* and EIA/TIA-606, *Administrative Standard for the Telecommunications Infrastructure in Commercial Buildings*, and appropriate sections from the Federal Communications Commission (FCC) Rules.

2. Updated Standards – Designers are responsible for monitoring revisions and addenda to existing standards, and updating requirements as new standards are adopted.

3. Compliance – Special care should be given to equipment or conditions that may be present within the school that could interfere with the cabling performance. For example, microwave ovens and copying equipment produce EMI signatures that reduce the transmission properties of unshielded cable, 802.11 wireless transmissions, and other low voltage signals.

4. UTP Performance – The horizontal cabling component shall comply with testing and transmission requirements as defined in Addendum 5 of ANSI/TIA/EIA-568-A, capable of supporting applications requiring a bandwidth of at least 100 MHz.

5. Network Management – Simple Network Management Protocol should be used in the design and configuration of the data cabling system.

6. Staff Training - School system staff training shall be incorporated into all installation contracts.

Horizontal Cabling Component

1. General Requirements

   a. Installation – Standards-based installation practices must be observed in the installation of horizontal cabling, to ensure system performance over the life of the application.

b. Topology – All horizontal cables shall run from the CNO back to the appropriate horizontal cross-connect. In a traditional layout, the horizontal cabling would be cross-connected in the IDF/MDF. In a collapsed backbone design, the horizontal cable would terminate in the cross-connect cabinet that serves the appropriate zone.

c. Cable Lengths – Horizontal cable lengths may not exceed 290 feet from the CNO to the termination at the horizontal cross-connect. It is recommended for designers to consider all factors of horizontal cable length when designing the telecommunications systems, to avoid exceeding this measurement both during design and actual installation.

2. Horizontal Cabling Media - All cabling used in the horizontal shall conform to all physical and performance requirements of the current ANSI/TIA/EIA cabling specifications.

3. Horizontal Cross-connects and Hardware

a. Standards – All cross-connect hardware and cables shall comply with EIA/TIA-568A and meet or exceed system cabling transmission performance.

b. Terminations - All horizontal cables shall terminate in cross-connects and work area CNOs, to allow for flexibility over the life of the system.

c. Data Copper UTP Cross-connections – Designers should provide a passive transition between the horizontal building cabling and the networking equipment, which may be in the same or adjacent racks. UTP terminations should be made on 110-style insulation displacement contacts (IDC). Patch cords (with greater transmission performances than the horizontal cabling) shall be used between termination fields and active equipment. Either the EIA/TIA T568A or T568B pin-pair standards are acceptable.

d. Voice Copper UTP Cross-connections - Designers should provide a passive transition between the horizontal building cabling and the networking equipment, which may be on a wall-mounted fire-rated plywood backboard or contained within a wall- or floor-mounted rack/cabinet. UTP terminations should be made on 110-style insulation displacement contacts (IDC). 4-Pair UTP Patch cords or IDC jumper cables (both with greater transmission performances than the horizontal cabling) shall be used between termination

fields and active equipment. Sufficient cable management should be included within the design.

e. Horizontal Fiber Cross-connects – When fiber is used as the transmission media in the horizontal, the horizontal cross-connect shall be made in optical fiber patch panels. Connections shall be made using SC conductors, which are EIA/TIA-568A compliant.

Backbone Cabling Component

1. General Requirements

a. Installation – Standards-based installation practices must be observed in the installation of backbone cabling, to ensure system performance over the life of the installation.

b. Cable Lengths - Backbone cable lengths may not exceed 800 meters (2624 feet) for Cat 3 UTP cables, 2000 meters (6560 feet) for 62.5/125 multi mode fiber-optic cables, or 3000 meters (9840 feet) for single mode fiber-optic cables.

c. Grounding – Backbone cabling systems should be grounded to protect personnel and equipment, as per the requirements of ANSI/TIA/EIA-607.

2. Acceptable Data Backbone Cabling

a. Multi Mode Fiber Optic Cable – 62.5/125 μm multimode graded-index optical fibers, which comply with ANSI/TIA/EIA-492AAAA and are enclosed in a protective cover. All cables shall be plenum-rated and comply with the requirements of NFPA 262-1985 and UL-910 standards if installed in air plenum spaces.

b. Single Mode Fiber Optic Cable - 8/125 μm to 9/125 μm single mode graded-index optical fibers, which comply with all ANSI/TIA/EIA standards for specification and performance of single mode fiber optic cables. All cables shall be plenum-rated and comply with the requirements of NFPA 262-1985 and UL-910 standards if installed in air plenum spaces.

c. Hybrid Cables – Hybrid cables of single- and multi-mode fibers may be permitted when necessary for optimal system performance.

Cable Identification

1. General Requirements – All installed components shall be clearly marked in a consistent fashion, and adhering to a standards-based labeling scheme. Examples of components that shall be labeled are: CNOs, horizontal and backbone cabling, pathways, termination hardware and equipment, racks, and telecommunications spaces. All cables shall be marked with a unique identifier to permit the tracing of such cables from origin to termination.

2. Identification Standard – Labeling shall be consistent in accordance to EIA/TIA-606 "*The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*". However, identification standards may be altered at the request of the client with respect to an existing identification strategy.

3. Documentation – All labeling information shall be maintained to reflect as-built and changes documentation. All test documents shall reflect the building labeling scheme.

Testing and Administration

1. General Requirements – All cables and terminations shall be thoroughly tested for defects in installation and to verify conformance with performance standards under installed conditions. Tests shall be conducted as specified by the most recent edition of TIA/EIA testing standards. Full documentation shall be provided to the client for the project record.

2. UTP Copper Cabling Testing

    a. UTP voice cables – Each voice cable shall be tested for continuity, polarity and pair reversals, shorts and opens. Horizontal voice cabling should be tested to meet the same performance specifications as the horizontal data cabling and for length.

    b. UTP Data Cables – Each data cable shall be tested for all of the above requirements, plus tests to verify the installed performance.

    c. Length – All installed cables shall be tested for length, as specified within TIA/EIA-568A. They shall be tested from: patch panel to patch panel, block to block, patch panel to CNO, or CNO to block as appropriate. For multi-pair cable, the longest pair shall serve as the "cable length".

d. Performance Verification – The criteria of Addendum No. 5 of TIA/EIA-568A shall be utilized, as well as an approved automated test set. The test shall be capable for the following: Power Sum Near End CrossTalk (NEXT), Attenuation, Ambient Noise, and Attenuation to CrossTalk ratio (ACR).

3. Fiber Optic Cabling Testing

a. Visual Inspection – All optical fiber terminations shall be visually inspected with a minimum 100x microscope to ensure that no imperfections exist after polishing.

b. Attenuation – Each fiber shall be tested for attenuation with an optical power meter and light source. Backbone multimode fiber shall be tested at 1300 and 1500 nm using an LED light source in one direction. EIA/TIA-568A, Annex H: *Optical Fiber Link Performance Testing* shall be utilized for all testing.

c. Length and Splice Loss – Where required, optical-fiber cable shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses.

I. Telecommunication Equipment Rooms

Every school will have a Technology Distribution Center. Depending on the data communications infrastructure topology for an individual school there could be one or more Telecommunications Rooms.

Technology Distribution Center

The Technology Distribution Center (TDC) is a multi-function, secure, climate controlled space dedicated to the exclusive use of building telecommunications systems. It shall typically house entrance facilities and demarcation points for the various telecommunications systems serving the building and additional functions/equipment such as:

- A server farm for the data network.
- A PBX for the telephone system.
- WAN servers and routers.
- Main Cross-connect for all telecommunications networking infrastructure; etc. (MDF)

- Video head-end equipment.
- Intercom and sound equipment.
- Alarm Security Systems.
- Video surveillance head-end equipment.
- Support space for network management/administration

The TDC is a special-function room that maintains a suitable operating environment for communications and/or computer equipment. The TDC contains terminations, cross-connects, and active equipment for telecommunications distribution. This space may also contain equipment used in the fire alarm, security and CATV systems. It may also contain the entrance facilities for the access providers for the data, voice and video networks. Suitable space should be allocated for the cross-connect between the backbone cabling and horizontal cabling for the voice and data networks.

It is strongly recommended that the TDC be located in or adjacent to the Media Center. Due to the technical nature of the equipment within the TDC, staffing or security may be increased due to this location. It also allows for the consolidation of technology resources within the Media Center. As an alternative, however, equipment to support such functions as video surveillance, alarm, and intercom may be located in a telecommunications room with greater adjacency to the main office. Likewise, the TDC is the preferred location for service entrance facilities, however, statutory requirements governing local utilities may require alternative locations. Entrance facilities shall comply with the requirements of TIA/EIA-569 and local utility requirements.

Location Considerations for TDC

- Allow for future expansion.
- Adjacent to backbone pathway (typically corridor).
- Avoid locations in proximity to water pipes and below lavatory facilities.
- Accessibility for after-hours maintenance is critical.
- Consider instructional aspects of TDC for students.
- Avoid sources of mechanical vibration.

- Avoid sources of EMI, such as elevators, electrical power supply transformers, motors, radio transmitters, and photocopy equipment.

Design Considerations of TDC

- Ceiling height should be a minimum of eight feet.
- Finishes should be smooth and sealed to prevent production and accumulation of dust.
- Wall should be of light colors to enhance room lighting and facilitate maintenance.
- Floor coverings should have anti-static properties. Well-sealed concrete is economical, and may be superior to many other materials in anti-static performance.
- Doors should be a minimum of 36” wide, open out where possible, and have heavy-duty locks. Where particularly large equipment is anticipated, consider 48” wide doors.

Mechanical Consideration of TDC

HAVC
An environmentally controlled atmosphere is required 24 hours per day, 365 days a year. If a standby power source is planned for the building, consideration should be given to connecting the HVAC equipment serving the TDC to this system. In addition:

- The ambient room temperature must be maintained between 60 and 80 degrees Fahrenheit.
- Relative humidity must be maintained between 30% and 60%.
- Adequate ventilation must be maintained where batteries are provided for back-up power

Fire Protection

Fire protection systems must be provided where required in conformance with applicable code.

- If sprinklers are required:
  - Provide sprinkler head protection such as wire baskets to prevent accidental discharge
  - Provide troughs or other protection to protect equipment from accidental leakage

- Configure piping so as to require the fewest number of sprinkler heads and fittings

- Consideration should be given to alternate fire suppressions systems.

- All penetrations shall be fire stopped.

Electrical Consideration of TDC

It should be noted that the following statement of electrical considerations should not preclude the telecommunications designer's consultation with the architect's electrical engineer who is the person with final responsibility for the electrical design of telecommunications equipment rooms.

Lighting

- Light levels should provide a minimum of 50 foot candles measured three feet above the finished floor.

- Locate light switches adjacent to the latch side of the entrance door(s).

- Lighting fixtures must not be powered from the electrical distribution panel, which serves the telecommunications equipment.

- Lighting must have low EMI characteristics.

Power Circuiting

- Provide dedicated electrical circuits serving only the TDC.

- Each circuit shall consist of phase, neutral, and ground conductors.

- The amount of electrical power required and the number of dedicated circuits required, shall be calculated based on the individual project needs and include a minimum of 25 percent spare capacity.

- In larger TDC's where a large number of circuits are required, like large middle or high schools, a dedicated equipment panel board should be provided for the TDC.

Power Receptacles

- A minimum of four quad wall-mounted receptacles is required to power telecommunications equipment.

- Each quad receptacle must be on its own 20-ampere circuit breaker.

- Receptacles may be isolated ground type. For isolated ground receptacles, the isolated ground conductor must be terminated on an isolated ground bus, which is insulated from the electrical panel board steel enclosure. The isolated ground must be bonded to the electrical system ground only at the neutral-to-ground bond for the separately derived source supplying the panel.

Uninterrupted Power Supply (UPS)

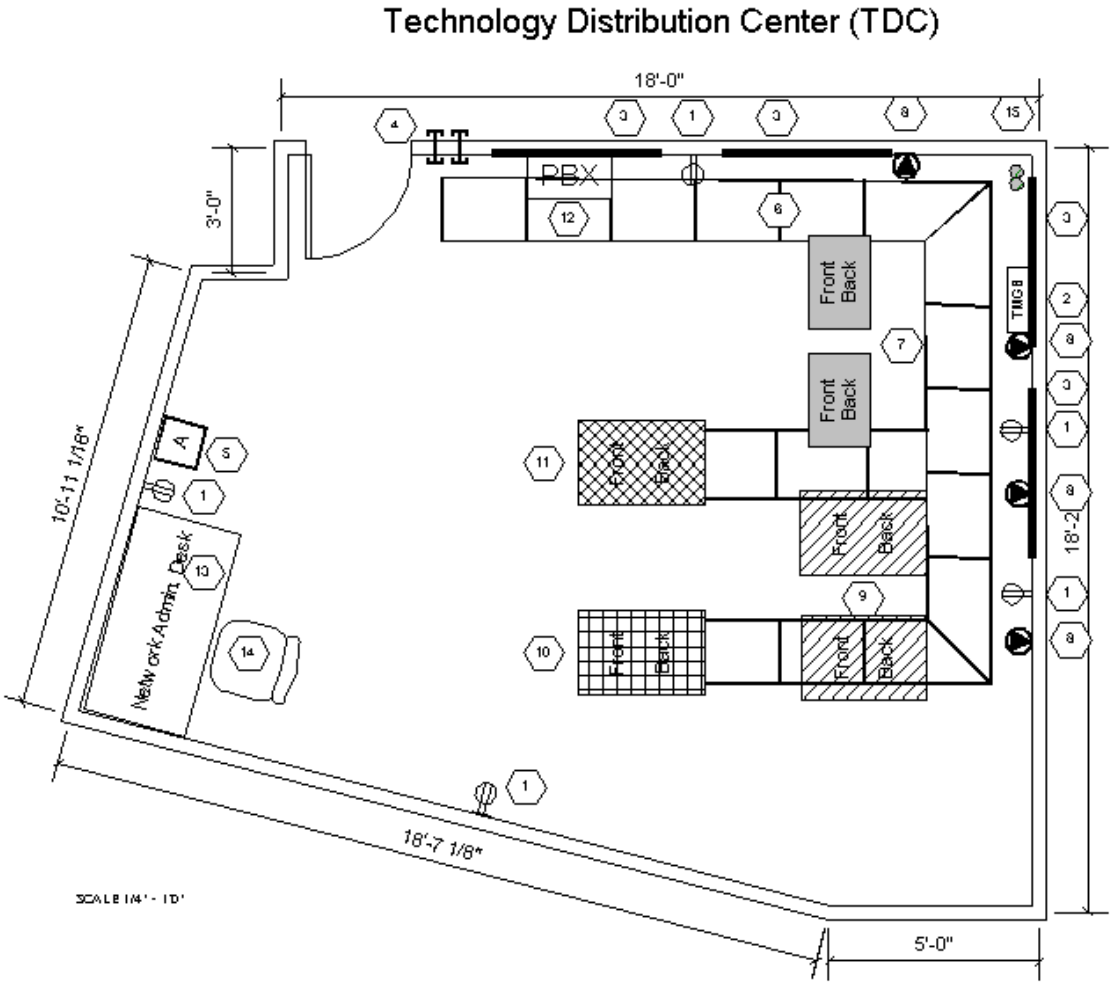
- The maximum size UPS to be located in the TDC shall be 10kVa.

- The UPS may require a receptacle with a different plug and a 30 amp circuit.

Size Requirements for TDC

Type of School	**Min. TDC Size Required (Square Feet)**
Elementary (up to 500 students)	100 net square feet
Elementary (up to 750 students)	150 net square feet
Elementary (over 750 students)	200 net square feet
Middle (up to 750 students)	150 net square feet
Middle (up to 1000 students)	200 net square feet
Middle (over 1000 students)	250 net square feet
High (up to 1000 students)	200 net square feet
High (up to 1400 students)	250 net square feet
High (over 1400 students)	300 net square feet
Technology (up to 250 students)	300 net square feet
Technology (up to 500 students)	350 net square feet
Technology (over 500 students)	400 net square feet

A typical Technology Distribution Center layout is shown below:



TECHNOLOGY DISTRIBUTION CENTER REFERENCE NOTES

1. TWENTY (20) AMP DEDICATED CIRCUIT SERVICING FOUR DUPLEX ELECTRICAL OUTLETS.
2. TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)
3. ¾" X 4' X 8' HIGH PLYWOOD WALLBOARD FOR TERMINATION OF VOICE CABLES IN 110 IDC BLOCKS AND VIDEO TERMINATION EQUIPMENT.
4. FIRE-STOPPED SLEEVES
5. COMMUNICATIONS NETWORK OUTLET (CNO).
6. 18" WIDTH LADDER RACK.
7. FLOOR MOUNTED DATA EQUIPMENT RACKS

PATCH PANEL	CAPACITY	SERVING	PORTS USED
NO. 1	48 PORTS	GENERAL	39 PORTS USED
NO. 2	48 PORTS	LIBRARY	41 PORTS USED
NO. 3	48 PORTS	ADMINISTRATION	40 PORTS USED
NO. 4	48 PORTS	GENERAL	39 PORTS USED
FIBER	18 PORT	TR	18 PORTS
UPS "A"			

PATCH PANEL	CAPACITY	SERVING	PORTS USED
NO. 1	48 PORTS	GENERAL	43 PORTS USED
NO. 2	48 PORTS	GENERAL	41
UPS "A"			

SWITCH EQUIPMENT TO BE CONFIGURED AS PER DATA CONNECTION DIAGRAM.

8. THIRTY (30) AMP DEDICATED CIRCUIT SERVICING A QUAD ELECTRICAL RECEPTACLE FOR FLOOR MOUNTED RACKS.
9. FLOOR MOUNTED FILE SERVER RACK.
10. FLOOR MOUNTED PA CABINET.
11. FLOOR MOUNTED PA CABINET.
12. PBX.
13. NETWORK ADMINISTRATOR DESK.
14. DESK CHAIR.
15. TWO (2) – 3" SLEEVES TO TR ON FLOORS DIRECTLY BELOW AND ABOVE.

Important TDC features:

- Sleeves providing cable paths to the floors above and below.
- Fire-stop around all wall penetrations.
- Closet Interconnect Conduit running between TDC and TRs.
- Telecommunications Grounding Bus bar to safely ground equipment found in the TR.
- Fire-rated plywood backboards for mounting telecommunications equipment on at least one wall.
- Specialized power receptacles for the active equipment driving the telecommunication networks.
- Floor mounted standard open data equipment racks may be used in spaces where student/staff access in highly controlled, otherwise use data equipment cabinets

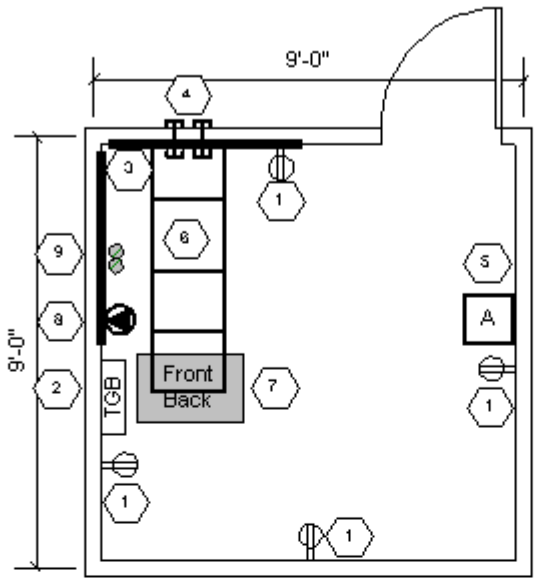
Allow three (3) feet of clear working space from cross-connect areas and equipment for ease of maintenance. Also, design with at least four (4) feet of clearance from the centerline of equipment racks and cabinets to the walls in front and to the rear of the rack/cabinet. Install wall-mounted plywood with six (6) inches of clearance from room corners.

Telecommunications Room (TR)

A Telecommunications Room (TR) serves the purpose of providing a facility for the horizontal distribution of network cabling. It also includes the cross-connect that routes the signals to and from the Technology Distribution Center. It should be sized and provisioned to store telecommunications equipment. Equipment and infrastructure that would hinder the voice, video and data transmissions should not be located in the TR.

Telecommunications Room design should follow all of the rules and guidelines as specified for the Technology Distribution Center. A typical telecommunications room layout is shown on the next page.

Telecommunications Room



SCALE 1/4" = 1'0"

TELECOMMUNICATIONS ROOM NO. 3 (IDF, Room C136) REFERENCE NOTES

1. TWENTY (20) AMP DEDICATED CIRCUIT SERVICING FOUR DUPLEX ELECTRICAL OUTLETS
2. TELECOMMUNICATIONS GROUNDING BUSBAR (TGB) – SEE DETAIL.
3. ¾" X 4' 8' HIGH PLYWOOD WALLBOARD FOR TERMINATION OF VOICE CABLES IN 110 IDC BLOCKS AND VIDEO TERMINATION EQUIPMENT.
4. FIRESTOPPED SLEEVES
5. COMMUNICATIONS NETWORK OUTLET (CNO).
6. 18" WIDTH LADDER RACK.
7. FLOOR MOUNTED DATA EQUIPMENT RACK

PATCH PANEL	CAPACITY	SERVING	PORTS USED
NO. 1	48 PORTS	GENERAL	PORTS USED
NO. 2	48 PORTS	LIBRARY	PORTS USED
NO. 3	48 PORTS	ADMINISTRATION	PORTS USED
NO. 4	48 PORTS	GENERAL	PORTS USED
FIBER	18 PORT	IDF	18 PORTS
UPS "A"			

SWITCH EQUIPMENT TO BE CONFIGURED AS PER DATA CONNECTION DIAGRAM.

8. THIRTY (30) AMP DEDICATED CIRCUIT SERVICING A QUAD ELECTRICAL RECEPTACLE (NEMA L5 -30R) FOR FLOOR MOUNTED RACKS
9. 2-3" CONDUIT CHASE FROM FLOOR OF ROOM C220. SEE DRAWING IT110.

Telecommunications Rooms should be located so that the total “horizontal” cable length (cross-connect to work station distance total) is no more than 290 feet. At a minimum, there should one TR per floor. Each TR should service the area on that floor. Do not attempt to service multi-floors from one

TR. Telecommunications rooms on multiple floors should be stacked one above the other to provide easier installation of interconnect backbone cable.

Special Case Telecommunications Room

A 48" wall mounted swing data cabinet can function as telecommunications room without the allocation of dedicated space in a distance area of the school with a low-density data and voice port count. When the combined voice and data port counts are equal to or less than 48, a wall mounted data cabinet may be used in such locations as a gym office, back of the stage, or cafeteria office.

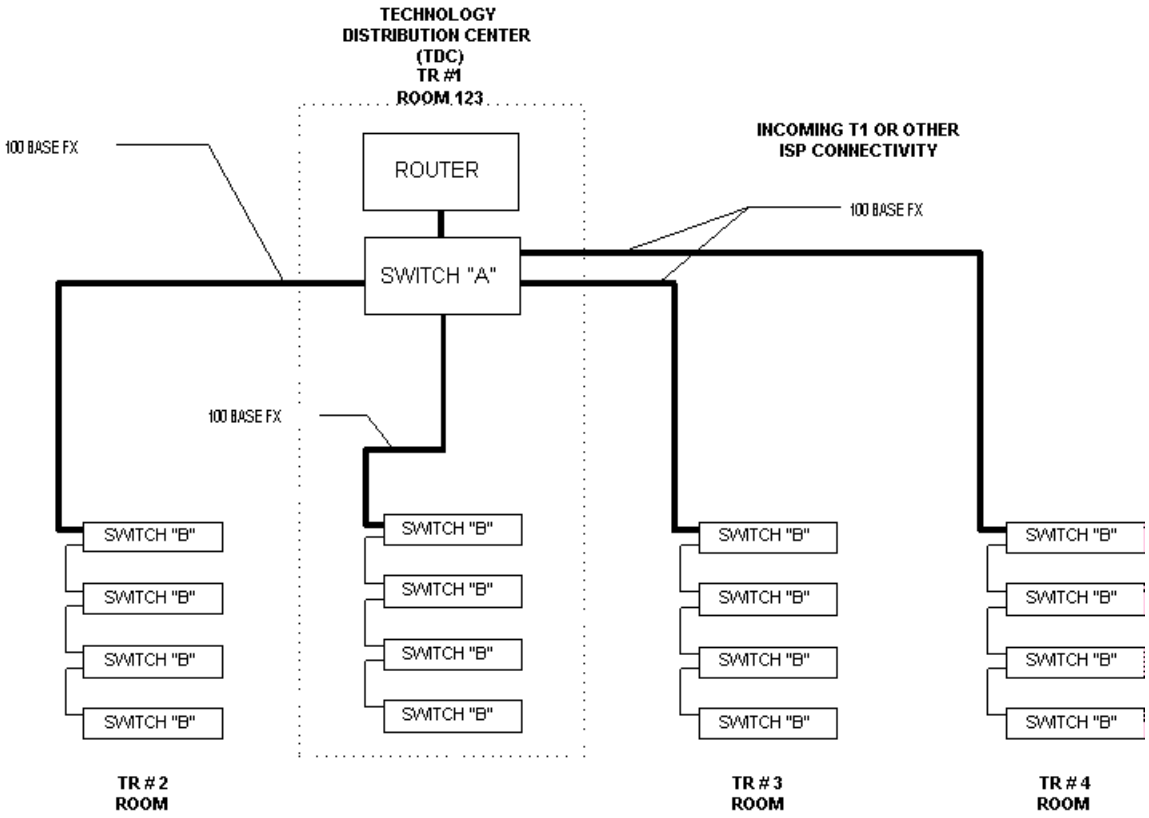
J. Electronic Data Equipment

The educational technology/telecommunications consultant is responsible for the specification and design of the all school-wide data communications equipment in accordance with this document and Division 17000. This responsibility includes (1) specification of the router and/or other equipment necessary to connect a particular school to the DC Wide Area Network, (2) a chassis type switch in the Technology Distribution Center with connectivity via fiber to all Telecommunications Rooms, and stackable switches in Telecommunications Rooms.

In general, the TDC shall contain an appropriately sized chassis type Ethernet switch. TRs, in the traditional MDF/IDF topology, will contain stackable type Ethernet switches. For zoned topology installations, a larger chassis switch with increased fiber connectivity will be required to support fiber runs to individual 24 port stackable switches in classrooms and other learning areas. The educational technology/telecommunications consultant should consult with the Office of the Chief Technology Officer prior to specifying router and switch equipment to ensure that the latest equipment is procured for individual schools. Section 17210, Switches and Routers, contains specification samples of the types of equipment, which might currently be specified into schools opening in August 2002. DCPS desires to maintain continuity of switch equipment with the currently installed base of Cisco equipment for ease of maintenance. Rack elevations for individual telecommunication rooms should identify the number and location of stackable switches without identifying the specific switch.

Specific switches will be specified by the educational technology or telecommunications consultant and procured by the installing contractor approximately four months prior to school opening. Electronic data equipment should be one of the last components installed and tested by the contractor prior to the overall systems acceptance testing.

A Data Connection Diagram, as per the sample below, should be provided on individual school IT drawings with specifications for individual switches included in Division 17000.



"SAMPLE" ELEMENTARY SCHOOL
DATA CONNECTION DIAGRAM

K. Electrical Requirements

It is critical that the architect's Electrical Engineer undertakes an analysis of future power requirements to support technology applications with new, modernized, and retrofit schools. The purpose of these paragraphs are to provide input to the Electrical Engineer design the electrical systems for schools with the understanding that the full responsibility resides with the Electrical Engineer. The analysis should, at a minimum, include the following:

- The total amount of power required for technology

- The condition of power required and supplied
- The electrical grounding situation within the school
- The number and specific location of power receptacles to support technology devices and equipment

The total amount of power required is determined by the summation of the individual power requirements of all the technology systems. Power requirements are usually listed in equipment manufacturers' specifications. The following general guidelines should be used to assist the Electrical Engineer in determining the total power requirements for the building-wide computer network:

Electrical Receptacles

- Each computer will require a minimum of one duplex (2 plugs) power receptacle.
- Quad receptacles are to be adjacent to data/video CNOs in areas where there is only one CNO standing alone. Examples are the "T" CNO in classrooms and "AV" CNO in offices and other similar locations.
- Duplex receptacles are sufficient in areas concentrated by single drop student CNOs. An example would be the computer wall in classrooms or computer labs. However, two duplex receptacles could be paired as one quad receptacle in support of the "D" CNO to save boxes and wall cutting.
- Power receptacles should be located in classrooms, offices, and other spaces within two (2) feet of each Communications Network Outlet. The Engineer should work closely with the Technology Consultant to ensure that the number of duplex and/or quad receptacles is adequate for the number of computer devices to be served from each type of Communications Network Outlets.
- Power receptacle faceplates in classrooms and other spaces dedicated for technology utilization should be clearly identified as such by means of color-coding.
- Power receptacle(s) is (are) required to support all roof mounted antennas. (i.e. the Instructional Television Fixed Services –IFTS - microwave antenna.)

Electrical Circuits

- One twenty (20) amp dedicated circuit is required for every four (4) to six (6) computers, printers or other network devices.
- A computer lab of thirty (30) computers, a file server, several printers, and other equipment will require a minimum of eight (8) dedicated electrical circuits.
- A four to one ratio of computers and other devices to the number of dedicated 20 amp circuits should be used to determine the number of circuits required for other technology spaces such as the media center.
- The current trend to centralize file servers/client server in the Technology Distribution Center (main distribution frame) significantly increases the power requirements of this room. One dedicated 20 amp electrical circuit should be provided in a single quad (four plug) power receptacle for every two file servers. In addition, a dedicated 20 amp electrical circuit serving a quad power receptacle should be provided for each 19" equipment rack containing intelligent switch equipment.
- Uninterrupted Power Supply (UPS) protection for traditional MDF/IDF topologies is provided by rack mounted UPSs in Telecommunication rooms. In Collapsed backbone installations, the electrical engineer should route all wiring serving remote equipment boxes (with local switches) to a separate panel and attached UPS.

Electrical Panels

- Each power receptacle dedicated for technology utilization shall be wired (line, neutral, ground) to a distribution panel dedicated to supplying the needs of telecommunications systems with the ground connection from the outlets to the distribution panel being an insulated wire.
- Transient voltage suppression shall be provided at the main service and at branch circuit panels feeding computer receptacles, as per DCPS Design Guidelines, Chapter 7 (Systems & Materials – Electrical systems), Section A.16 page no. 7600-2.

Raceway

- All electrical wiring serving technology power receptacles shall be placed in conduit or raceways and be installed in accordance with the

National Electrical Code. If surface-mounted raceways such as Wire-Mold are used, the raceway shall only contain power wiring unless there is an approved partition to also permit the installation of communications cables in a separate compartment.

Grounding Infrastructure

The school shall be provided with a telecommunications grounding and bonding infrastructure designed and installed in accordance with the applicable codes and the latest version of ANSI/TIA/EIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications. A telecommunications ground is always required and is typically found in one of the following locations:

- Technology Distribution Center
- Telecommunications entrance facility
- Telecommunications Room

Direct attachment to the closest point in the building's electrical service grounding electrode system is preferred.

The grounding and bonding infrastructure is composed of the major components, as shown in the attached figure.

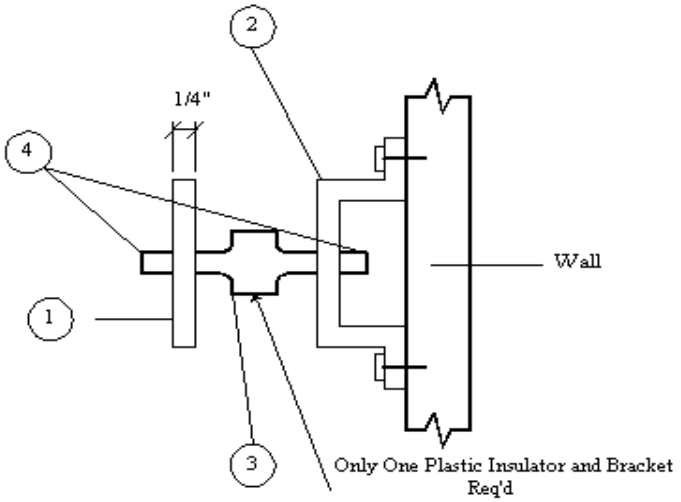
- The bonding conductor interconnects the telecommunications bonding and grounding infrastructure, through the TMGB, to the building service ground. It is recommended that a minimum 6 AWG copper conducted be used and installed in ¾" conduit.

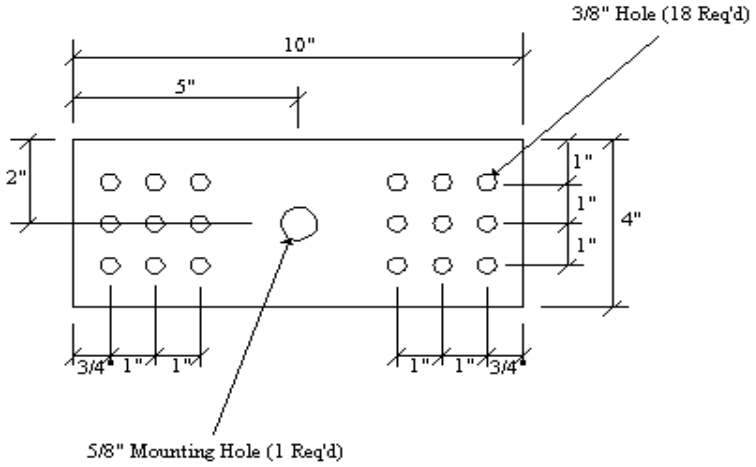
- The Telecommunications Main Grounding Busbar (TMGB) is located in the Technology Distribution Center and services as the termination point Telecommunications Bonding Backbone from Telecommunication Grounding Bars in Telecommunications Rooms.

- A copper Telecommunications Grounding Busbar (TGB) is to be provided in each Telecommunications Room and is connected by the bonding conductor to the TMGB in the TDC.

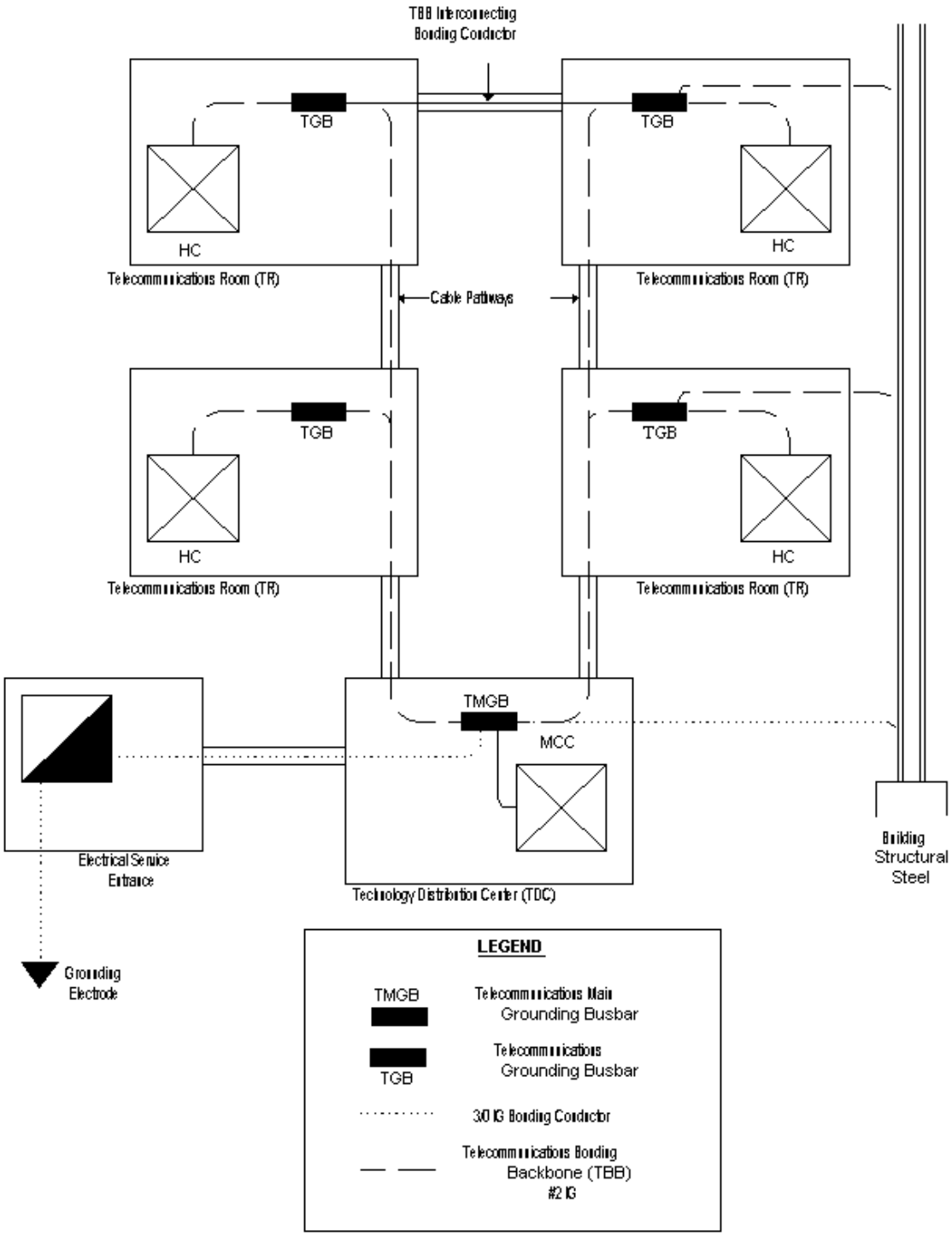
See Telecommunications Grounding Bus Bar Detail on the following page:

Telecommunications Grounding Bus Bar Detail (TMGB and TGB)





Newton Instrument Company Inc., Butner N.C.			
No.	Req'd	Part No.	Description
1	1	1/4" x 4" x 10"	Solid Copper Gnd. Bar
2	1	A-6056	Wall Mtg. Brkt.
3	1	3061-4	Insulators
4	2	3012-1	5/8" - 1 1 x 1" H.H.C.S.


TBB Interconnecting Bonding Conductor
TGB
TGB
HC
HC
Telecommunications Room (TR)
Telecommunications Room (TR)
Cable Pathways
TGB
TGB
HC
HC
Telecommunications Room (TR)
Telecommunications Room (TR)
TMGB
MCC
Electrical Service Entrance
Technology Distribution Center (TDC)
Building Structural Steel
Grounding Electrode
LEGEND
TMGB
Telecommunications Main Grounding Busbar
TGB
Telecommunications Grounding Busbar
3/0 IG Bonding Conductor
Telecommunications Bonding Backbone (TBB) #2 IG

SECTION V
TECHNOLOGY IMPLEMENTATION AND FACILITIES DESIGN GUIDELINES: PRODUCT – EXISTING SCHOOLS

A. Introduction

Purpose

The purpose of these guidelines are to establish standard technical voice, video, and data communications infrastructure designs and installation procedures for building-wide video and computer networks for existing schools in the District of Columbia Public School System for which major renovation or replacement is not scheduled in the next five years. Network specifications are designed to support both the instructional and administrative use of computers within the school. The guidelines are designed to have transportability among schools.

It is anticipated that an electrical upgrade to support technology will be undertaken as part of the building-wide voice, video and data communications infrastructure upgrade. At minimum, if an electrical upgrade is not included, split channel surface mounted raceway should be used to allow for upgrade of electrical service at a later time. The general requirements for electrical requirements to support technology provided in this document are provided for guidelines to the electrical engineer only and should not be thought of as electrical design specifications.

This section is intended to set non-school specific standards for video and data connectivity within existing school buildings. The document will need to be supplemented with individual school-specific design drawings providing specific locations of Communications Network Outlets, cable routing, and wire closet intelligent switch equipment configurations and specifications to communications infrastructure design for each school.

The guidelines and specifications propose a flexible communications network, which accommodates current technologies and provides capacity for future applications growth and technology migration. The recommendations are designed to allow for maximum technical capability within a cost-effective framework and a reasonable facility life.

The technical specifications are designed to assure high quality and consistent network cable and equipment installations for existing educational facilities and should be designed for comparable parity with new school infrastructure design. Standardization of cable, equipment,

and design is important to minimize staff and resource requirements to maintain and modify voice, video and data infrastructures in schools.

It should be noted that the design and specification of cable infrastructures and equipment is an on-going activity not a single event. Consequently, this Section should be reviewed and updated on a regular basis, at minimum every two years and preferably annually.

Scope

This Section is intended to provide the educational technology consultant and/or network designers with the necessary guidelines and requirements for cable pathways, telecommunication room space, and other data infrastructure requirements of the technology components for existing schools. In addition, this Section specifies voice communications cable from wire closet to classrooms and other instructional spaces. The technical specification portion of the document includes data and voice cable recommendations for both Enhanced Category 5 copper and fiber optic horizontal and fiber riser cable; cable raceway systems, telecommunications closet location, size and environmental conditions; network outlet location and type specifications; and telecommunication room intelligent switch and other equipment specifications. The infrastructure is intended to support current topologies 10/100 BASE-T twisted pair Ethernet complying with the Institute of Electrical and Electronic Engineers' (IEEE) 802.3 standards for Ethernet. The 10/100 BASE-T is a star topology, CSMA/CD access method, 10/100 MB/sec, Ethernet network operating on a combination of twisted pair and fiber optic cable.

This Section also addresses the design and specification of broadband video distribution systems and video head-end equipment, but does not include design of: Security alarm, fire, WAN, PA sound systems.

Use

It is anticipated that these guidelines would be used to assist:

- Educational technology consultants and network designers in the design and specification of video and data communications infrastructure installation bid documents for existing schools.

- School district staff and community members understand and plan for the communications infrastructures necessary to support instructional and administrative applications and uses of computers.

- DCPS staff prepare technical specifications and drawings for infrastructure installation bid packages.

Standards

Where these guidelines differ from the reference standards, the guidelines shall take precedence except with the National Electrical Code, which shall dominate. The standard references for the layout and construction of the system shall be as listed below:

- EIA/TIA-568B – Commercial Building Standard for Telecommunications Wiring.
  Electronic Industries Association/
  Telecommunications Industry Association
  2001 Pennsylvania Avenue
  Washington, D.C. 20006.

- EIA/TIA-569 – Commercial Building Standard for Telecommunications Pathways and Spaces.

- EIA/TIA-607 – Commercial Building Grounding/Bonding Requirements.

- EIA/TIA-606 – Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings.

- BICSI-TDM Manuals – Building Industry Consulting Service International- Telecommunications Distribution Methods Manuals.
  BICSI Executive Offices
  University of South Florida
  Tampa, FL 33620-8700.

- ANSI – American National Standards Institute
  ANSI
  1430 Broadway
  New York, NY 10081.

- UL Listed – Underwriter's Laboratories Listed.

- UL Certified – Underwriter's Laboratories LAN Cable Certification Program.

- NEMA – National Electrical Manufacture's Association.

- ANSI: Proposed Fiber Distribution Data Interface (FDDI) Physical Media Documents.
- NFPA 262-1985 National Fire Prevention Association.
- IEEE 802.3 Institute of Electrical and Electronics Engineers LAN Standard for Ethernet.
- IEEE 802.5 Institute of Electrical and Electronics Engineers LAN Standards for Token Ring.
- IEEE 802.11a and 802.11b Institute of Electrical and Electronics Engineers LAN Standards for wireless.

B. Design Procedures and Deliverables

The design of communications infrastructures for existing schools consists of two major phases, site analysis and detail design. These two phases each have a series of tasks that must be performed by educational technology network designer to obtain a complete infrastructure design for the school

The educational technology network designer will create a reproducible set of 1/8" scale drawings of the footprint of each school from current drawings provided by DCPS. The number of drawings provided for each school will vary based upon the type and size. Elementary schools school will typically comprise 1-6 drawings; middle schools 6-9 drawings and high schools may have up to 20 drawings.

Site Analysis

The network designer is to visit each room within the school to:

- Determine, room-by-room, exact CNO count and location using the communications Network Outlet Scheme and CNO Configuration Detail Drawing. The designer will create a school specific CNO matrix in accordance with actual school conditions.
- The CNO matrix must indicate telecommunication room service areas and be entered in Section 17165 School Specific CNO Specifications.
- Determine the number and location of required telecommunication rooms. The minimum size for the Technology Distribution Center is at least 150 square feet and the other Telecommunication rooms

are at least 80 square feet. Areas less than this will need to be designed to allow access to the racks/cabinets and sufficient air circulation for the equipment.

- Provide detailed design of the Technology Distribution Center and all other Telecommunications rooms to include the CNOs within the room, rack/cabinet locations, sleeve locations, wall board and wire support.

- Design the layout of the computer lab for the location of all CNOs.

- Obtain information that would impact the detail design from on-site administrative staff though personal interviews.

Detail Design

The on-site work will provide the information for the designer to complete the design and all Division 17000 documentation:

- Complete remainder of detail design as per the guidelines, specifications and sample product deliverables.

Design Guidelines

In addition to this document, the primary standards to be used to design the school communications infrastructure systems should be:

- The BICSI "Telecommunications Distribution Methods Manual (TDMM)", Ninth Edition, Volumes I and II dated 2000.

Deliverable Products

The technology consultant/telecommunications designer is to produce the following list of deliverable products to document the communications infrastructure for each school:

- **Section 17165 – School Specific CNO Specifications**. This document is to be developed data collected at the site visit and will show (1) actual type and count of CNO locations determined from the site visit, (2) telecommunication room locations and service areas, and (3) summary counts of voice, video, and data connectors per wire closet service area. See sample in Division 17000 standards.

- **Set of 1/8" Scale Voice and Data (IT) School Drawings.** Drawings to be provided both in reproducible prints and electronic (AUTOCAD 14 or later) format and to show all information necessary for installation of the voice and data communications infrastructure. This is to include, but not necessarily be limited to, (1) location, specification and layout of TDC and all TRs, (2) location and identification of all CNOs, including connector ID numbers, (3) chase locations, sleeves and raceway, and (4) drawing reference notes. These drawings may also contain electrical specifications. See electrical design sections of this document.

- **One or more 1/8" Scale Voice and Data (IT) Reference Drawings**. At least one reference drawing shall be the CNO Configuration Details (see attached E-02 and E-03) describing the surface mounted raceway and voice, video and data connector configurations for each type of Communications Network Outlet (CNO). Individual drawing notes should call attention to the few school specific situations where modifications to these standard CNO types and configurations are required. This drawing is in the specification package provided to the design contractor. See attached sample CNO Configuration Detail drawing.

  An additional reference drawing may be required, if space is not available on school drawings, to provide the following items:
  - ¼" scale layouts of TDC and all required TRs
  - Wire closet layout reference notes
  - Voice riser diagram
  - Wire closet interconnect diagram
  - Equipment rack elevations
  - Chase details

- **Set of 1/8" Scale Video (TV) School Drawings.** Drawings to be provided both in reproducible prints and electronic (AUTOCAD 14 or later) format and to show all information necessary for installation of the video communications infrastructure. This is to include, but not necessarily be limited to, (1) video CNO locations, (2) tap locations, drawing reference notes and (3) cable routings.

- **1/8" Scale Video (TV) Reference Drawing.** A reference drawing may be required, if space is not available on school video drawings, to provide the following items:
  - ¼" scale layouts of TDC and all required TRs
  - Schematic elevation of video distribution board

- Typical head end detail
- Wire closet layout reference notes
- Video riser diagram
- Head end equipment rack elevation

- **Technical Specifications-Division 17000**. Written technical specifications are to cover infrastructure installation for all schools in the bid package. All sections of the technical specifications EXCEPT FOR SECTION 17165 (SCHOOL SPECIFIC COMMUNICATION NETWORK OUTLETS) are standard to all bid packages.

C. Communications Network Outlet Requirements

The educational technology consultant or telecommunications designer is to use the following set of definitions and symbols for communications network outlets in classroom, labs and all other school spaces. These symbols should appear on IT drawings and in Section 17165 of Division 17000 specifications.

Communications Network Outlet (CNO) Symbol Scheme and Matrix

S	Student CNO with 4 data jacks
SS	Special design Student CNO with 4 data jacks
TM	Low Teacher and high Monitor CNO in a single piece of surface mounted raceway. Low Teacher has 1 data jack, 1 voice jack and 1 video F/G connector with cable from head-end; and 1 SVHS connector, 2 RCA audio jacks, and 1 RCA jack for video to high Monitor CNO
T	This low Teacher's CNO is a separate surface mounted raceway from the M CNO with the same connector and cable arrangement as indicated for the Teachers CNO in the TM above.
M	This high Monitor CNO is a separate surface mounted raceway from the T CNO with same connector and cable arrangement as indicated for the Teachers CNO in the TM above.
D	Student Double CNO with two (2) data jacks
F	Fiber CNO – 6 strands of multimode fiber terminated in remote equipment box
A	Administrator's CNO with 1 data jack and 1 voice jack
AV	Administrator's CNO with 1 data jack, 1 voice jack, and 1 video F/G connector with cable from head-end
V	Monitor CNO with 1 video F/G connector with cable from

head-end

G Gym CNO with 1 data jack, 1 voice jack, and 1 video F/G connector b with cable from head-end

W Wireless connectivity with 1 data wire terminated in data jack and located within a single gang box attached to the building structure.

The network designer will develop a CNO Matrix for each school using the criteria shown below:

Room Use	CNO Type and Count	Data Total	Voice Total	Video Total
Full Size Classroom	1-TM, 1-S,1-W ,1-F	6	1	2
Full Size Special Education	1-TM, 1-S,1-W, 1-F	6	1	2
Resource Room	1-TM, 1-D, 1-W, 1-F	4	1	2
Speech Room	1-TM, 1-D, 1-W, 1-F	4	1	2
Reading Room	1-TM, 1-D, 1-W, 1-F	4	1	2
Teacher Planning Room	1-AV, 1-A (1-AV for first teacher's desk plus 1-A for each additional teacher's desk. **Estimate** the number of teacher's desks from the size and configuration of the room and apply the above rule.)			
Conference Room	1-AV, W*	1	1	1
Art & Music Rooms	1-TM, 1-S,1-W, 1-F	6	1	2
Music Practice Room	1-D, W*	1	0	0
Science Labs	1-TM, 9-D, 1-W, 1-F	20	1	2
Computer Lab	1-TM, up to 16-D, 1-W, 1-F	34	1	2
Principals Office	1-AV, W*	1	1	1
Assistant Principals Office	1-AV, W*	1	1	1
Other offices	1-AV, W* (See note for Teacher Planning Room)			
General Office Room	2-A, 1-V, W*	2	2	1
Lobby	1-V, W*	0	0	1
Health Exam Room	1-A, W*	1	1	0
Teacher's Dinning/Lounge	1-AV, W*	1	1	1
Media Center (library) – Elementary	1-TM for presentation area 1-A & 1-D in/at circulation desk, 1-W 8 data drops in some combination of "S" and/or "D" CNOs, 1-F	13	2	2
Media Center (library) – Middle	1-TM for presentation area 1-A & 1-D in/at circulation desk, 1-W 12 data drops in some combination of "S" and/or "D" CNOs, 1-F	17	2	2

Media Center (library) – Senior	1-TM for presentation area 1-A & 1-D in/at circulation desk, 1-W 16 data drops in some combination of "S" and/or "D" CNOs, 1-F	21	2	2
Media Center Workroom	1-AV, 1-D, W*	3	1	
Gymnasium	1-G, 1-W, 1-F	1	1	1
Cafeteria	1-AV, 1-W, 1-F	1	1	1
Food Service Office	1-AV, W*	1	1	1
Serving area	2-D, W*	2	0	0
Stage – Elementary/middle	1-AV, 1-W, 1-F	1	1	1
Stage – Senior	2-AV, 1-W,1-F	2	2	2
Storage Room > 100 Square Feet	1-A, W*	1	1	0
Boiler Room	1-A	1	1	0
Technology Distribution Center	1-A, 1-SS, W*	5	1	0
Telecommunications Room	1-A, W*	1	1	0
Total		Sum	Sum	Sum

* Wireless connectivity to be provided from nearby Access Point.

Criteria for Teacher Station and Video Projection System Design

The video projection system to be located at the teaching station is designed to provide the following capabilities:

- Projection of the teacher's computer workstation display screen to the high mounted wall TV monitor for large or small group presentation.
- Connection of the teachers computer workstation to the building wide network.
- Projection of output from a cart mounted VCR to the high TV monitor.
- Reception on the high wall mounted TV monitor of video from the video distribution system, from either local school origination or cable provider.
- Video origination (broadcast) from the low video connector.
- See CNO Configuration Detail drawings at end of this Section for detail of CNO faceplate configurations.

The TM CNO should be located either on the window side of the front classroom wall or in the center of the front wall. If a single vertical piece of

surface mounted raceway is not appropriate to the classroom environment, the teachers CNO ("T") is to be located at 18" A.F.F. in close proximity to the "M" CNO.

D. Typical Learning Area Layouts

Typical Classroom Layouts

The typical full sized regular or special education classroom is to receive four student data connectors in addition to the teacher's presentation area. Typically an "S" CNO is located along a back or sidewall that has space for four computers, i.e. 12' of clear wall space. The provision for wireless connectivity in classrooms and throughout the building will be to provided by an additional data connection in the ceiling. See the CNO Configuration Detail on drawings E-02 & E-03 for detail specifications for the student "S" and wireless "W" CNOs.

Several alternative layouts are suggested where sufficient open wall space doesn't exist in a classroom:

- Two "D" double CNOs can be used if two separate locations of clear 6' wall space are available.
- In some classrooms with folding walls a "SS" CNO can be used in a corner to service computers on 6' tables.
- As a last resort, a telecommunications power pole can be used to service a learning center not located along a classroom wall.

Media Center Configurations

The location of CNOs in the media centers is to be designed to service three separate functions; a teacher's presentation area, the circulation desk, and a research/reference area for student use.

- The teacher's presentation area shall consist of a "TM" CNO similarly located as in regular classrooms. The area is to provide for presentation to a class of students visiting the media center.
- Three data and one-voice connectors should be located in the vicinity of the circulation desk. Typically, a "A" and "D" CNO is located near the circulation desk via vertical surface mounted raceway, tele-communications power pole, or installed within an existing circulation desk with surface mounted device boxes and flexible conduit.

- Student research/reference stations
  - Elementary schools are to receive up to 8 data connectors,
  - Middle schools are to receive up to 12 data connectors, and
  - High schools are to receive up to 16 data connectors.
  - Data connectors can be multiple combinations/clusters of 4-6 student drops using “SS”, “S”, or “D” CNOs depending on the existing layout of the media center.

Computer Lab Configurations

The location of CNOs in the computer lab are to be designed to service three separate functions; a teacher’s presentation area, printer stations, and individual student workstations.

- The teacher’s presentation area shall consist of a “TM” CNO similarly located as in regular classrooms.

- Depending on the size of the computer lab, a location should be identified that will accommodate 2-4 networked printers. This can be accomplished by locating 1-2 “D” CNOs separate from student workstations or by inter-spacing a series of extra “D” CNOs among student workstations.

- The typical computer lab should accommodate 24-30 student workstations depending on the size and layout of the room available. In most schools, a regular sized classroom has been converted to a computer lab and creates specific size limitations, which dictate the layout of the lab.

The first consideration in planning the layout of a computer lab is determining the intended function and operation of the lab. The configuration of the lab should be as flexible as possible and based upon whether it is to be used as a student-directed activity area, for teacher-directed instruction or a combination of the two. Teacher directed labs may be configured in a conventional classroom row type seating arrangement. However, the changing role of the teacher should make this layout the least desirable. A combination teacher-directed and student-directed lab layout might have computer lined around three sides of the perimeter of the room with work tables in the center. A computer lab designed for student activities should have a series of island computer tables where either individual or small groups/teams of students can work together on projects.

Consideration should be given to the following items in the design of computer labs:

- Strive to minimize the number of students who must rotate more than 90 degrees to observe the group presentation at the teacher's multi-media station.
- Strive for sight lines that allow a teacher to observe all monitors from one location in the lab.
- Ease of the teacher's movement around the lab.
- A student's line of sight to the large group presentation area, i.e. through telecommunications power poles.
- Level of satisfaction with the current lab layout. Implement the existing lab configuration if satisfactory.
- Replacement of existing LAN cable if not enhanced Category 5 and/or networked within the lab. Existing network cable should remain operational until DCPS final acceptance of the new communications infrastructure and the lab has been switched over to the new cable plant.
- Extensive modification of existing casework, cabinets, bookshelves, and unit ventilators should be avoided.
- Although some schools will have existing custom designed computer furniture; most will utilize existing or new 6' tables for the computer lab.

The layout of the computer lab will dictate one or more of the following methods of routing cables to CNOs.

- Split channel surface mounted raceway installed horizontally at counter top height around the perimeter of the lab.
- Split channel surface mounted raceway installed horizontally back-to-back across the top of a series of two wide 6' tables projecting from a wall in a peninsula fashion or an island table and serviced from tale-communications power poles.
- Telecommunications power poles serving an island table(s).

- "SS" or "D" CNOs installed in surface mounted device boxes attached to the underside of 6' tables and serviced via 1" flexible conduit and tele-communication power poles. Tables will be fastened securely to the floor.

- The provision for wireless connectivity is to be provided by an additional data connection in the ceiling.

Science Lab Configurations

The location of CNOs in science labs is to be designed to service three separate functions; a teacher's presentation area, a data analysis/printer station, and 6-8 student lab stations.

- The teacher's presentation area shall consist of a "TM" CNO similarly located as in regular classrooms.

- Depending on the size of the science lab, a location should be identified that will accommodate 2-4 networked workstations and/or printers. This is to be a location where students could go to have access to a computer for data analysis and report generation. This can be accomplished by locating 1-2 "D" CNOs separate from student lab stations.

- The typical science lab layout should accommodate 6-8 4-person lab stations depending on the size and layout of the room available. Two computer drops should service each lab station of four students.

The layout of the science lab will dictate one or more of the following methods of routing cables to CNOs.

- Split channel surface mounted raceway installed horizontally at counter top height around the perimeter of the lab.

- Split channel surface mounted raceway installed vertically to individual "D" CNOs.

- Telecommunications power poles serving an island table(s).

- "SS" or "D" CNOs installed in surface mounted device boxes attached to the underside of 6' tables and serviced via 1" flexible conduit and tele-communication power poles.

- The provision for wireless connectivity is to be provided by an additional data connection in the ceiling.

Administrative Office Layouts

Administrative, support and teacher planning offices are to receive an "AV" CNO for the first occupant and an "A" CNO for each additional occupant. This will place one low wall-mounted video outlet in each office and one voice and one data outlet for each occupant.

The provision for wireless connectivity in administrative space is to be provided by an addition 1-"W" CNO every 60' in space above corridor ceilings.

E. Data Infrastructure Topology Design

The data infrastructure topology for each school is that it be hard-wired with specific numbers of teacher and student drops in learning areas, as defined in Paragraph C of this section, and have building-wide wireless connectivity. In addition, each learning area will be provided with six strands of "dark" multimode fiber from the TR for future use.

The traditional MDF/IDF topology will be utilized in all technology retrofits of existing schools. The central point in the traditional topology is the Technology Distribution Center (TDC) in or adjacent to the media center. Housed within the room are the racks, cabinets, wallboards, termination equipment, and other equipment necessary to provide connectivity to/from the outside world. The TDC also provides service to all data and voice communication network outlets within a 290-foot radius through Category 5e copper UTP cables. Unfortunately, the size of most schools causes cable lengths to extend this maximum distance, necessitating one or more additional telecommunication rooms at strategic locations throughout the school. The purpose of these additional TRs is to reach any workstation within the school by copper cable runs of less than 290 feet. To allow for data to be quickly and efficiently passed between any two points in the network, the telecommunication rooms are connected back to the MDF by 12-strand multimode fiber optic cables, in a "Star" configuration.

F. Video Infrastructure Topology Design

General Description

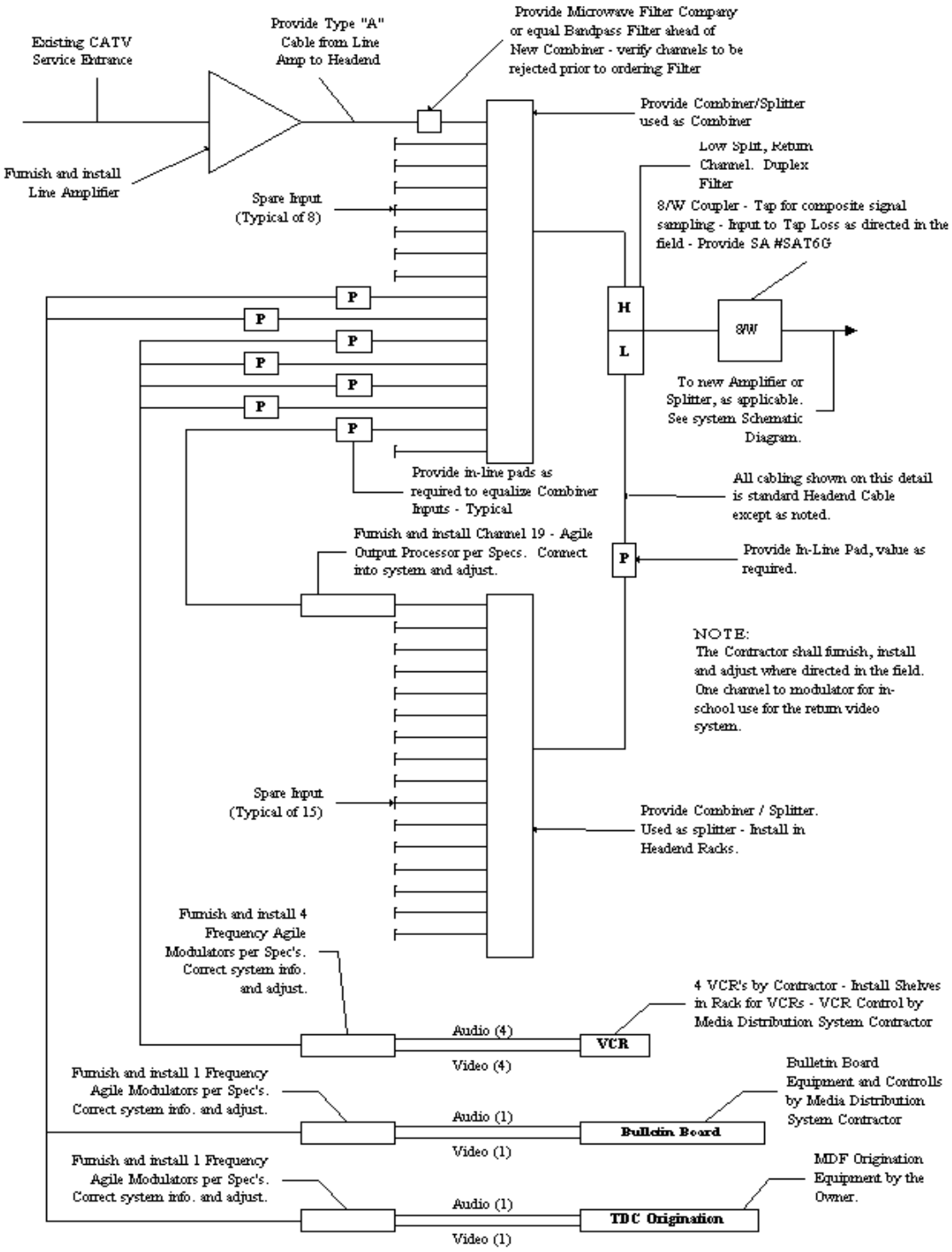
The broadband coaxial video distribution system shall operate over the 5 to 750 MHz range with a sub-split spectrum. The network design shall use 1000 MHz CATV equipment and installation techniques. The network design shall permit simultaneous transmission of data, audio and video information. All communications circuits shall be full duplex without the use of multiple cables. All devices attached to the network will be considered "drops", except the devices will send information in the "reverse" direction to the head-end and receive information in the "forward" direction from the head-end. Teacher presentation will be to either a high/low mounted video monitor or to a ceiling/table mounted digital projector.

Headend Equipment

Video headend equipment is to be installed in the Technology Distribution Center located in or adjacent to the media center with only necessary amplifiers located in telecommunication rooms. The premises video system shall be capable of receiving multiple video programming signals from a variety of outside sources at the TDC and distributing these signals on multiple broadband channels to each video outlet in the school. Outside programming sources may include cable television (CATV) from the local provider, master antenna television 9MATV), satellite downlink (C and/or KU-band), microwave and/or instructional television fixed service (ITFS) depending on available service.

The video system shall also have the capability of distributing local programming generated on-site from centralized sources such as VCR's, laserdisc, DVD's, computers, video cameras or video file servers. However, it is anticipated that each learning area will be equipped with a 27-30" video monitor and separate VCR.

The typical video headend depicted below for an elementary school is provided not as recommended design but rather as a representative generic design and an example of the required specificity and detail of the design.



TYPICAL ELEMENTARY SCHOOL VIDEO HEADEND DETAIL
NOT TO SCALE

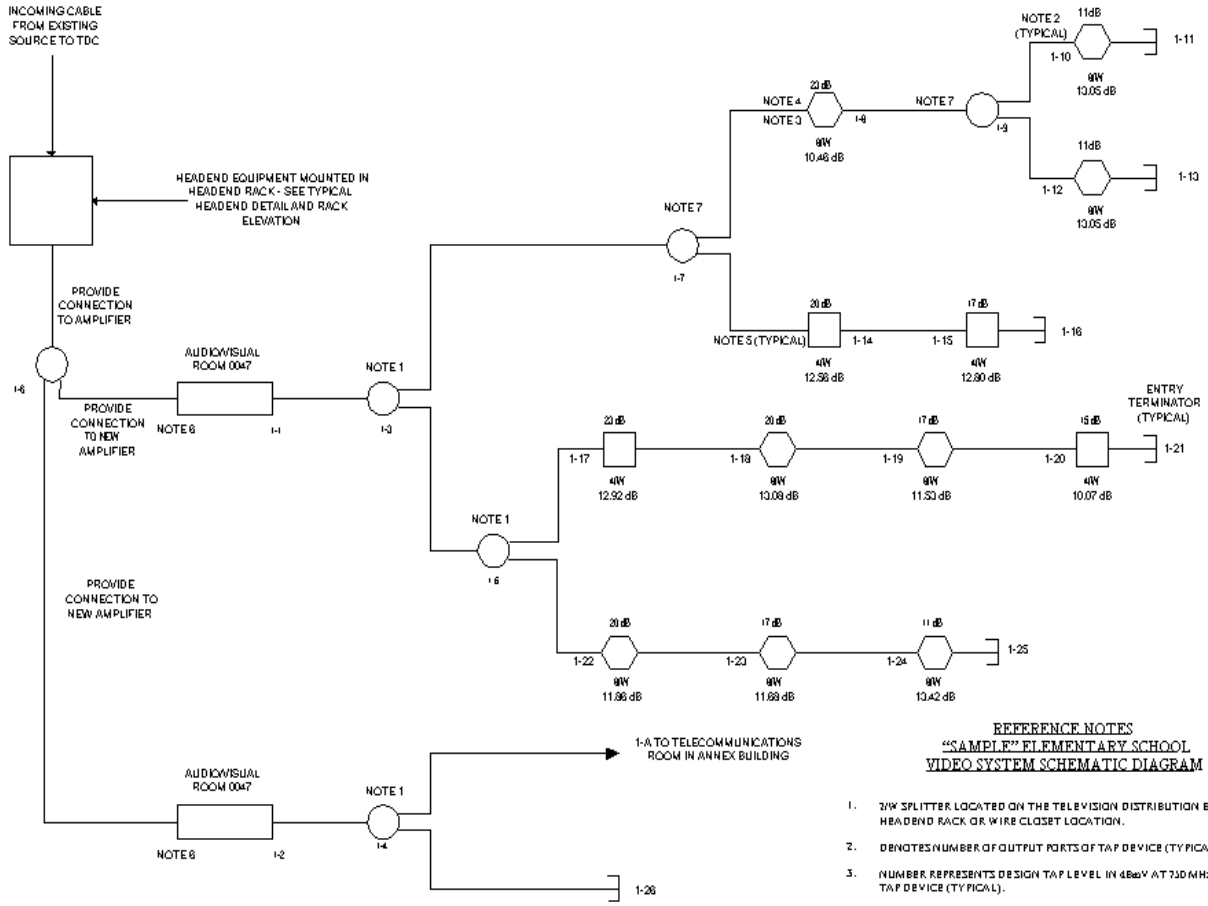
Cable Plant

Most building-wide video distribution is implemented over either coaxial or UTP cable infrastructures.

At this time, coaxial systems are the most common and typically the most cost-effective implementation and that recommended for DCPS. Coax based cable distribution systems are based on time-proven technology and, properly designed and installed, can provide reliable long-term service. The two types of coax cable plant designs are tap and drop and home-run systems. The home-run model provides video coax cable runs from CNOs to nearest TDC/TR while the tap and drop provides taps in corridors connected by video trunk cable and horizontal coax cables routed from the tap to CNOs. The recommend coax cable plant design for DCPS is the tap and drop system utilizing RG-6 horizontal cable from taps to classrooms etc. and trunk coax cable as appropriate and defined in Division 17000. The video cable plant can utilize the same cable trays and other low voltage pathways as voice and data cabling.

UTP video distribution systems are now available and are undergoing rapid improvement. They typically involve a star-wired topology utilizing Category 5e wiring, have a “plug and play” ease of installation and use, are very easy to modify and troubleshoot, and promise a large bandwidth capability. However, at this time, the most successful systems tend to use proprietary equipment and standards and are not recommended by DCPS. Such systems require pre-design approval by the Office of the Chief Technology Officer prior to consideration.

The video system schematic diagram depicted below is provided not as recommended design but rather as a representative generic design and an example of the required specificity and detail of the design.

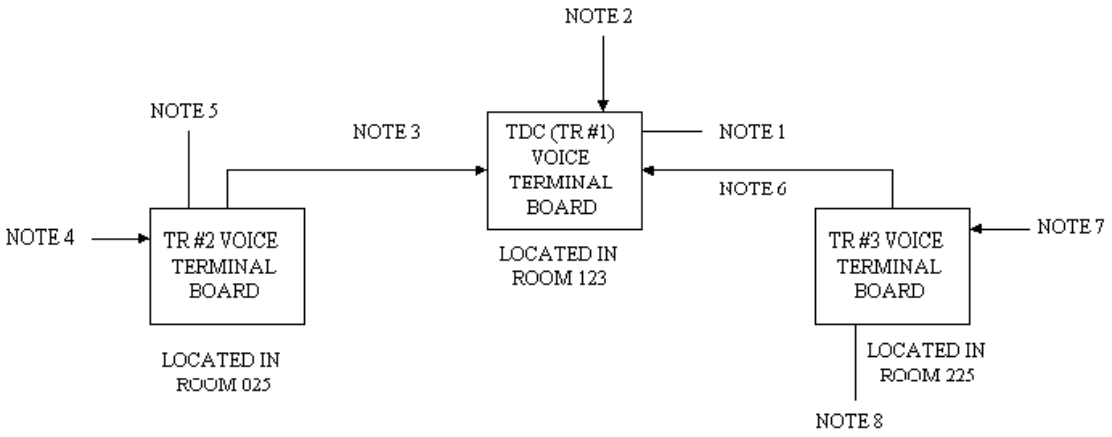


REFERENCE NOTES
"SAMPLE" ELEMENTARY SCHOOL
VIDEO SYSTEM SCHEMATIC DIAGRAM

1. 2W SPLITTER LOCATED ON THE TELEVISION DISTRIBUTION BOARD AT THE HEADEND RACK OR WIRE CLOSET LOCATION.
2. DENOTES NUMBER OF OUTPUT PORTS OF TAP DEVICE (TYPICAL).
3. NUMBER REPRESENTS DESIGN TAP LEVEL IN dBmV AT 750 MHz AT ALL PORTS OF TAP DEVICE (TYPICAL).
4. NUMBERS ABOVE 2W, 4W AND 7W TAPS DENOTE NOMINAL TAP LOSS TO ALL PORTS OF TAP DEVICE (TYPICAL).
5. NUMBERS ADJACENT TO ITEMS OF EQUIPMENT CORRESPOND TO NUMBERS ON FLOOR PLANS ADJACENT TO SAME ITEMS OF EQUIPMENT.
6. NEW BIDIRECTIONAL AMPLIFIER-MOUNT AT HEADEND-SEE SPECIFICATIONS - OUTPUT LEVELS TO BE 47 dB at 750 MHz AND 41 dB AT 130 MHz.
7. 2W SPLITTER LOCATED IN THE ACCESSIBLE CEILING SPACE.

G. Voice Infrastructure Topology Design

The voice cable plant will consist of Category 5e horizontal cable from the phone jack in the CNO to with TR and the appropriate number of Category 3 tie cables from the TR to the TDC as per sample voice riser diagram provided below:



"SAMPLE " ELEMENTARY SCHOOL
VOICE RISER DIAGRAM
NO SCALE

VOICE RISER DIAGRAM NOTES:

1. 4' WIDE BY 8' HIGH PLYWOOD SHEET FURNISHED AND INSTALLED UNDER THIS CONTRACT AND BOLTED TO WALL. ALL HORIZONTAL AND TIE CABLES ENTERING THIS TELECOMMUNICATIONS ROOM TO BE TERMINATED IN 110 BLOCKS MOUNTED ON THIS BOARD.
2. ENHANCE D CATEGORY 5 CABLES FROM VOICE OUTLETS IN TELECOMMMUNICATIONS ROOM SERVICE AREA.
3. 25 PAIR CATEGORY 3 VOICE TIE CABLES FROM EXISTING IDF #1 VOICE TERMINAL BOARD TO TDC. TERMINATE ON 110 BLOCKS AT BOTH ENDS.
4. ENHANCED CATEGORY 5 CABLES FROM VOICE OUTLETS IN TELECOMMUNICATIONS ROOM SERVICE AREA.
5. 4' WIDE BY 8' HIGH PLYWOOD SHEET FURNISHED AND INSTALLED UNDER THIS CONTRACT AND BOLTED TO WALL. ALL HORIZONTAL AND TIE CABLES ENTERING THIS TELECOMMUNICATIONS ROOM TO BE TERMINATED IN 110 BLOCKS MOUNTED ON THIS BOA RD.
6. 25 PAIR CATEGORY 3 VOICE TIE CABLES FROM EXISTING IDF #2 VOICE TERMINAL BOARD TO TDC. TERMINATE ON 110 BLOCKS AT BOTH ENDS.
7. ENHANCED CATEGORY 5 CABLES FROM VOICE OUTLETS IN TELECOMMUNICATIONS ROOM SERVICE AREA.
8. 4' WIDE BY 8' HIGH PLYWOOD SHEET FURNI SHED AND INSTALLED UNDER THIS CONTRACT AND BOLTED TO WALL. ALL HORIZONTAL AND TIE CABLES ENTERING THIS TELECOMMUNICATIONS ROOM TO BE TERMINATED IN 110 BLOCKS MOUNTED ON THIS BOARD.

H. Telecommunications Pathways

This section addresses the specific requirements, codes, and standards concerning telecommunication pathways. Pathways are used to distribute and support horizontal and backbone voice, video and data cable and connecting hardware between the work area outlet and the telecommunications closet. These pathways and spaces represent the routing and are the "container" for the horizontal and backbone cabling.

Horizontal Pathways

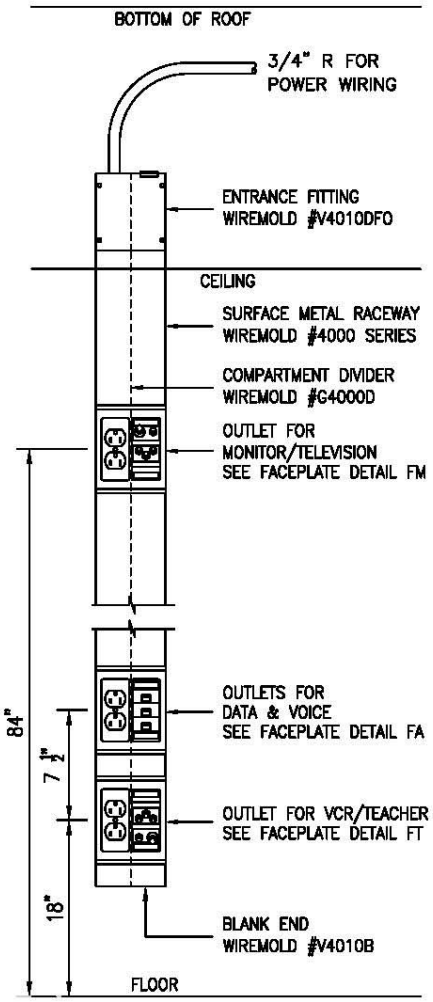
Horizontal pathway systems consist of structures that conceal, protect, support and provide access to horizontal cables, which transport telecommunication signals, between the telecommunications outlet/connector in the work area and the horizontal cross-connect in the telecommunications closet. The horizontal pathway system must be designed to handle all types of telecommunications – low voltage – voice, video and data cable. The following considerations must be given to the design of horizontal pathways:

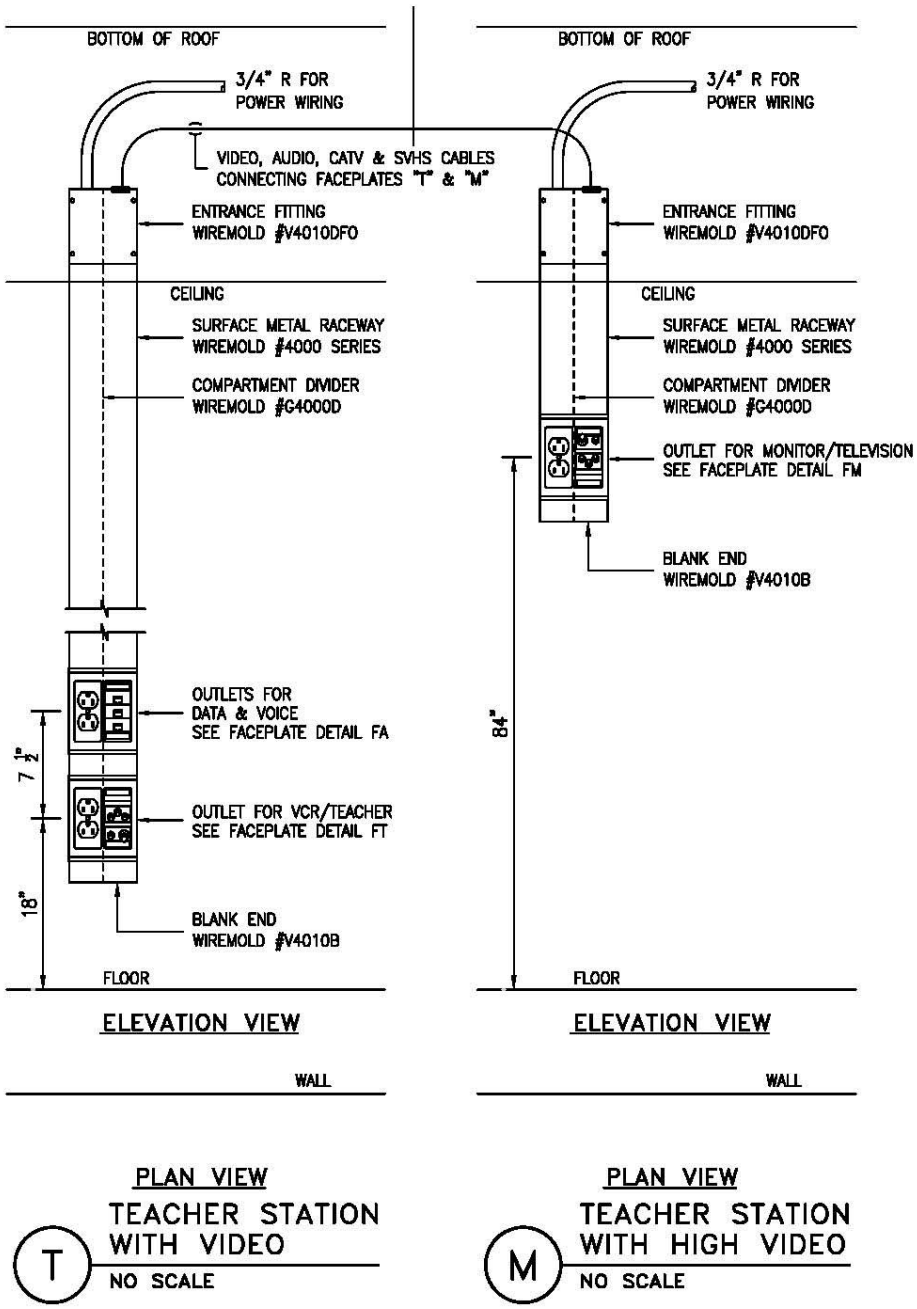
- Design to meet current cable counts and allow for growth.
- Conduit or other enclosed pathways such as surface mounted raceways or telecommunications poles are to be provided from all CNOs to the space above suspended ceilings in room or corridor.
- Conduit or other enclosed pathways are to be used in all spaces without suspended ceilings and areas required by applicable electrical codes.
- Conduit will be sized not to exceed data listed in Table 4.4-1 of the ANSI/EIA/TIA Standard or Table 4.10 of the 2000 BICSI TDM Manual.
- Conduit pathways shall meet all standards of Chapter 4, Section 1 of the 2000 BICSI TDM Manual.

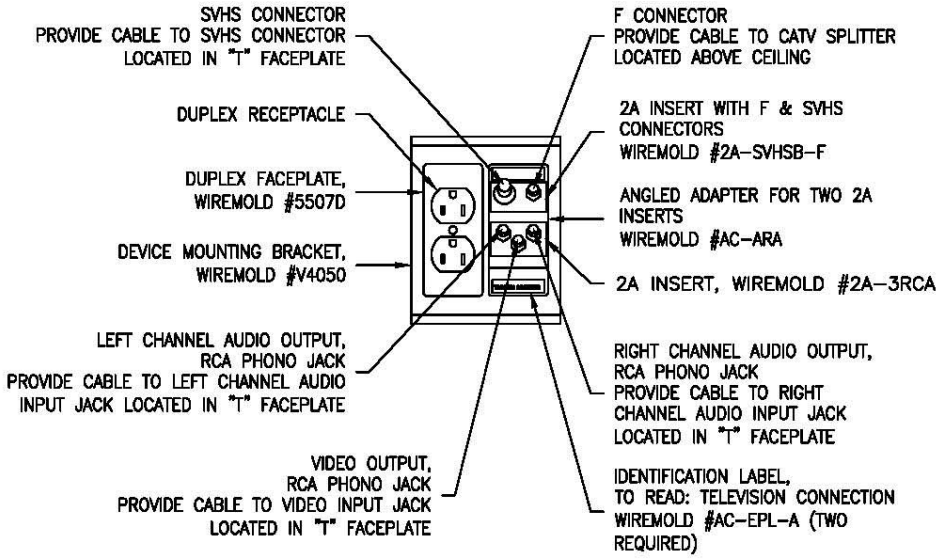
<u>Surface Mounted Raceway</u>

Surface mounted raceway for use with voice and data and electrical wiring shall be split channel Wiremold 4000 Base and Cover ivory finish. The Wiremold 4000 B & C system shall be furnished and installed complete,

including all required couplings, bushings, support clips, straps, connection covers, ground clamps, elbows, tees, box connectors, conduit connectors etc., as required for a complete installation. See the following CNO Configuration Detail drawings for detailed specifications on split channel raceway.

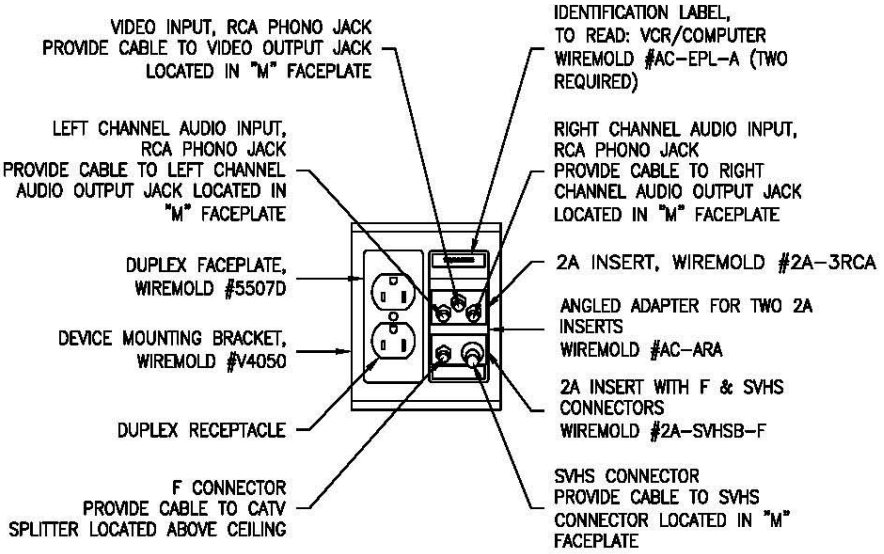

BOTTOM OF ROOF
3/4" R FOR
POWER WIRING
ENTRANCE FITTING
WIREMOLD #V4010DFO
CEILING
SURFACE METAL RACEWAY
WIREMOLD #4000 SERIES
COMPARTMENT DIVIDER
WIREMOLD #G4000D
OUTLET FOR
MONITOR/TELEVISION
SEE FACEPLATE DETAIL FM
84"
7 1/2"
18"
OUTLETS FOR
DATA & VOICE
SEE FACEPLATE DETAIL FA
OUTLET FOR VCR/TEACHER
SEE FACEPLATE DETAIL FT
BLANK END
WIREMOLD #V4010B
FLOOR
ELEVATION VIEW
WALL
PLAN VIEW
TEACHER STATION
WITH VIDEO
TM
NO SCALE


BOTTOM OF ROOF
3/4" R FOR POWER WIRING
VIDEO, AUDIO, CATV & SVHS CABLES CONNECTING FACEPLATES "T" & "M"
ENTRANCE FITTING WIREMOLD #V4010DFO
CEILING
SURFACE METAL RACEWAY WIREMOLD #4000 SERIES
COMPARTMENT DIVIDER WIREMOLD #C4000D
OUTLETS FOR DATA & VOICE SEE FACEPLATE DETAIL FA
7 1/2"
OUTLET FOR VCR/TEACHER SEE FACEPLATE DETAIL FT
18"
BLANK END WIREMOLD #V4010B
FLOOR
ELEVATION VIEW
WALL
PLAN VIEW
T
TEACHER STATION WITH VIDEO
NO SCALE
BOTTOM OF ROOF
3/4" R FOR POWER WIRING
ENTRANCE FITTING WIREMOLD #V4010DFO
CEILING
SURFACE METAL RACEWAY WIREMOLD #4000 SERIES
COMPARTMENT DIVIDER WIREMOLD #C4000D
OUTLET FOR MONITOR/TELEVISION SEE FACEPLATE DETAIL FM
BLANK END WIREMOLD #V4010B
84"
FLOOR
ELEVATION VIEW
WALL
PLAN VIEW
M
TEACHER STATION WITH HIGH VIDEO
NO SCALE



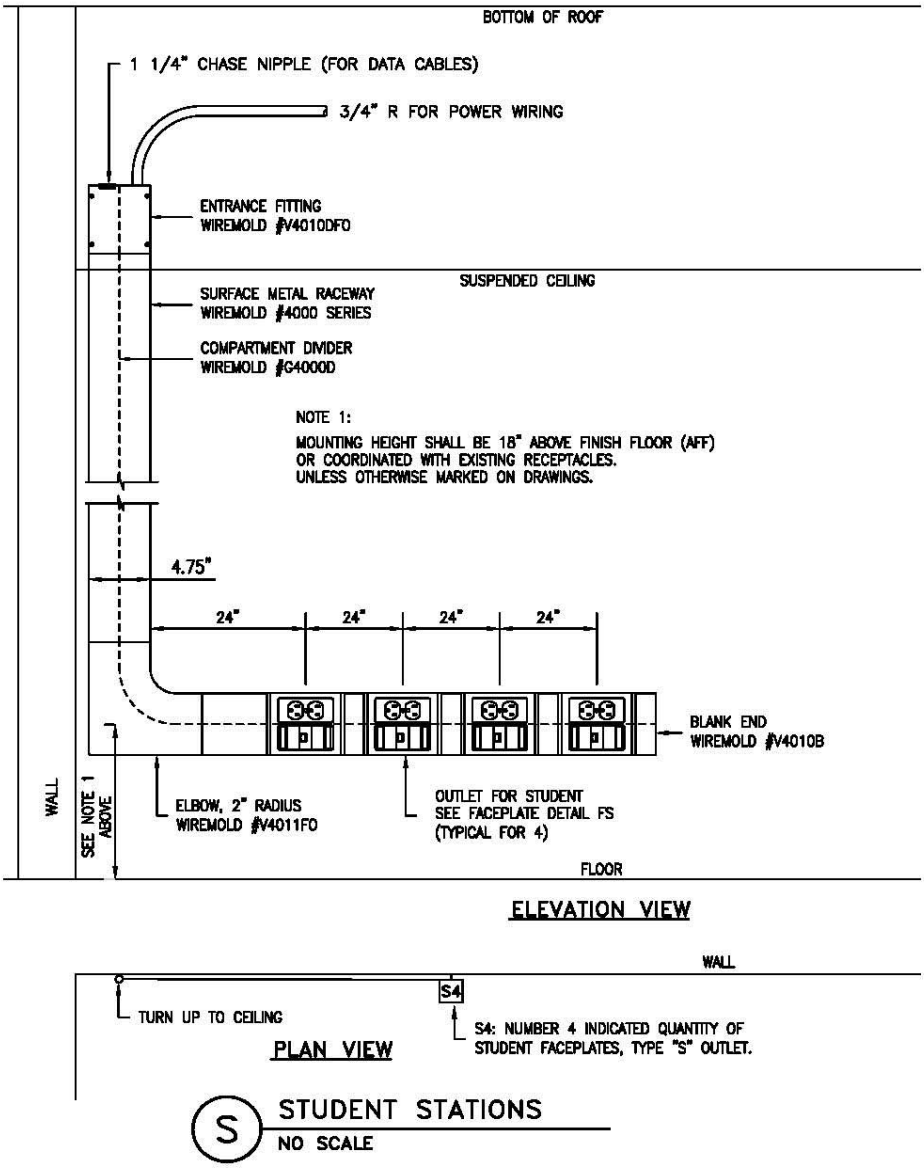
FM MONITOR/VIDEO FACEPLATE – TYPE "M" OUTLET

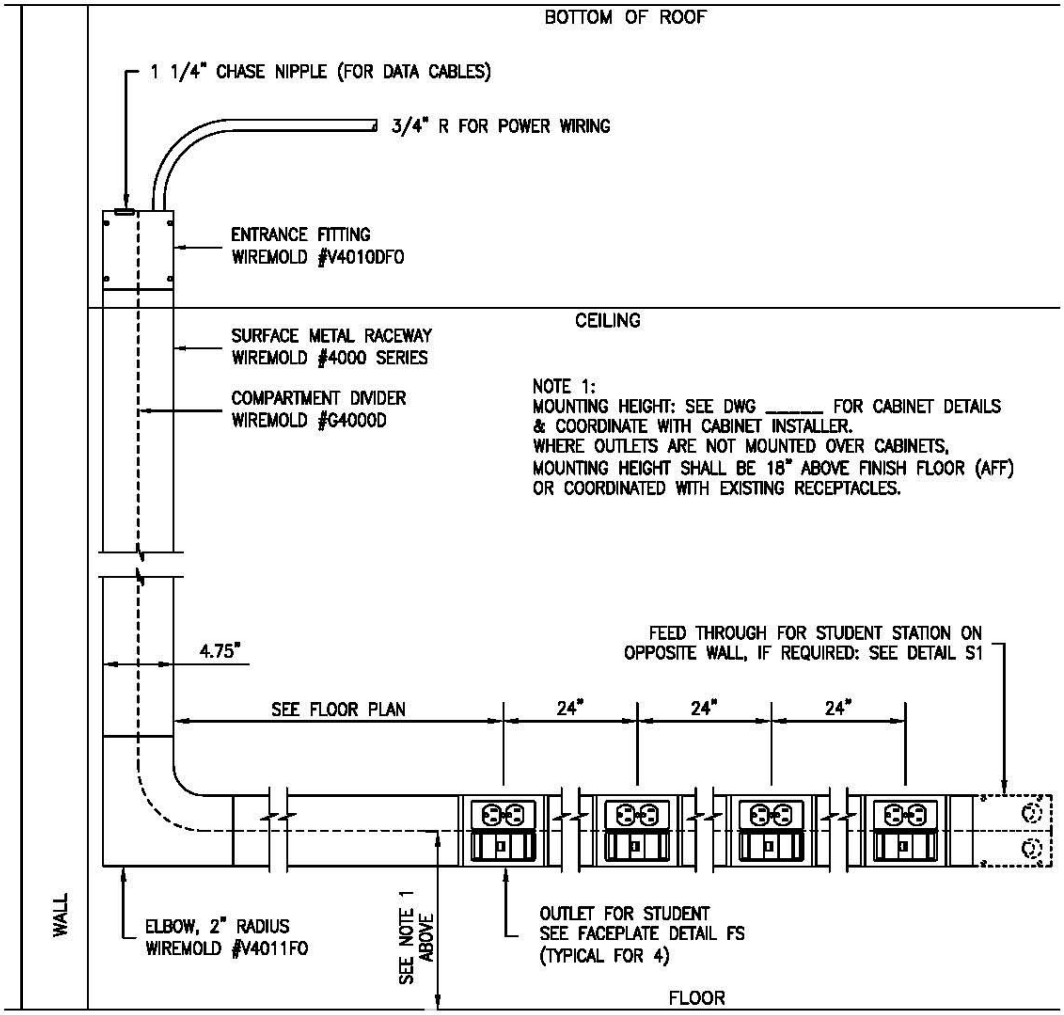
NO SCALE
DETAIL



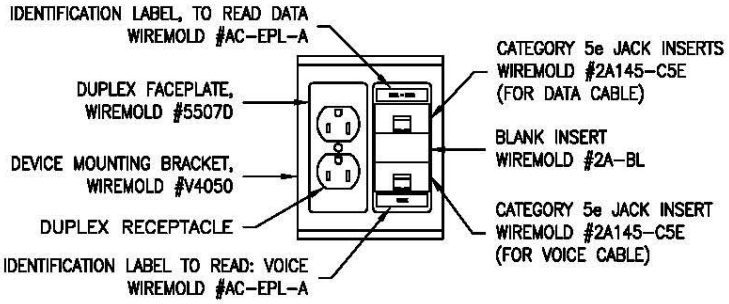
FT TEACHER/VCR FACEPLATE – TYPE "T" OUTLET

NO SCALE
DETAIL

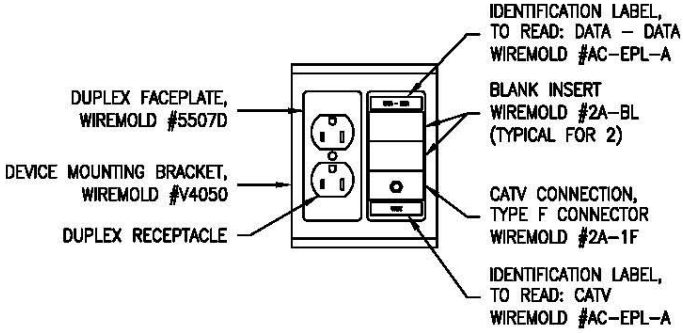

BOTTOM OF ROOF
1 1/4" CHASE NIPPLE (FOR DATA CABLES)
3/4" R FOR POWER WIRING
ENTRANCE FITTING
WIREMOLD #V4010DFO
SUSPENDED CEILING
SURFACE METAL RACEWAY
WIREMOLD #4000 SERIES
COMPARTMENT DIVIDER
WIREMOLD #G4000D
NOTE 1:
MOUNTING HEIGHT SHALL BE 18" ABOVE FINISH FLOOR (AFF)
OR COORDINATED WITH EXISTING RECEPTACLES.
UNLESS OTHERWISE MARKED ON DRAWINGS.
4.75"
24"
24"
24"
24"
BLANK END
WIREMOLD #V4010B
WALL
SEE NOTE 1
ABOVE
ELBOW, 2" RADIUS
WIREMOLD #V4011FO
OUTLET FOR STUDENT
SEE FACEPLATE DETAIL FS
(TYPICAL FOR 4)
FLOOR
ELEVATION VIEW
WALL
S4
TURN UP TO CEILING
S4: NUMBER 4 INDICATED QUANTITY OF
STUDENT FACEPLATES, TYPE "S" OUTLET.
PLAN VIEW
S
STUDENT STATIONS
NO SCALE



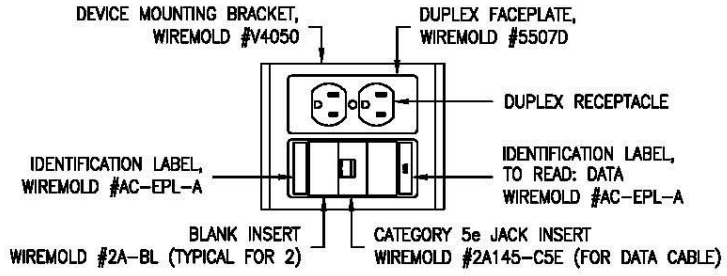
SS STUDENT STATION THROUGH WALL
NO SCALE



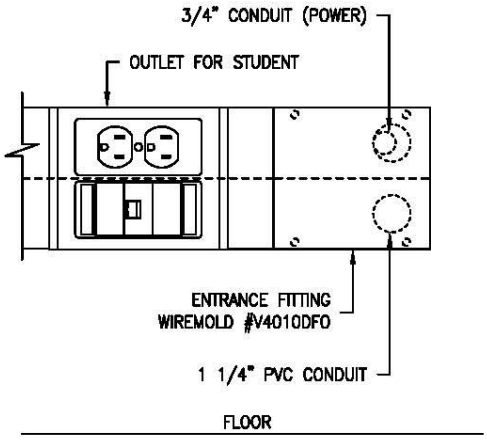
FA DATA/VOICE FACEPLATE – TYPE "A" OUTLET
NO SCALE
DETAIL



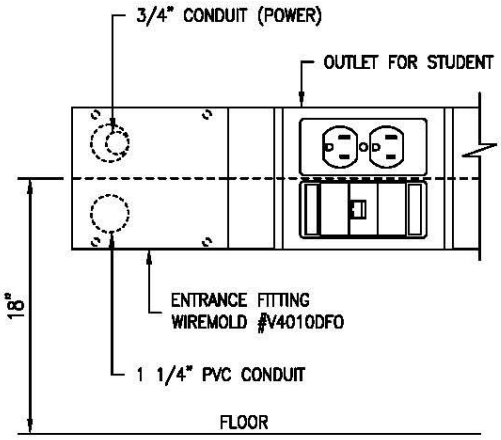
FV VIDEO FACEPLATE – TYPE "V" OUTLET
NO SCALE
DETAIL



FS STUDENT FACEPLATE – TYPE "S" OUTLET
NO SCALE
DETAIL

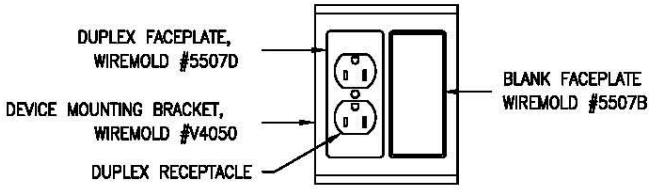


STUDENT STATIONS WITH
ACCESS TO CEILING

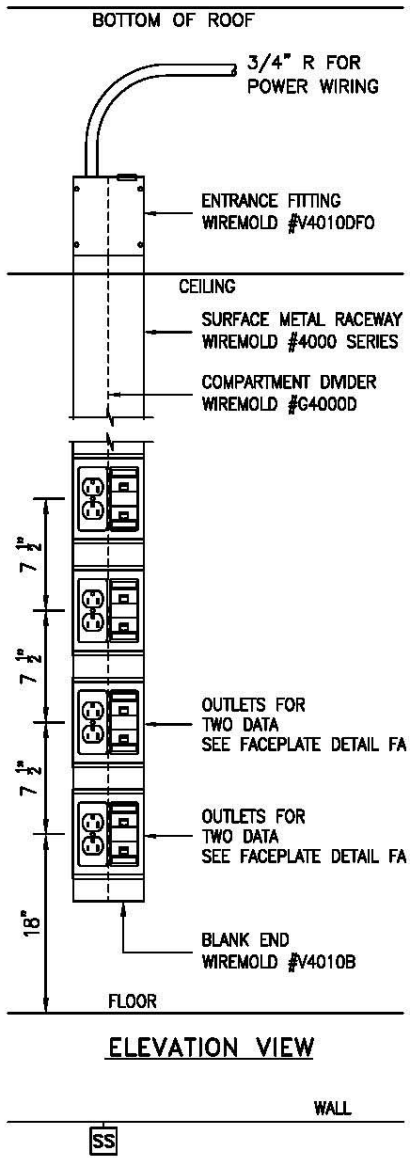


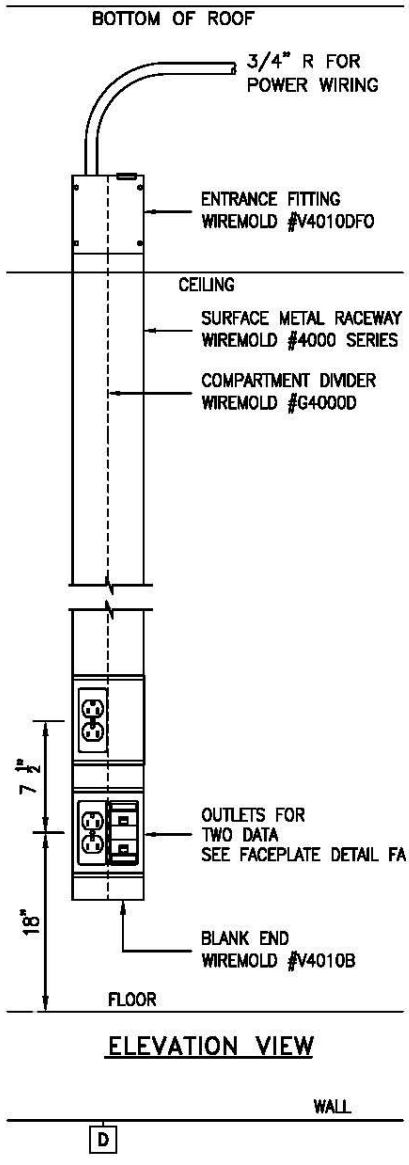
STUDENT STATIONS WITHOUT
ACCESS TO CEILING

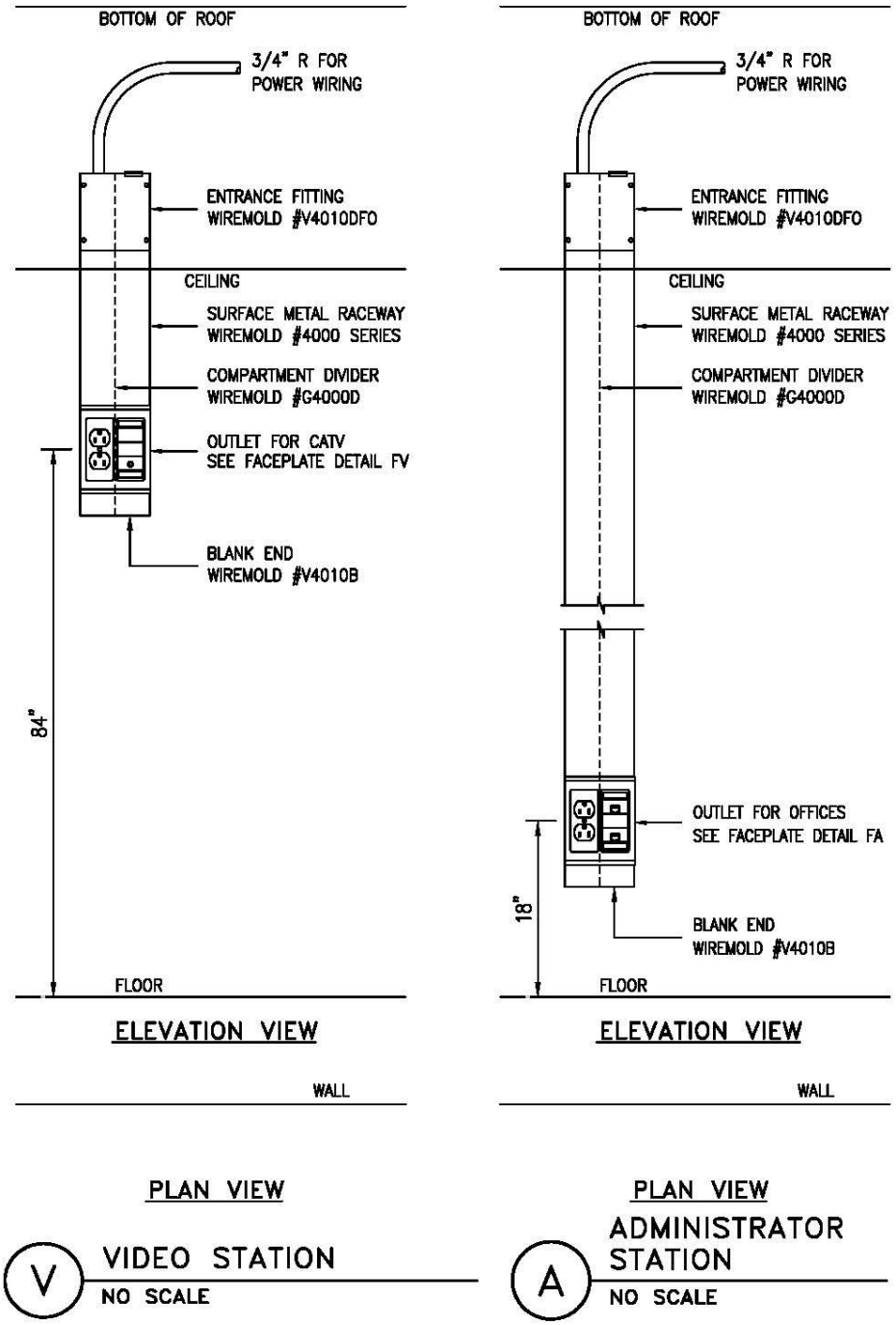
S1 STUDENT STATIONS BACK FEED DETAIL
NO SCALE

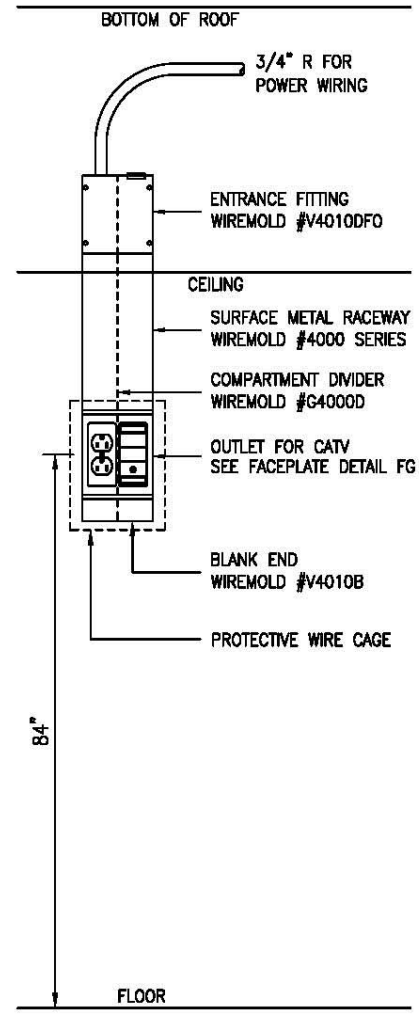


FR RECEPTACLE ONLY FACEPLATE – TYPE "R" OUTLET
NO SCALE
DETAIL


BOTTOM OF ROOF
3/4" R FOR
POWER WIRING
ENTRANCE FITTING
WIREMOLD #V4010DFO
CEILING
SURFACE METAL RACEWAY
WIREMOLD #4000 SERIES
COMPARTMENT DIVIDER
WIREMOLD #G4000D
7 1/2"
7 1/2"
7 1/2"
18"
OUTLETS FOR
TWO DATA
SEE FACEPLATE DETAIL FA
OUTLETS FOR
TWO DATA
SEE FACEPLATE DETAIL FA
BLANK END
WIREMOLD #V4010B
FLOOR
ELEVATION VIEW
WALL
SS
PLAN VIEW
SS
SPECIAL STUDENT
NO SCALE


BOTTOM OF ROOF
3/4" R FOR
POWER WIRING
ENTRANCE FITTING
WIREMOLD #V4010DFO
CEILING
SURFACE METAL RACEWAY
WIREMOLD #4000 SERIES
COMPARTMENT DIVIDER
WIREMOLD #G4000D
7 1/2"
18"
OUTLETS FOR
TWO DATA
SEE FACEPLATE DETAIL FA
BLANK END
WIREMOLD #V4010B
FLOOR
ELEVATION VIEW
WALL
D
PLAN VIEW
D
DOUBLE STUDENT
NO SCALE

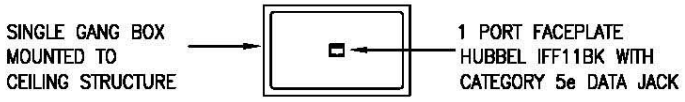

BOTTOM OF ROOF
3/4" R FOR POWER WIRING
ENTRANCE FITTING WIREMOLD #V4010DFO
CEILING
SURFACE METAL RACEWAY WIREMOLD #4000 SERIES
COMPARTMENT DIVIDER WIREMOLD #G4000D
OUTLET FOR CATV SEE FACEPLATE DETAIL FV
BLANK END WIREMOLD #V4010B
84"
FLOOR
ELEVATION VIEW
WALL
PLAN VIEW
V
VIDEO STATION
NO SCALE
BOTTOM OF ROOF
3/4" R FOR POWER WIRING
ENTRANCE FITTING WIREMOLD #V4010DFO
CEILING
SURFACE METAL RACEWAY WIREMOLD #4000 SERIES
COMPARTMENT DIVIDER WIREMOLD #G4000D
OUTLET FOR OFFICES SEE FACEPLATE DETAIL FA
18"
BLANK END WIREMOLD #V4010B
FLOOR
ELEVATION VIEW
WALL
PLAN VIEW
A
ADMINISTRATOR STATION
NO SCALE



G GYM STATION
NO SCALE

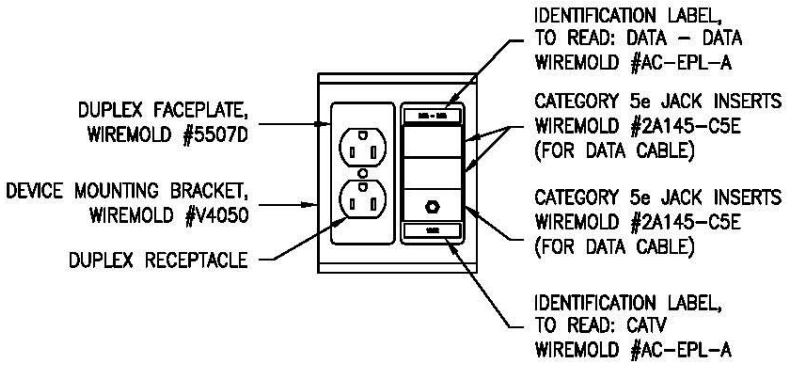
NOTES

1. SURFACE METAL RACEWAY (SMR) SHALL BE INSTALLED PER MANUFACTURERS INSTRUCTIONS & RECOMMENDATIONS. DESIGN BASIS FOR SMR: WIREMOLD.
2. ALL ADDITIONAL FITTINGS REQUIRED SHALL BE "FIBERREADY" 2" RADIUS. EXAMPLE INTERNAL ELBOW, EXTERNAL ELBOW, & TEES.
3. FIELD CUTTING OF RACEWAY SHALL BE WITH MANUFACTURES APPROVED TYPE CUTTERS & JIG. THE JIG SHALL BE AT LEAST 4' LONG TO HOLD THE SMR PERPENDICULAR TO THE CUTTER.
4. ALL RACEWAY INSTALLATION SHALL BE COORDINATED WITH THE INSTALLER OF TACK BOARDS & CHALK BOARDS.



FW WIRELESS FACEPLATE–TYPE "W" OUTLET

NO SCALE



FG VIDEO FACEPLATE – TYPE "V" OUTLET

NO SCALE
DETAIL

Suspended Ceiling

- Ceiling Distribution Requirements
  - Low voltage voice, video and data cable may be supported above suspended ceilings by “J” hooks attached directly to the roof support structure.
  - Ceilings must be accessible in all areas
  - Cable shall not be laid directly on ceiling tiles or suspension parts.
  - Cable to be bundled in not more than 50 cables, not tied, and support every 60” by a “J” hook.

Horizontal Sleeves

- Sleeve Requirements
  - Conduit sleeves are required for all wall penetrations. For example, conduit sleeve size of 3” sleeve will allow for 41 cables.
  - Conduit sleeves for classrooms, offices, etc. should be located over doors.
  - Sleeves shall be fire stopped where required by code.

Cable Trays

- Cable trays and raceway requirements
  - Wall or ceiling mounted open cable tray may be used in high cable volume areas such as corridors, around Computer Labs, near and around the TDC, and TRs. In all cases except telecommunications rooms cable trays are to be above suspended ceilings.
  - Access to Cable trays shall not be restricted by other building components.
  - Cable trays should carry low voltage cables only unless engineered to carry both high and low voltage cables.

Corridor Conduit

Contractor shall size, provide, and install electrical metallic tubing (EMT) conduit, closed cable tray, or surface mounted raceway in corridors and other spaces for voice, video and data cabling in those schools (or portions of schools) that do not have suspended ceilings in corridor spaces. Conduit, closed cable tray and surface mounted raceway for voice, video and data cabling is to be sized for a maximum fill of forty (40) percent. The exact routing around bulkheads and other obstructions is to be determined on-site.

Closed cable tray to be Wiremold SpecMate SPM Series either attached to wall with C-hanger or suspended from ceiling with trapeze hanger or approved equivalent.

Within Casework

Voice, video and data cable may be routed within casework such as science lab or demonstration tables from in-wall conduit to CNOs installed in the same casework. Cabling installed in exposed area with possibility of damage must be installed within fixed or flexible conduit.

Exposed Conduit

- Low voltage voice, video and data cable routed in areas without suspended ceiling must be appropriately sized conduit or other surface mounted raceway. Examples of such locations are:
  - Boiler rooms
  - Stage areas
  - Gymnasium

Backbone Pathways

A building backbone system is the part of a premises distribution system that provides connection between equipment rooms, telecommunication rooms, and telecommunication service entrance facilities. Fiber optic cable from the Technology Distribution Center or a Telecommunications Room to a remote equipment box located in a learning area is considered to be part of the backbone pathway requirement.

Interduct

- Interduct Requirements
  - All fiber optic cable used for backbone cabling are to be run in interduct sized appropriately for 40% fill.

Backbone Cable Pathways

- Backbone Cable Pathway Requirements
  - Backbone pathways shall be capable of accommodating all telecommunications media recognized in ANSI/EIA/TIA-568A, including 100Ohm Unshielded Twisted Pair (UTP), 62.5/125 um optical fiber, single-mode optical-fiber cable and 50-Ohm coaxial cable.
- Capacity
  - Pathways shall be sized to accommodate the anticipated size, type, and quantity of cables, and provide capacity for future growth. Provide additional empty conduits, trays, sleeves, etc., where as may be necessary to add additional capacity without causing significant disruption to the facility.
- Fire-stopping
  - All pathway penetrations through fire-rated construction assemblies are to be fire stopped in accordance with applicable codes.

I. Telecommunication Cable Standards

All standards and requirements of Section IV Paragraph I Telecommunication Cable Standards shall apply to cable standards for existing school communications infrastructure retrofits.

General Requirements

1. All horizontal cables shall run from the CNO back to the appropriate horizontal cross-connect in the TDC/TR

2. Horizontal voice and data cable to be Enhanced Category 5 plenum UTP with lengths not to exceed 290 feet from the CNO to the termination at the horizontal cross-connect. It is recommended for designers to consider all factors of horizontal cable length when designing the telecommunications systems, to avoid exceeding this measurement both during design and actual installation.

3. Horizontal fiber data cable to be 6-stand multimode plenum fiber TDC/TR to each remote equipment box in each learning area.

4. Backbone data cable to be 12-stand multimode plenum fiber from TDC to each TR with 2000 meters (6560 feet).

5. Backbone voice cable to be multi-pair Category 3 plenum UTP from TDC to each TR. The number of pairs in the cable to be determined by multiplying the number of rooms in the TDC/TR service area by 4 pairs plus 15% spare. Cable can be 50, 100, 200, or 300-pair as appropriate.

6. Horizontal coax cable from corridor tap to CNO to be plenum RG-6/U.

7. Backbone video cable to be either RG-11U or .500 hardline coax as appropriate to the distance and design.

J. Telecommunications Equipment Rooms

Criteria for Architectural Design

Every effort will be made to utilize existing building spaces to accommodate telecommunications rooms without structural alterations. If structural modifications are required to provide adequate protection and security of communications network equipment, alterations will be kept to the minimum necessary to meet these requirements. The standard drawing details and specifications provided in this package should be sufficient to address any such alterations.

Telecommunications Equipment Room Design-Number and Location

Each building should have one Technology Distribution Center. Additional Telecommunication Rooms may be required based upon the size and design of the school. The following guidelines should be used in the telecommunications room analysis:

- The design objective is to minimize the number of TR locations while still meeting the design distance requirements for cable length from TR patch panel to the farthest Communication Network Outlet. The UTP Enhanced Category 5 cable length limitation to support 10/100 BASE-T Ethernet is 290 feet of cable. Minimizing the number of wire closets serves to minimize the square footage required, reduce intelligent switch equipment costs by providing a greater concentration of equipment and reduce the amount and length of backbone fiber optic cable required to support the building-wide computer network.

- Minimizing the number of wire closets needs to be balanced with reducing the length of cable runs from high-density locations such as computer labs and the media center.

- Space should be allocated for a Technology Distribution Center in each school. If centrally located for small elementary schools, this may be the only wire closet required.

- The Technology Distribution Center should be located within or near the Media Center for central location within the building and to facilitate personnel responsibilities.

- A Telecommunications Room should be located on each floor of the school. As an exception, a basement level with only a few CNOs might be serviced by a first-floor TR using a vertical chase-way.

- Remote areas of schools with a minimal number of CNOs and limited availability of floor space can be economically serviced from a wall-mounted lockable 24" or 48" data cabinet.

- For existing schools, space for TRs can be accommodated by installing either floor mounted standard 19" rack, floor lockable data cabinets or wall mounted open swing racks or cabinets in book storage areas, supply closets or offices. Storage and office spaces frequented by students or staff should use lockable cabinets rather than open racks.

- Wire closets should not be located adjacent to major electrical closets, operating motors or other electrical equipment, or elevators. Likewise, wire closets should not be located under or adjacent to restrooms or sources of potential water leakage.

Space Requirements – Technology Distribution Center

Overall space requirements for the Technology Distribution Center (TDC) will depend upon the usage of the space. It is desirable that the TDC contain telephone termination, video distribution cable termination, and

video head-end equipment in addition to serving as the main distribution frame for the computer network. The TDC is also often used for the

central location of building file servers. Consequently, the special requirements and shape of the TDC will vary significantly depending type

of school, the size of the data communications service area, and other functions of the room. The following guidelines should be used as a starting point for determining the square footage requirements of the TDC:

Function	High School	Middle School	Elementary School
Data only	150-200	100-150	100
Data and centralized file servers	250-300	175-250	150
Voice, video, and data with centralized file servers	350-450	250-300	200
Voice, video, and data, non-centralized file servers	200-250	150-200	150

Space Requirements-Telecommunications Rooms

The following considerations should be used when determining the size and space utilization for TRs:

- TR space should not be shared with electrical panels, transformers, or other electrical equipment.
- TR space should not be shared with janitorial space.
- Convenient access should be provided for administration and maintenance of data communications equipment.
- Most Telecommunications Rooms will not contain video distribution equipment, voice equipment, or file servers.
- The special requirements and shape of Telecommunications Rooms will vary significantly depending primarily on the size of the data communications service area. The following guidelines should

be used as a starting point for determining the square footage requirements of Telecommunications Rooms:

High School	Middle School	Elementary School
80-120	80-100	80

Environmental Requirements – Both TDC and TRS

Primary environmental considerations for design include environmental conditioning, power and grounding, security, lighting, and access by operational and maintenance personnel. The following should be taken into consideration:

- Telecommunications equipment rooms should be uncluttered and contain adequate space to maintain equipment racks. Racks should have a minimum of 2½ feet clearance on the front and back.
- Lighting requirements of 50-70 foot candles measured three feet above the finished floor are recommended. Non-EMI lighting should be installed.
- Spaces should be air-conditioned and have good air circulation through vented doors and open ceiling spaces. The ambient room temperature must be maintained between 40 and 80 degrees F. Relative humidity shall not exceed 60 percent.
- All standard TIA 19" equipment racks must be permanently and effectively grounded to an electrical grounding bar provided by the electrical contractor.
- Non-conductive fire suppression and smoke evacuation systems are required as per national BOCA code guidelines.
- Concrete floors should be sealed and covered with vinyl tile or painted. Carpet is not acceptable.
- Thirty-inch standard height lockable doors should be used for entrance to telecommunication equipment rooms. Inward door swing, if necessary, should swing so that clearance is provided for equipment racks and other equipment.

The Technology Distribution Center containing the MDF should be located in the media center area. Typically the Media Center Workroom or Storage Room. The TDC should contain sufficient space for the following functions:

- Data MDF rack (s) and/or cabinets (s).
- Video head-end equipment termination on wallboard and rack (s) and/or cabinet (s).
- Voice cable termination and future installation of new telephone switch equipment on plywood wallboard.
- File server locations (1-2 6' tables).

The following functions are most likely installed in different locations in the existing school and should remain there:

- Security head-end equipment in locked cabinets.
- Public Address head-end equipment.
- Alarm head-end equipment.
- Video surveillance.

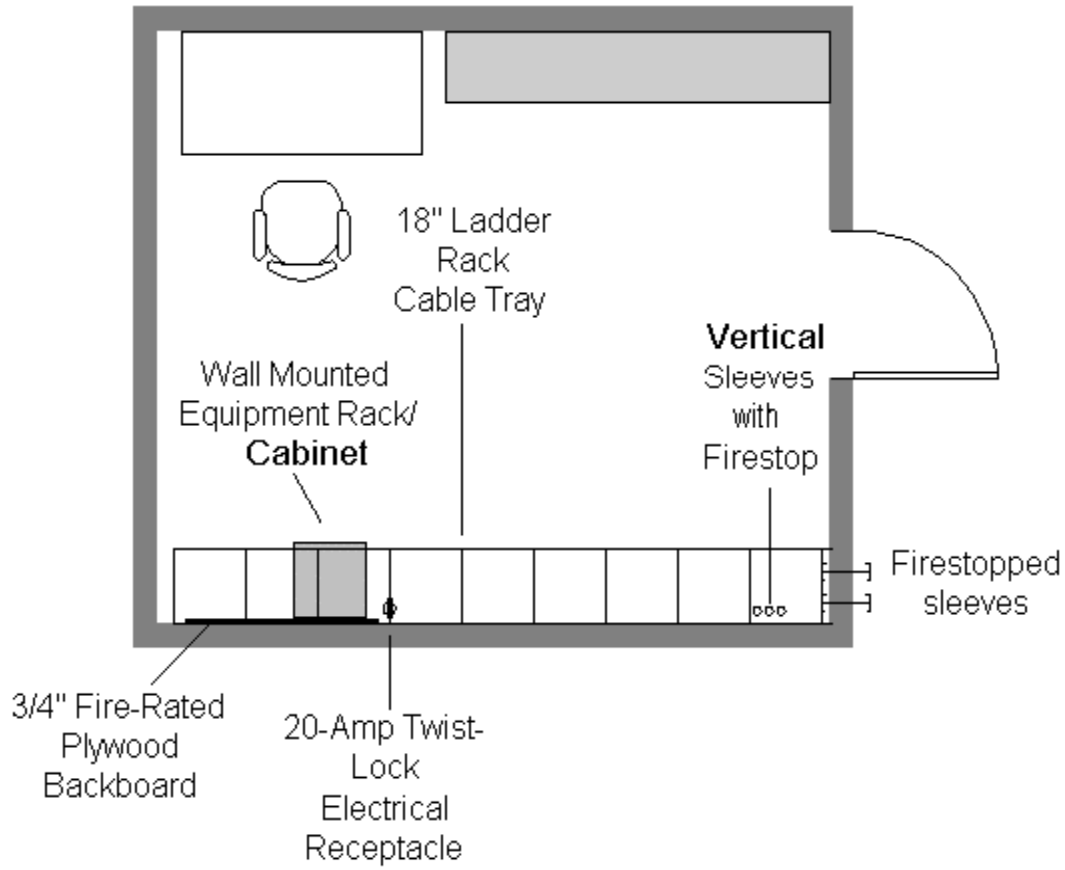
The following criteria should be used in locating Telecommunication rooms:

- The design objective is to minimize the number of TRs while meeting the design distance requirements of cable length of 290 feet of cable from wall outlet to patch panel in the TR.
- Minimizing the number of TR s needs to be balanced with reducing the length of cable runs from high-density locations (i.e. computer labs).
- Locate at least one (1) per floor.
- Stacking of TRs above one another is desirable.

Samples of telecommunication room layouts for existing schools are Provided. It is often necessary to use book or supply storage rooms and in some cases, teacher offices. The cable tray depicted in the office is above the suspended ceiling.

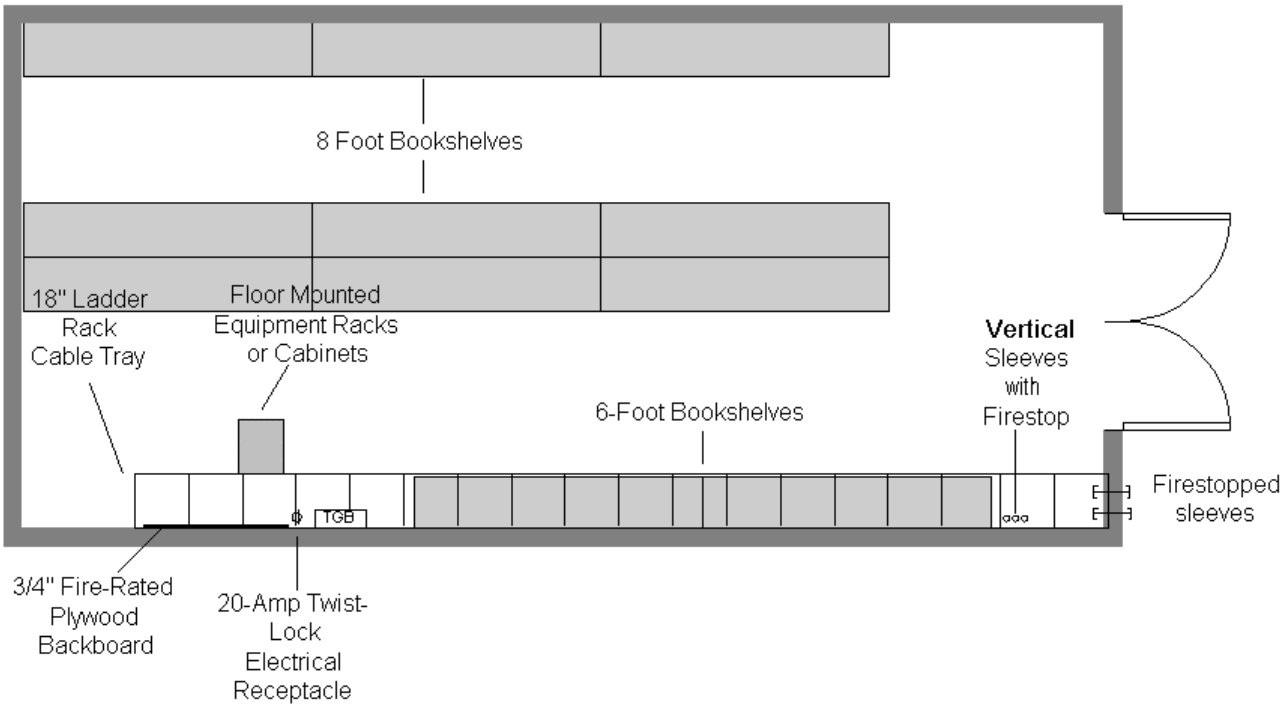
Telecommunications Room Located in a Faculty Office

Not to Scale



Telecommunications Room
Located in Book Storage Room

Not to Scale



K. Electrical Requirements

With the exception of the extensive use of split channel surface mounted raceway, the electrical requirements for telecommunications equipment rooms and CNO locations are identical to that provided in Paragraph H. Section IV Technology Implementation And Facilities Design Guidelines: Product –New And Modernized Schools. See also the CNO Configuration Detail drawings on the following pages for additional information concerning electrical receptacles.

SECTION VI
TECHNICAL SPECIFICATIONS – DIVISION 17000

TABLE OF CONTENTS

SECTION 17000: COMMUNICATIONS SUMMARY/PROJECT OVERVIEW

PART 1 GENERAL

1.1 PROJECT IDENTIFICATION

A. District of Columbia Public Schools, [Name of school project]

1.2 RELATED DOCUMENTS

A. Drawings and Bidding, Contracting and General provisions of the Contract, including General and Supplementary Conditions and Division 0, Division 1 and Division 17 Specification Sections, apply to this Section.

1.3 SECTION INCLUDES

A. Guidelines for voice, video and data cabling plant and related equipment

1.4 CODES AND PERMITS

A. Obtain local inspection approvals for all appropriate building/construction codes associated with the work.

1.5 OWNER'S INSTRUCTIONS

A. No deviations shall be made from the drawings or specifications. Should the Contractor find at any time during the progress of the work, that in his judgment, conditions made desirable or necessary modifications in the requirements covering any particular item or items; he shall report such matters promptly to the Owner for his decision and instructions.

B. The Owner will verify that all required activities have been performed in a final joint walk-through with the Contractor prior to system acceptance.

C. If mention has been omitted herein of any items of the work or materials usually furnished for, or necessary to the completion of the cabling work or if there are conflicting points in the specifications and/or drawings, Owners attention should be called to such an item or items in sufficient time for a formal addendum to be issued. Any and all conflicting points in the specifications and/or drawings which are not questioned by the Contractor and clarified prior to contract award shall be subject to the Owners interpretation after award of the contract, and its interpretation shall be binding upon the Contractor.

D. There shall be no provision for automatic acceptance. Full payment will only be made after full and complete acceptance of the entire system. Acceptance shall only occur based on the written notification to the Contractor from the Owner. The following criteria must be met:

1. All cables have been tested and shown as meeting all specifications to the satisfaction of the Owner. All test reports required shall have been submitted and approved by the Owner through the normal chain of communications.
2. All outlets are completely installed and operational in the specified locations.
3. All required patch panels are installed and operational.
4. All patch cables and cross connects cables have been delivered.
5. Owner provided final as-built drawings and CAD files.
6. Owner provided training and tools for cable management personnel in the maintenance and use of the installed cabling systems.
7. Each optical fiber has been tested end-to-end and a written report of signal loss and continuity has been provided.

8. The site is clean and neat, ready for permanent use.
9. All fire-stops have been installed.

E. Examine all drawings and observe the conditions under which the work will be done or other circumstances, which will affect the work before submitting his bid. No subsequent allowance will be made for errors or omissions in connection with this examination.

1.6 PACKING, SHIPPING, HANDLING AND UNLOADING

A. Ensure that all system equipment, devices, and materials arrive at the designated installation site in good condition, intact in factory package or crate. Any damaged equipment will be removed from the project site and will be replaced by the Contractor at their expense.

B. Store all equipment, devices, and materials in their factory containers or package until ready for use. Storage facilities will be a clean, dry and indoor space, which provides protection against the weather. Avoid damage by condensation by providing temporary heating when required. Large reels of cable may be stored outdoors provided there is adequate protection from physical damage and the cable ends are properly sealed to prevent moisture ingress. The Bidder shall state how much space and floor loading will be required. Storage related costs are the responsibility of the Contractor. Coordinate all storage of materials and equipment with the Owner.

C. Handle all equipment, devices and materials carefully to prevent breakage, denting or scoring of the finish or cable jackets. Damaged materials will be removed from the project site, and replaced at no additional cost. No sheath cuts will be accepted. All cables must be installed with sheath intact to the point of termination.

D. Strict limitations will be enforced on the size, weight, and arrangement of cable reels. In general, cable reels must be of a size to be lifted on the interior freight elevator, and fit through standard doorways.

1.7 STORAGE AND PROTECTION

A. Any cable found to be damaged or defective shall be replaced at no additional cost to the Owner.

1.8 WASTE MANAGEMENT AND DISPOSAL

A. Control litter at all times by keeping it in containers. Remove any installation debris from the site and dispose of it properly. Remove major trash daily. All other cable-related trash, dust, dirt, etc. must be removed and cleaned prior to acceptance.

1.9 SCHEDULING

A. The telecommunications work shall be scheduled with the work of the other trades to avoid delays, interference, and unnecessary work.

B. The plans are diagrammatic and reference must be made to structural, architectural, and mechanical systems plans and actual construction. Work under this section shall coordinate with the different trades so that interference between electrical raceways, piping, equipment, architectural, and structural work shall be avoided.

C. The project manager will be responsible for providing written reports to the Owner at the beginning of every week for the previous week's work completed and upcoming weeks planned work.

D. Coordinate work with any other communications parties on-site, specifically, any PBX Installer, the LAN Installer, the Computer Installer, and other third parties whose work may affect or be affected by the cabling systems described herein.

E. During installation, the Owner and/or Representative will conduct periodic inspections to verify that cable installation is proceeding according to the guidelines specified in this document. The Contractor, at no additional expense to the Owner, will promptly correct any deficiencies found within 7 days of notification.

F. Meet with the appointed representative of Owner prior to the start of installation work, to determine phasing and timing of planned installation.

G. Any and all overtime required to complete the scope of work within the proposed schedule will be included in the quoted price. No additional overtime will be paid. Selected tasks may be performed during school hours with the approval of the Owner's representative.

SECTION 17100 – DATA AND VOICE CABLE PLANT OVERVIEW

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and Bidding, Contracting and General provisions of the Contract, including General and Supplementary Conditions and Division 0, Division 1 and Division 16 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes data and voice horizontal and backbone cable plant components.

B. Related Sections include the following:

1. Division 16 “Electrical” Sections for conduits, raceways, connection boxes, pull boxes, junction boxes, and outlet boxes permanently installed in walls, floors, and ceilings.
2. Division 16 “Electrical” Sections for room lighting fixtures, power receptacle outlets, interconnecting wiring for these circuits and electrical breaker panels.
3. Section 07920 “Through-Penetration Firestop Systems”
4. Section 09260 “Gypsum Board Assemblies For Acoustical Sealants.“

C. Bid Proposals

1. Examine all drawings and observe the conditions under which the work will be done or other circumstances which will affect the work before submitting his bid. No subsequent allowance will be made for errors or omissions in connection with this examination**.**
2. Include appropriate quantities of materials and equipment, whether indicated or implied, that are necessary to provide a complete and functional system.
3. Include shift differential and overtime necessary for timely completion.

1.3 REFERENCES

A. National Electric Code (NEC), NEPA 70

B. State and Local Building and Electrical Codes

C. Maryland Building Performance Standard (MBPS)

D. Code of Maryland Regulations (COMAR) 0502.02

E. National Fire Protection Agency (NFPA) No. 101

F. BOCA National Building Code

G. ADA The Americans with Disabilities Act

H. Federal Communications Commission (FCC) Rules

1. Part 68 and Subpart J of Part 15, including required FCC registration and numbering.
2. FCC47 CFR68 and 15 – Code of Federal Regulations (FCC regulations regarding broadband video distribution)

I. ANSI EIA/TIA

1. 568A, Commercial Building Telecommunications Cabling Standard

2. 569A Commercial Building Standards for Pathways and Spaces
3. EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure in Commercial Buildings
4. TIA/EIA-607 Commercial Building Standards for Grounding and Bounding Requirements
5. TIA/EIA TSB 67
6. TIA/EIA TSB 72
7. TIA/EIA TSB 75

J. IEEE 802.3 CSMA/CD Access Method – Carrier Sense Multiple Access with Collision Detection access method and physical layer specifications.

K. IEEE 802.11a Standards for Wireless Networking

L. Underwriters Laboratories (UL)

M. Electronics Testing Laboratories, Inc. (ETL)

1.4 DEFINITIONS

A. The term "Bidder" refers to those parties who are submitting proposals for the work set forth in this document. The term "Installer" refers to the successful Bidder and to any work or issues after the award of the contract.

B. The term "Owner" refers to the Baltimore City Public Schools Project Manager and/or his/her designated representative or agent.

C. The term “Telecommunications Distribution Center (TDC)” refers to the room adjacent to the Information Resource Center (IRC), which contains the Main Cross-Connect for the data network and a horizontal cross-connect to provide connectivity to the CNO’s within the TDC service area.

D. The term “Horizontal Cabling” refers to the Horizontal Category 5e copper UTP data cabling installed between the TDC or Remote Equipment Cabinet and Communications Network Outlets (CNO's), including CNO’s located in systems furniture.

E. The term “Backbone Cabling” is that portion of the data cabling system that connects the Technology Distribution Center to remote equipment cabinets throughout the building. Backbone cabling consists of the actual transmission media, fusion terminations, intermediate and main cross-connects, and any patch cords or jumpers used for backbone-to-backbone connection.

F. A "Communications Network Outlet (CNO)" refers to a specific channel-end communications termination location. A "jack" refers to the physical communications termination device that is installed at the CNO location. A "faceplate" is a decorative cover that covers the termination field of the jack and attaches to the outlet.

1.5 SYSTEM DESCRIPTION

A. The voice- and data-wiring plan for the facility is a Structured Cabling System. The plan is based on the EIA/TIA-568A Standard. The building-wide computer network is to be an implementation of 100 BASE-T twisted pair Ethernet complying with the Institute of Electrical and Electronic Engineers' (IEEE) 802.3 standards for Ethernet. 100 BASE-T is a star topology, CSMA/CD access method, 100 MB/sec, Ethernet network operating on a combination of twisted pair and fiber optic cable. Provide a complete, integrated telecommunications cabling system: fully operational, capable of operating at 100 Mbps or better, ready for the occupants to use as indicated.

B. The cable system design is based on the universal-cabling concept. The same cables are installed to all workstations; connectors, adapters, and interconnections determine how the cable operates, i.e. with appropriate cross connects, voice cable can be used for data.

C. Data System Design Requirements

1. For a collapsed backbone design,

   a. Category 5e UTP cable from the CNO locations back to the TDC or remote equipment cabinet

   b. Stackable switches located in the Remote Equipment Cabinet or Telecommunication Room for horizontal cable distribution

   c. Six-strand multimode fiber from the TDC to remote equipment cabinets and terminated in cabinet-mounted “six-pack” fiber receptacles

   d. Backbone cabling between the central Technology Distribution Center (TDC) and other Telecommunication Rooms (TR’s) shall consist of data fiber optic cable data containing 12 strands of multimode and 6 strands of single-mode fiber.

   e. Chassis switch located in the TDC for backbone distribution

2. For a traditional, hierarchical star design,

   a. Category 5e cable from CNO location back to the TR

   b. Stackable switches located in each Telecommunication Room for horizontal cable distribution

   c. Backbone cabling between the central Technology Distribution Center (TDC) and other Telecommunication Rooms (TR’s) shall consist of data fiber optic cable data containing 12 strands of multimode and 6 strands of single-mode fiber.

   d. Chassis switch located in the TDC for backbone distribution

3. The data network will support the cabling needs for both Wireless and Voice-over-IP (VoIP) systems.

D. Voice System Design requirements

1. Cat 5e UTP cable from the CNO locations back to the TR
2. Cables terminated on a 110-block and cross-connected to Cat 3 25-pair cables running back to the TDC

1.6 SUBMITTALS

A. Manufacturer’s product data including model number for all equipment and certification that cable, components, and equipment meet specifications stated and are accepted for use in Ethernet networks, by the system warranty provider.

B. Samples of voice and data cable, fiber optic cable, patch cords, patch panels, faceplates and jacks. Samples shall be returned upon written request.

C. Shop drawings, coordinated with Electrical, Mechanical and Audio-Visual shop drawings showing proposed cable routing, rack design, TDC/TR layout, details of all proposed fire-stops for two-hour rated walls. Departures from the original contract drawings should show details of such departures and reasons for changes and should be submitted with the shop drawings. Approved departures recommended by the Contractor shall be made at no additional cost to Owner or shall result in a net decrease in cost. The Owner shall obtain the benefits of any cost reductions of these changes.

D. Copy of Wireless Site Survey Report by manufacturer's certified representative.

E. Schedule of Cable Terminations, listing cable origination, destination and description of cross-connect field.

F. Outline of Training Program

G. Closeout Submittals

1. Operation Maintenance Manuals

2. Certified Channel Warranty

3. The RCDD shall certify the final installation in writing and shall provide written verifications that he/she has inspected the completed installation and that the installation meets the terms and conditions of the design requirement of the BICSI methods, EIA/TIA standards, NFPA, NEC and all local codes.

4. Electronic CAD (AUTOCAD 2000 or above) and reproducible hard copy drawings of as-built drawings of the installed cable system including any design, which deviates form the specified routes. As-built drawings shall include all cable routes and labeling, patch panel configurations, TDC/TR configuration, cross connect details, riser system, patch cord details, riser system, fiber storage and labeling. Owner will provide contractor with electronic as-designed CAD files of IT drawings to be used to produce as built CAD files and drawings.

1.7 QUALITY ASSURANCE

A. Pre-Installation Coordination Meetings and Schedules

1. Coordinate scheduled activities with Owner

B. Installers

1. Must have 5 years experience in this field.

2. Shall employ on their staff a Registered Communications Distribution Designer (RCDD) registered with the Building Industries Consulting Services International (BICSI).

1.8 WARRANTY

A. See Section 17190 for specifications of the warranty required for the data cabling system.

1.9 COMMISSIONING

A. Owner will determine acceptance of the system by field testing, using his own forces.

B. The following criteria must be met:

1. All cables have been tested and shown as meeting all specifications.

a. Each optical fiber has been tested end-to-end and a written report of signal loss and continuity has been provided.

b. All test reports required have been submitted and approved.

2. All CNOs are completely installed and operational in the specified locations.

3. All fire-stops have been installed.

4. All required patch panels are installed and operational.

5. All patch cables and cross-connect cables have been delivered.

6. Final as-built drawings.

7. Training program, scope and schedule, has been approved in writing.
8. The site is clean and neat, ready for permanent use.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish and install new and undamaged materials conforming to the applicable standard.

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate work with other communications parties on-site, specifically, any PBX Installer, the LAN Installer, the Computer Installer, and other third parties whose work may affect or be affected by the cabling systems described herein.

B. Furnish all material, labor, transportation, tools, equipment, and supervision to install and leave ready for operation a complete communications systems in accordance with the contract documents.

C. All offsets, bends fittings pull boxes, stems and supports for the complete installation are not indicated on the drawings. It is the Installer's responsibility to furnish and install all such equipment for the complete installation.

D. Pathways

1. Cable Tray and Conduit are provided under separate contract.
2. Provide additional pathway devices including J-Hooks and inner duct, as required.

E. All work shall conform to the requirements of the authorities having jurisdiction over this work.

3.2 FIELD QUALITY CONTROL

A. Provide all tools and test equipment required for installation and testing work. Test equipment will be maintained in accurate calibration and will display the dates of the last calibration and next scheduled calibration.

B. Perform all tests indicated at the end of each section and submit results to the Owner for review and approval prior to continuing installation.

1. For all tests, the Owner or its agent must be present at the beginning of testing and at such times, as the Owner deems appropriate.
2. Correct any problems or defects discovered during testing.

SECTION 17110 – COMMUNICATIONS EQUIPMENT ROOMS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Drawings, Bidding, Contracting and General provisions of the Contract, including General and Supplementary Conditions and Division 0, Division 1, Division 7 and Division 16 Specification Sections, apply to this Section.

1.2 SUMMARY

A. All distribution racks, patch panels, connectors, and other components for the distribution of the data communications backbone and horizontal cable systems.

1.3 REFERENCE STANDARDS

A. Refer to Section 17100 “Data and Voice Cable Plant”

B. EIA Standard RS-310C

1.4 DESIGN REQUIREMENTS

A. Architectural/Mechanical Requirements

1. If overhead sprinklers are located within the Communications Equipment Room, provide a trough or other protection to protect equipment from accidental leakage.

1.5 SUBMITTALS

A. Product Data

1. Equipment Rack
2. File Server Rack
3. Server Cabinet
4. Remote Equipment Cabinet
5. UPS Equipment
6. Plywood
7. Fire Retardant Paint
8. Cable Management Equipment

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Hubbell Premise Wiring Products

B. Alternate Manufacturers:

1. Lucent Technologies
2. Ortronics Corporation
3. AMP Corporation
4. Siemons Corporation
5. Interlink Technologies
6. Leviton Corporation

2.2 MATERIALS

A. Equipment Distribution Rack

1. Basis of Design: Hubbell number HPW84BR19 with MCCPSS19 10 outlet surge protection power strip and shelving and wire management accessories.

a. Conform to EIA Standard RS-310C for 19-inch racks and shall be complete with all rack mounting hardware.

b. Constructed of steel, capable of supporting up to 600 pounds and shall be open, Type B universal mounting rail hole pattern.

c. Grounded

i. The equipment rack grounding kit, required for each rack, shall be IBM Specification No. 4716804, or approved equal.

B. File Server Racks

1. Basis of Design: Hubbell number HPW84BR19 with MCCPSS19 10 outlet surge protection power strip and shelving and wire management accessories.

a. Constructed of steel, capable of supporting up to 600 pounds and shall be open, Type B universal mounting rail hole pattern.

C. Server Cabinets

1. Basis of Design: Hubbell number SVR84

D. Remote Equipment Cabinets

1. Basis of Design: Hubbell REBOX RE4

a. Contain fan kit (Part #REKF) and key lock kit (Part #REKL).

2. Grounded through a 6 AWG green conductor routed back to the designated telecommunications room grounding bus bar.

E. Cable Management

1. Rack cable management and blank panels to be:

a. 1 position split ring panel

b. 2 position split ring panel

c. 1 position bank panel

2. Provide a ladder rack from top of floor-mounted racks to backboard or wall with a minimum of 30” separation.

F. Plywood

1. ¾” A-C, void-free, plywood for voice and video equipment termination.

G. Telecommunications Bus Bar

1. Provide Telecommunications Bus Bar as shown in Information Technology (IT) Drawings.

2.3 **EQUIPMENT**

A. Uninterruptible Power Supply (UPS) Equipment

1. Basis of Design:

a. Floor-Mount Racks and Cabinets - APC Smart UPS XL Series Model SU2200RMXLNET with SU48RMLBP external battery pack,

or approved equal. The UPS unit and external battery pack shall be “rack mounted.”

b. Wall-Mount Racks and Cabinets - APC Smart UPS 1400 Series Model SU1400RMXLNET or approved equal. The UPS unit shall be “rack mounted.”

2. Requirements:

a. In-line interactive design with a maximum transfer time of 4 milliseconds.

b. Provide a minimum of 2000 VA of output power

c. Provide a minimum battery runtime of 20 minute at full load

d. Provide a minimum of six NEMA 5-15R output receptacles

e. Be covered by a two year on-site warranty

f. Provide front panel display indicating load level, battery charge level, and replacement battery indication.

PART 3 EXECUTION

3.1 INSTALLATION

A. Racks and Cabinets

1. Assemble all distribution racks and patch panels according to manufacturer's instructions as indicated on the communication drawings.

2. Position Network Equipment Racks to allow use of twist-lock and special electrical receptacles.

3. Attach racks/cabinets to the floor with appropriate sized fasteners.

B. Cable Management

1. Supply and dress all cross-connect patch cables within the TDC, Telecommunications Rooms and Remote Equipment Cabinets. DO NOT SECURE PATCH CABLES WITH CABLE TIE WRAPS.

C. Plywood

1. Paint plywood on all six sides with two (2) coats of fire-resistant paint.

3.2 REPAIRS/RESTORATION

A. Fire Stopping and Applied Fire Proofing

1. Refer to Division 1 for requirements on cutting and patching fire stop systems, and Division 7 for Applied Fireproofing and Through-Penetration Firestop Systems.

2. Repair any disturbance to existing fire stop systems.

SECTION 17130 – INTERIOR COMMUNICATIONS PATHWAYS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Drawings, Bidding, Contracting and General provisions of the Contract, including General and Supplementary Conditions and Division 0, Division 1, Division 7 and Division 16 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Pathways and related equipment.

1.3 REFERENCE STANDARDS

A. Refer to Section 17100 “Data and Voice Cable Plant Overview”

B. NEC, Article 318 - "Cable Trays"

C. Annex A of ANSI/EIA/TIA-569A

1.4 SUBMITTALS

A. Product Data

1. Conduit/Sleeves
2. Cable Tray
3. Cable Hangers
4. Surface Mounted Channel Raceway

PART 2 PRODUCTS

2.1 MATERIALS

A. Conduit/Sleeves

1. Rigid, metallic conduit.

B. Cable Tray

1. Basis of Design

a. Hallways: Cablofil 12” or 18” EZ Tray, basket-type (suspended ceiling) or Wiremold Spec Mate SPM Series solid cable tray with cover installed (hard ceiling).

b. Telecommunications equipment rooms: 12-18” wall mounted ladder type.

C. Cable Hangers

1. Prefabricated, zinc-coated steel hangers designed specifically for Category 5e and optical fiber cable installations
2. Hangers shall have open top, rolled edges and a 3-inch or 4-inch minimum diameter loop.
3. Provide beam clamps, rod fasteners, flange clips and brackets as job conditions require.

D. Surface Mounted Channel Raceway

1. Basis of Design: Wiremold 4000 Base and Cover ivory finish

2. Include all required couplings, bushings, support clips, straps, connection covers, ground clamps, elbows, tees, box connectors, conduit connectors etc., as required for a complete installation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Conduit/Sleeves

1. Install conduit with no more than two (2), 90 degree bends in any continuous section.
2. Do not fill conduit beyond 40 percent capacity.
3. Coordinate installation of conduit with other trades to maximize use of ceiling space
4. Where cables must penetrate walls, the Contractor shall provide metallic sleeve to appropriately penetrate the area.
5. Where wiring requirements exceed that of a single sleeve, multiple sleeves shall be installed in accordance with the following:

Conduit Size	Maximum No. of Cat 5e Cables
3/4"	2
1"	4
1¼"	8
1½"	11
2"	18
2½"	27
3"	41
3½"	55

B. Cable Tray

1. Provide at least 3-inch clearance between the ceiling tiles and support channels (T-bars) to ensure accessibility.
2. Provide 6 inches of clearance above the cable tray to facilitate install, maneuver and maintain cables within the tray.

C. Cable Hangers

1. Provide cable hangers a maximum of 6’ apart but not consistently on 6’ centers, wherever conduit is not present.
2. Ceiling ties and rods shall not be used to hang cable or cable supports.
3. Load hangers as recommended by the manufacturer. Provide hangers side by side on a common bracket where cable quantities require.

D. Surface Mounted Channel Raceway

1. May be used for student drops under outside wall windows, around walls in science and computer labs, and other areas by necessity of access.
2. Include in-wall conduit from raceway to the space above suspended ceiling.

3.2 REPAIRS/RESTORATION

A. Fire Stopping and Applied Fire Proofing

1. Refer to Division 1 for requirements on cutting and patching fire stop systems, and Division 7 for Applied Fireproofing and Through-Penetration Fire stop Systems.
2. Fire stopping shall be provided at all locations where a telecommunications pathway penetrates a fire-rated building assembly, in accordance with applicable codes.
3. Repair any disturbance to existing fire stop systems.

SECTION 17150 –DATA AND VOICE BACKBONE CABLING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Drawings, Bidding, Contracting and General provisions of the Contract, including General and Supplementary Conditions and Division 0, Division 1, Division 7 and Division 16 Specification Sections, apply to this Section.

1.2 SUMMARY

A. All distribution racks, patch panels, connectors, and other components for the termination of the data and voice communications backbone cable systems.

1.3 REFERENCE STANDARDS

A. Refer to Section 17100, “Reference Standards”

B. ANSI/ICEA S-80-576-1983

C. REA PE-71

D. Bell Systems 48007

E. NEC-770-53

1.4 SUBMITTALS

A. Product Data

1. Single-Mode Fiber Optic Cable
2. Multi-Mode Fiber Optic Cable
3. Fiber Patch Panels
4. Six-Pack Adapter – Bracket Mount
5. UTP Copper Cable

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Berk-Tek Cable

B. Alternate Manufacturers:

1. Lucent Technologies
2. CommScope
3. Mohawk
4. Superior Essex

2.2 MATERIALS

A. Single mode Fiber Optic Cable

1. Basis of Design: Berk-Tek Tight Buffered Single mode Fiber Optic Cable (#PDP012-AB0707)

a. 6 to 144 count, Single Mode – Plenum

b. Rugged Sheath

c. 8 to 9 Micron Single mode Graded Index

d. 125 Micron Clad Diameter

e. 1.0 dB/km Attenuation at 1310 and 1500 nm

B. Multimode Fiber Optic Cable

1. Basis of Design: Berk-Tek Tight Buffered Multimode Fiber Optic Cable (#PDP012-CB3510/15)

a. Rugged Sheath

b. 62.5 Micron Multimode Graded Index

c. 125 Micron Clad Diameter

d. 1.5 dB/km Attenuation at 1300 nm

e. 3.75 dB/km Attenuation at 850 nm

f. 500 MHz/km Bandwidth at 1300 nm

g. 160 MHz/km Bandwidth at 850 nm

C. Inner Duct

1. The inner duct shall have the following characteristics:

a. 1 ¼" in diameter

b. Orange in color

c. Plenum rated

D. Voice Backbone Cable

1. Basis of Design:

2. Description: 25 Pair Category 3 UTP plenum

a. 24 AWG

b. Solid Copper 4 twisted pair

c. Unshielded

d. Insulation Coating: Polyethylene

e. Maximum DC resistance per 1000 feet, 28.6 Ohms

f. Maximum attenuation:

Frequency	Attenuation
1 Mhz	7 dB/1000ft
4 Mhz	12 dB/1000ft
10 Mhz	26 dB/1000ft
16 MHz	35dB/1000ft

E. Termination Equipment

1. Fiber Terminations

a. Terminate all fiber optic cables in duplex-SC type connectors.
b. Use fusion type connections for fiber terminations.

2. Rack Mount Patch Panels - 3 & 4 Rack Space

a. Panels shall be constructed of cold rolled 16 ga steel with a black powder paint finish and provide for fully enclosed fiber patching and termination.

b. Panels shall have a removable smoked Plexiglas front cover. The panel shall have a removable rear cover. Panels shall come with rack mounting brackets that allow it to be mounted with the front cover flush with the front of the rack, or with the front of the panel extended 5.0" in front of the rack.

c. Panels shall be a 3-rack space, 72-port version accepting 12 six-pack adapter plates.

d. Panel shall have a splice tray mounting stud incorporated into the base for mounting of mechanical or fusion splice trays. Adapter tray shall have cable management anchor points and come with cable anchors allowing for the maintenance of the incoming cable with the proper minimum bend radius.

e. Panels shall have 2 cable entrance ports on the top and 2 on the bottom with plastic dust covers. Panels shall have two jumper ports in the bottom at the front of the panel with plastic dust covers for routing of jumpers.

3. Patch Panel Bracket

a. Basis of Design: Hubbell #REFPK

b. Brackets shall accommodate one "six-pack" adapter panel.

c. "Six-packs" shall be populated with 6 duplex-SC type adapter panels (Hubbell #FSPSCD6).

4. Patch Cables

a. All fiber optic patch cords shall be Berk-Tek Single-Mode or Multi-Mode patch cables.

b. Provide patch cables of appropriate lengths for an orderly and manageable arrangement of distribution equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Division 1 for requirements on cutting and patching fire stop systems, and Division 7 for Applied Fireproofing and Through-Penetration Firestop Systems.

B. Traditional (MDF-IDF) Topology:

1. Install 12-strands of multi-mode and 6 strands of single mode fiber optical cable between the data head-end room (TDC) and each intermediate wiring closet (TR).

2. See Data System Connection Diagram on IT drawings.

C. Collapsed Backbone Topology:

1. Install multi-mode and single-mode fiber optic cable between the TDC and all intermediate telecommunications rooms (TR).

2. Install 6 strands of multi-mode cable between all intermediate telecommunications rooms (TR) and each Remote Equipment Cabinet (REBox).

3. See Data System Connection Diagram on IT drawings.

D. Voice Backbone Cable

1. Install the indicated number of 25 pair Category 3 voice tie cables between the voice head-end (TDC) and each telecommunications room closet as shown on the Voice Riser Diagram on IT drawings.
2. Substitute appropriate combination(s) of 25/50/100 pair Category 3 voice tie cables to match specifications as shown on the Voice Riser Diagram.
3. Connect each voice pair from wall or rack mounted 110 modular panels in TR to wall mounted 110 blocks in TDC. Label each pair connected and spares in each closet.

E. Inner Duct

1. Place fiber optic cables in inner duct whenever the cable penetrates any architectural assembly
2. Place two, 1 ½" inner ducts and one 1" inner duct in each Trade Size 4 conduit or sleeve used for the data network backbone cabling. Terminate inner ducts a minimum of 3" outside of the conduit or sleeve.

F. Termination Equipment

1. Fiber Terminations
   a. Terminate fiber optic cables using a fusion type device.
   b. Preserve the polarity of fibers during termination.
2. Patch Cables
   a. Install patch cord cable management as appropriate for a neat and orderly appearance.
3. Patch Panel Bracket
   a. Mount brackets in the top right corner of the Remote Equipment Cabinet, aligned with the appropriate punch-out for a 1" conduit.

SECTION 17160 – DATA AND VOICE HORIZONTAL CABLING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Drawings, Bidding, Contracting and General provisions of the Contract, including General and Supplementary Conditions and Division 0, Division 1, Division 7 and Division 16 Specification Sections, apply to this Section.

1.2 SUMMARY

A. All cabling, patch panels, connectors, and other components for the installation and termination of the data communications horizontal cable systems

1.3 REFERENCE STANDARDS

A. Refer to Section 17100 “Data and Voice Cable Plant Overview”

B. Cable must conform to one of the following:

1. ANSI/ICEA S-80-576-1983
2. REA PE-71
3. Bell Systems 48007

C. Cat 5e jacks must conform to the following:

1. UL VERIFIED for TIA/EIA enhanced category 5 electrical performance.
2. UL LISTED 1863 and CSA certified.
3. EIA/TIA TSB-95.

D. Patch Panels must conform to the following:

1. ANSI/TIA/EIA-568-A and ISO/IEC 11801 enhanced category 5 compliant.
2. UL VERIFIED for TIA/EIA category 5e performance.
3. UL LISTED.

1.4 SUBMITTALS

A. Product data

1. Horizontal Data and Voice Cable
2. Faceplates
3. Modular Jacks
4. Surface Housings
5. Patch Panels
6. Wireless Access Points and Controller
7. Wireless Site Survey Report

PART 2 PRODUCTS

2.1 MATERIALS

A. Horizontal Data and Voice Cable (Category 5e UTP)

1. Basis of Design: Berk-Tek LANmark-350 (#10032065)
2. Acceptable Manufacturers:

a. Beldon

b. CommScope

c. Mohawk

d. Superior Essex

3. Description: 4 Pair, Category 5e copper UTP, plenum rated

4. Specifications:

a. 24 AWG

b. Solid Copper 4 twisted pair

c. Unshielded

d. Insulation Coating: Polyethylene

e. Maximum DC resistance per 1000 feet, 27 Ohms

f. Characteristic Impedance from 1 to 25 MHz - 100 Ohms

g. Maximum Attenuation:

Frequency	Attenuation
1 Mhz	2 DB/1000ft
4 MHz	4 DB/1000ft
10 Mhz	6.5 DB/1000ft
16 MHz	8 DB/1000ft
20 MHz	10 DB/1000ft
25 Mhz	12 DB/1000ft

h. Near end crosstalk at 16 MHz shall not be less than 44 DB/1000 ft.

i. Cable jacket shall be blue for data and white for voice for uniformity of facility, or a color as required matching system color-coding requirements.

B. Modular Jacks – Enhanced Category 5 Jacks

1. RJ-45, 8 positions un-keyed

2. Individually constructed unit and shall snap-mount in an industry standard keystone opening

3. Terminate 22-26 AWG stranded or solid conductors

4. Compatible with EIA/TIA 606 color code labeling and accept snap on icons for identification or designation of applications

5. Marked as either T568A or T568B wiring

6. Supplied with dust covers to protect the jack opening and internal elements during installation until the jack is in use

7. Voice jacks shall be green in color.

8. Wireless data jacks shall be orange in color.

9. Data jacks, not including wireless and VoIP, shall be red in color.

C. Faceplates

1. UL Listed and CSA Certified

2. Six ports; double gang

3. TIA/EIA 606 compliant

D. Patch Panels

1. Black anodized .090-inch aluminum in 48-port configurations.
2. Available in both T568A and T568B wiring schemes
3. Equipped with 110-style termination made of fire retardant thermoplastic.
4. Port identification numbers on both the front and rear of the panel. The port identification numbers on the panel front shall be located so as to minimize obstruction by patch cords.
5. Optional rear cable support bar for strain relief that shall clip to the rear of the patch panel
6. Provide wiring identification & color code and maintain a paired punch down sequence that does not require the overlapping of cable pairs.
7. Support 22-26 AWG solid conductors, maximum insulated conductor outside diameter 0.050".

E. Poke-Through/Pass-Through

1. Basis of design: WALKER RCI RC900-AM Communications Series Poke-Thru or Pass-Through (coordinate with furniture plan).
   a. UL listed and fire-rated at or above the floor rating.
   b. Mount flush to floor, with a jack cover in place over communication jacks when not connected to a patch cord.
   c. Accommodate up to four, Enhanced Category 5 terminations as Poke-Through
   d. Accommodate up to 8 Enhanced Category 5 cables as Pass-Through

2.2 **EQUIPMENT**

A. Wireless Access Points

1. Access Points shall be Cisco Aironet Access Points
2. Wireless Access Point Controller shall be Cisco Aironet AP Controller

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Install all cabling with extreme care. Cables must not be cinched, subjected to sharp bends in excess of the manufacturer's recommended bending radius or anything similar that would change the specified characteristics of the cable.

B. All horizontal cables will run above hallways/ corridors and above doorways except where necessary to avoid EMU sources. When entering a designated classroom or work area, cable will run to the center of the room and then to the actual CNO. Ensure that adequate length exists to allow reinstallation of the CNO anywhere within the room.

C. All cables shall be run in bundles of a size not to exceed 50 cables per bundle using J-Hooks supported from permanent structures on not more then 5-foot centers. Do not use suspended ceiling supports. In no case shall cable be supported from below by contact with the ceiling system. A minimum of 3" shall be provided above ceiling support members for cable pathways. No cable shall droop more than 8" and will not touch light fixtures.

D. All cable bundles that exceed 50 count shall be run on ladder rack or other cable tray.

E. All cable must be located at least 24 inches from any fluorescent fixtures or low-level sources of EMU, and at least 40 inches from motors or high-level EMU sources. Install external EMU shielding in any areas where the Contractor must violate these guidelines.

F. From CNO wall plate to wire closet, cables are to be continuous, without splices.

G. Each cable shall be tagged with the connector identification number as shown on the drawing in the following locations:

1. Faceplate
2. Inside outlet box
3. 110 Connector Block
4. Patch Panel Faceplate
5. At data and/or voice head end

H. Terminate all modular jacks (voice and data) according to EIA/TIA-568B pin assignment standard.

I. Supply one, 10' Category 5e workstation cable with RJ45 plugs at each end for use from (1) CNO to computer device and (2) cross-connect facility for each data and voice jack.

J. CABLING TO COMPUTER NETWORK OUTLETS - Install the following cables between each identified Communication Network Outlet (CNO) and the wire closet identified on the drawings:

CNO Symbol	Number and Type of Cable(s)
D	2 Enhanced Category 5 Data
V	1 Coax to trunk line (high)
A	1 Enhanced Category 5 Data 1 Enhanced Category 5 Voice
AV	1 Enhanced Category 5 Data 1 Enhanced Category 5 Voice 1Coax to trunk line
W	1 Enhanced Category 5 Data (in ceiling space for wireless access point)
Q	4 Enhanced Category 5 Data
T1	3 Enhanced Category 5 Data
T1F	3 Enhanced Category 5 Data (In floor)
QF	4 Enhanced Category 5 Data in floor box
TM	1 Enhanced Category 5 Data (low) 1 Enhanced Category 5 Voice (low)

	1 Coax to trunk line (low) 1 Coax to trunk line (high) Video cable harness from low “T” to high “M”
C	1 Enhanced Category 5 Data 1 Enhanced Category 5 Voice 1 Coax to trunk line
G	1 Enhanced Category 5 Data 1 Enhanced Category 5 Voice 1 Coax to trunk line All at 84” AFF and covered by wire cage
CT	Denotes counter top Installation

SECTION 17170 – DATA AND VOICE TESTING, IDENTIFICATION AND ADMINISTRATION

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Drawings, Bidding, Contracting and General provisions of the Contract, including General and Supplementary Conditions and Division 0, Division 1, Division 7 and Division 16 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Guidelines for testing and administration issues of data and voice cabling infrastructure

1.3 REFERENCE STANDARDS

A. Refer to Section 17100 “Data and Voice Cable Plant Overview”

B. ANSI/EIA/TIA

1. 568-A and Addenda
2. 526-14
3. 568-B.1
4. TSB 67
5. TSB95

1.4 TEST EQUIPMENT

A. Provide all tools and test equipment required for installation and testing work. Test equipment will be maintained in accurate calibration and will display the dates of the last calibration and next scheduled calibration.

1.5 SUBMITTALS

A. Product Data

1. Testing Documentation
2. Labels

PART 2 PRODUCTS

A. Not used in this Section

PART 3 EXECUTION

3.1 IDENTIFICATION

A. Each voice and data connector will be labeled with a permanent-marking scheme with an identification number according to the following scheme. The corresponding patch panel or termination field for the cable will be labeled with the identical number.

1. The first (left most) digit of the eight digit identification number will identify the wire closet number to which the cable is run
2. The second digit will represent the patch panel number at which the cable is terminated
3. The next four digits will identify the room number
4. The last two digits will identify the sequence number of the connector within the room

3.2 FIELD TESTING

A. Unshielded Twisted Pair Cabling

1. Test all data UTP cabling using a Level IIe tester.
2. Test and document each four (4) pair UTP data cable for the following conditions:
   a. Proper polarity
   b. No reversals
   c. No transpositions
   d. Continuity
   e. No shorts
   f. No AC voltage
   g. No DC voltage
   h. No opens
3. Provide test documentation.

B. Fiber Optic Cable

1. Use an Optical Test Set consisting of an Optical Source (transmitter) and Optical Meter (receiver) to determine end-to-end attenuation and fiber length. Conduct the procedure in three steps; reference set-up, jumper test, and actual patch panel to patch panel testing. Measure each fiber in one direction at both 850 and 1300 wavelengths.
2. Conduct testing of the fiber interconnect cable to determine and document the following information for each fiber:
   a. End-to-end attenuation
   b. Fiber length
   c. Location and cause of any loss
3. Conduct Optical Time Domain Reflectometer (OTDR) testing on each connectorized fiber to determine location and cause of any loss and provide a reference data base visual display of the location of individual system components and attenuation loss. Provide an OTDR trace slope for each fiber clearly indicating fiber number, vertical scale, horizontal scale, wavelength, and refractive index.
4. Provide test documentation consisting of:
   a. Manufacturer's Cable Data Sheet for each fiber providing the end-to-end attenuation readings from factory testing.
   b. Data sheet, indicating the installed end-to-end attenuation and actual length of each installed fiber.
   c. The OTDR trace for each installed fiber.

3.3 TRAINING

A. Provide sixteen (16) hours of on-site training for demonstration and instruction of data network system utilization:

1. Four (4) hours with general overview of data system capabilities and facilities layout for faculty and administrators;

2. Four (4) hours with specific demonstration of system layout and functional description for network support personnel;
3. Four (4) hours of detailed system description and troubleshooting seminar with school-based and district-wide personnel;
4. Remaining time will be coordinated through the principal for demonstration or clarification of data network usage.

SECTION 17190 – SUPPORT AND WARRANTY

PART 1 - **GENERAL**

1.1 WARRANTY

A. A fifteen (15) year Product Warranty and Systems Assurance Warranty for this wiring system shall be provided by the Manufacturer as follows:

1. Extended Product Warranty: The Extended Product Warranty shall ensure against product and workmanship defects, that all approved cabling components exceed the specifications of TIA/EIA 568A and ISO/IEC IS 11801, exceed the attenuation and NEXT requirements of TIA/EIA TSB 67 and ISO/IEC IS 11801 for cabling links/channels, that the installation will exceed the loss and bandwidth requirements of TIA/EIA TSB 67 and ISO/IEC IS 11801 for fiber link/channels, for a fifteen (15) year period. The warranty shall apply to all passive SCS components, including both cable and connecting hardware as a combined system. Any claim covers replacement costs on any defective product, both material and labor.

2. System Assurance: The System Assurance shall cover the failure of the wiring system to support the application which it was designed to support (Enhanced Category 5 and 100 BASE FX), as well as additional application(s) introduced in the future by recognized standards or user forums that use the TIA/EIA 568A and ISO/IEC IS 11801 component and link/channel specifications for cabling, for a fifteen (15) year period.

3. System Certification: Upon successful completion of the Installation and subsequent inspection, the client shall be provided with a numbered certificate, from the manufacturing company, registering the installation.

1.2 Warranty shall be one of the following:

A. Hubbell Premise Wiring Mission Critical Warranty

B. Lucent Technologies LIMITED SYSTIMAX Structured Cabling System Assurance

C. Ortonics Extended Product Warranty and Applications Assurance

D. Siemons Systems Products and Applications Extended Warranty

E. Interlink Technologies End-to-End Systems Warranty

F. AMP NETCONNECT Performance Warranty

G. Leviton Warranty

SECTION 17210 – SWITCHES AND ROUTERS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Drawings, Bidding, Contracting and General provisions of the Contract, including General and Supplementary Conditions and Division 0, Division 1, Division 7 and Division 16 Specification Sections, apply to this Section.

1.2 SUMMARY

A. All active distribution equipment for the of the data communications system

1.3 REFERENCE STANDARDS

A. Refer to Section 17000 “General Requirements”

B. ANSI/EIA/TIA Standards

1.4 SCHEDULING

A. Coordinate all equipment installation schedules with the owner to ensure adequate building security.

1.5 SUBMITTALS

A. Product Data

1. Router
2. Chassis Switch
3. Stackable Switch

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Cisco Systems

2.2 EQUIPMENT

A. Chassis Switch

1. Large School: Cisco Catalyst 4000 (6 slot) chassis switch (or approved equivalent) with associated supervisor engine, server switching module, and other appropriate equipment.
2. Small School: Cisco Catalyst 6000 (13 slot) chassis switch (or approved equivalent) with associated supervisor engine, server switching module, and other appropriate equipment.
3. All chassis switches shall have:
   a. A redundant power supply
   b. A system engine
   c. Software management
   d. Supervisory module
4. Chassis switch and/or stackable switches in TDC will have sufficient port capacity to activate 100% of data connectors in CNOs in the TDC service area.

B. Stackable Switch

1. Cisco Catalyst 24 port 10/1000 Series 3500 XL series, or approved equivalent.
2. Each Telecommunications Room/Remote Equipment Cabinet shall have the appropriate number of 24 port 10/100 Ethernet stackable switches as indicated in the Data Connection Diagram on the IT drawings.
3. At least one stackable switch in either the TR or remote equipment cabinet shall have 100/1000 FX fiber optic uplink capabilities to the chassis switch in the TDC.
4. At least one stackable switch in each TDC/TR shall be the Cisco Catalyst 10/100 3524-PWR XL, or approved equivalent, to support wireless access points.
5. Stackable switches in TR will have sufficient port capacity to activate 100% of data connectors in CNOs in the TR service area.

C. Router

1. The TDC data equipment rack shall contain a router approved for current installation by the Office of the Chief Technology Officer.
2. The telecommunications designer shall recommend a Cisco router for connectivity of the school to the DCPS WAN.
3. The router/access server currently being installed in schools is the Cisco 2511.

PART 3 EXECUTION

3.1 INSTALLATION

A. Furnish, install and test all data electronic data equipment as specified in this document and shown in the data connection diagram on school specific IT drawings.

B. Electronic data equipment shall include, but not necessarily limited to, the building router located in the TDC, the chassis Ethernet switch in the TDC, and stackable Ethernet switches located in either the IDF or remote equipment boxes in classrooms or other learning areas.

C. Assure that all equipment shall be UL listed and complacent with National Electrical Code, EIA/TIA 568, 569 and BICSI standards.

D. Provide product data submittals on all electronic data equipment proposed for installation and receive approval from the Office of the Chief Technology Officer, District of Columbia Public Schools.

SECTION 17400 - VIDEO DISTRIBUTION OVERVIEW

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish and install all equipment, accessories, and materials in accordance with these specifications and drawings so as to provide a complete and operating video distribution system consisting of amplifiers, coaxial cable, video headend distribution equipment, media retrieval components, electronic bulletin board, portable video origination system, taps, splitters, connectors, conduit, etc., as required for a complete and operable video distribution system.

2. The work includes a video distribution system to be complete and ready to use. The system shall include all cables, cable fittings, terminal outlets, outlet boxes, wiring devices and all other parts, components and equipment necessary to provide a system for the distribution of signals received from the CATV system cable available at the site and from the local origination sources specified herein.

3. All necessary equipment and installation materials, whether or not specified, shall be furnished and installed in order to provide complete and satisfactory operating systems.

B. General Requirements:

1. The conditions of the General Provisions (General, Supplementary, and other conditions) and the General Requirements of the District of Columbia Public Schools are hereby made a part of this Specification.

2. All bids shall be based on the systems as specified herein. All contractors and systems must be approved by the District of Columbia Public Schools (hereinafter referred to as “the Owner”).

3. Contractor shall provide copies of submittals as specified within 1.03 Submittals. Bidder shall provide a demonstration of the proposed system, if requested.

4. The Owner reserves the right to determine the final approval of the system at the time of scheduled job completion. Failure to meet the installation schedule or provide the "precise functional equivalent" shall result in the removal of the system at the Contractor's expense.

1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

1. NEC - National Electrical Code
2. UL - Underwriters' Laboratories, Inc.
3. NEMA - National Electrical Manufacturers Association
4. ANSI - American National Standards Institute, Inc.
5. FM - Factory Mutual Engineering Corp.

6. IEEE - Institute of Electrical and Electronic Engineers
7. EIA - Electronics Industries Association

B. Qualification:

1. The complete system shall be of a design, which has been in satisfactory operation for at least five years.

2. All work in conjunction with this installation shall be in accordance with good engineering practices. The installation shall be in accordance with the latest requirements of the National Electrical Code, State and local codes, ordinances and regulations of any other governing body having jurisdiction.

3. The Contractor shall submit a list to include at least five of the Contractor's installations of the proposed system, which have been in satisfactory operation for a minimum period of three years.

C. Quality Control:

1. The Contractor shall warrant the equipment to be new and free from defects in materials and workmanship and will, within two years from the date of acceptance, repair or replace all or any part of the equipment found to be defective. The Contractor shall provide warranty maintenance during normal working hours at no expense to the Owner.

2. All work shall be under the supervision of an organization regularly engaged in this work. It shall be the responsibility of this organization to check and inspect this installation. This organization shall also train the Owner's operating personnel on the proper operation of the system. All work in conjunction with this installation shall be in accordance with good engineering practices.

3. The entire installation shall meet all applicable requirements of existing installation codes and especially that of the National Electrical Code.

4. The Contractor or his subcontractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization, capable of furnishing adequate inspection and service to the system, including standard replacement parts. He or his agent shall be prepared to offer a service contract for the maintenance of the system after the guarantee period.

5. All system equipment shall be limited to the products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature made available and in effect at the time of bidding.

6. All items of equipment and wire used for the media retrieval and bulletin board systems shall be designed by the manufacturer to function as a complete system. The design shall include all service notes, drawings, details, and adjustments authorized by the manufacturer.

7. The Contractor shall have been in the video distribution system integration installation business not less than 5 years prior to the bid date.

8. The Contractor shall be an authorized distributor for the proposed equipment and system with full manufacturer's warranty privileges.

9. The Contractor shall maintain a complete inventory of all parts necessary for satisfactory service and maintenance of the proposed system.

10. The Contractor shall provide equipment of one manufacturer for the media retrieval and bulletin board components of the video distribution system unless specifically approved in writing by the Engineer.

11. The Contractor shall furnish eight (8) hours of in service training with the system. Operating manuals and user guides shall be provided at the time of the training. Provide a minimum of three operating manuals.

1.3 SUBMITTALS

A. Shop Drawings:

1. Contractor shall submit original specification sheets or clear copies of same on all items. Manufacturer's name, make and model number shall appear on each sheet. Submittals shall be indexed and presented in a neat and logical order in a binder. Submittals shall contain installation, operation and programming manuals of the proposed systems to provide the Owner and Engineer complete information as to system features, functions and capabilities.

2. Submit manufacturer's latest publication of the following:

   a. 2/W, 4/W and 8/W Taps
   b. Outlets
   c. Traps and Filters
   d. Splitters and Directional Couplers
   e. Entry Terminators
   f. Coaxial Trunk and Drop Cable
   g. Amplifiers
   h. Equipment Rack
   i. Channel Elimination Filters
   j. Modulators
   k. Diplex Filters (Multiplexers)
   l. RF Processors
   m. Audio/Video Patch Panels
   n. Combiners
   o. Electronic Bulletin Board equipment
   p. Video Cassette Recorders
   q. Electronic Communication System Control/Interface Unit for Media Retrieval

3. Submittal shall contain manufacturer's part numbers and quantity listings of all supplied components.

4. The Contractor shall submit one line drawing of all systems showing all major components of the systems. Submit wiring diagrams showing typical connections for all systems and equipment.

5. The Contractor shall submit to the Engineer for approval, prior to the installation of any part of the video distribution system, engineering drawings of the system showing the interconnections of all media retrieval and bulletin board equipment with the designed video distribution system with calculated signal levels. Specification sheets covering all component parts of the system shall be submitted along with the engineering drawings. The system and equipment as shown on the engineering drawings and specification sheets shall meet all items of the specifications.

6. The Contractor shall submit a certificate of completion signed by the Owner and the Engineer at the completion of the job.

7. The components and system shall be listed by the Underwriters' Laboratories.

1.4 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Product Handling: Deliver all materials in good condition; store in a dry place, off ground, and keep dry at all times.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. The components of the general video distribution system shall be as hereinafter specified and as shown on the drawings.

2. The media retrieval and bulletin board components of the video distribution system shall be provided under performance-based specifications. A manufacturer's equipment may be submitted provided that every operational function contained herein is provided. Equipment manufacturers shall be as specified under Section 2.02 Materials. All specified items, functions and quantities are critical to the operation of the School and must be provided exactly as specified. The Owner/Engineer reserve the right to determine if alternate means of operations meet the requirements of the School.

3. The intent is to establish a standard of quality, function and features. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard set forth in these specifications.

4. All equipment shall be new and shall be the latest product of a manufacturer of established reputation and experience of quality electronic equipment.

5. All equipment referred to in this section is to be furnished and installed as a part of this contract.

6. The Contractor shall coordinate all interface requirements with new and existing equipment to insure seamless operation.

2.2 MATERIALS

A. Video System Specification:

1. System Components: Provide a complete and operational video distribution system with media retrieval consisting of, but not limited to, the following:

    a. Coax Cabling and Connectors
    b. Video Taps, Splitters, Directional Couplers
    c. Video Headend Distribution Equipment
    d. Portable Video Origination System
    e. Media Retrieval Components
    f. Electronic Bulletin Board
    g. Control/Interface Unit
    h. Interface with satellite reception system

2. Scope and Description:

    a. The work to be provided under this specification section consists of furnishing and installing a complete, operable, broadband coaxial cable network capable of concurrent data and video communications.

    b. The system shall provide for interactive two-way transmission of video and audio from each and every CATV outlet in the building. It shall be possible to transmit multiple channels of information simultaneously.

    c. The broadband coaxial cable network shall operate over the 5 to 750 MHz range with a sub-split spectrum as hereinafter defined. The network shall use 1000 MHz CATV equipment (where available) and standard CATV installation techniques. The network design shall permit simultaneous transmission of data, audio and video information.

    d. All communications circuits shall be full duplex without the use of multiple cables. All devices attached to the network will be considered "drops", except devices will send information in the "reverse" direction to the head- end and receive information in the "forward" direction from the headend.

    e. The coaxial cable network shall use a sub-split CATV frequency configuration. All amplifiers shall have the following frequency characteristics:

        1) "Reverse Direction" - signals amplified toward the headend - approximately 5 to 30 MHz.
        2) "Forward Direction" - signals amplified away from the headend - approximately 54 to 750 MHz.

    f. Signal levels at various points in the system shall be as shown on the drawings. All unused ports of all cable devices (couplers, taps, splitters, etc.) shall be terminated with shielded 75-ohm terminations to minimize reflections and noise pickup. Excluding the drop line attenuation, no additional attenuators shall be required between a tap port and a drop line device to achieve the specified signal levels.

    g. System AC feeds, RF inputs and outputs shall be provided with appropriate surge protection devices.

h. The system shall also provide for the elimination of six (6) channels from the CATV spectrum for insertion of the above listed channels and the local origination system listed below. Selection of the channels to be eliminated shall be as directed by Owner.

i. If any known signal source will interfere with proper signal transmission on channels selected by the Owner for deletion, then it shall be the responsibility of the Contractor to select alternate channels and place the alternate channel selections in their submittal for approval.

j. The system shall provide for input from a remote sub-band local origination system and be capable of retransmitting the processed signals over a standard CATV channel. The system shall provide local video origination capability at each CATV system outlet.

k. The system shall pass all channels without noticeable degradation of intelligence and color fidelity.

l. The system shall be suitable for the proper connection of standard TV receivers.

m. The system shall deliver a minimum of 3 dBmv and a maximum of 10 dBmv to each receiver on every TV channel in the system from 50-750 MHz. This condition shall be met when every outlet is connected to a load. The Contractor shall adjust system amplifiers, combiners, etc. as required to provide proper signal levels.

n. The video carrier-to-noise ratio shall not be less than 43 dB, measured in a 4 MHz band. Neither cross-modulation distortion (XM), nor composite triple beat distortion (CB) shall exceed -57 dBmV with the network fully loaded with a video carrier in each 6 MHz channel.

o. The system as installed shall be rated and capable of continuous 24-hour operation.

3. Equipment:

a. The Contractor shall provide sufficient quantities of materials and equipment in order to comply with the specifications and provide the functions listed therein. All basic equipment for which there are Underwriters' Laboratories standard requirements shall be listed by Underwriters' Laboratories and be so labeled, or shall conform to their requirements, in which case, certified statements to the effect should be furnished by the manufacturer with a copy of an examination report by a recognized laboratory acceptable to the Local Authority.

b. Certain items of headend equipment are specified on IT drawings.

c. Carts, cameras, microphones and mixers, and LDPs etc. shall be furnished by the Owner.

4. Media Retrieval System Control/Interface:

a. Contractor shall provide the media retrieval system control/interface units for control of devices (VCR, LDP, etc.), which are compatible with the electronic

communication system equipment. Coordinate exact type required with system manufacturer prior to installation.

b. Video source controllers shall be provided in the headend rack location that shall accept signaling from the classroom telephone and convert it to direct video source commands. Provide one (1) controller for each VCR/LDP specified in Section 2.02.A.

c. The interface to a VCR and CDI devices shall be via infrared or uhf data transmission. The interface shall be a universal device and shall be compatible with a majority of commercially available VCR's and CDI's. Interface to LDP devices shall be RS232C for direct interface with Owner's laser disk players.

d. Systems, which require modification of the video source or its remote control device, thus voiding the warranty shall not be acceptable.

e. A Media Center Telephone and loudspeaker shall be provided in the media center. The Media Center Telephone shall be a standard telephone with a rack mounted backlighted digital readout. The telephone shall provide standard administrative level telephone communication functions.

f. The digital display may be used by media center personnel to review the status and assignment of each video source. The display shall indicate which sources are in use and which classroom currently has each source reserved. During the review process, the media center personnel may use the telephone to release specific sources or to pre-assign a specific source to a specific classroom. A single button shall be supplied to provide a completely automated review process of all device assignments.

5. Electronic Bulletin Board:

a. Provide a separate computer based device and associated software to generate a color Electronic Bulletin Board for the distribution of messages and announcements to televisions school-wide via a dedicated channel on the CATV system.

b. The Electronic Bulletin Board software package shall allow for the creation, storage, editing and display of up to 1000 pages. It shall be possible to scroll messages vertically or horizontally. It shall also be possible to wipe pages from the screen vertically or horizontally.

c. The Bulletin Board Computer shall be provided with a rack mounted color display screen (13" minimum) for programming and a keyboard for information input. Bulletin Board system shall be rack mounted with pullout drawer for keyboard set at 26"-29" A.F.F.

6. Video Cassette Recorders (VCR):

a. A total of four (4) VCR's shall be supplied by the Contractor and installed in the media retrieval racks. VCR's shall be compatible with the media retrieval controllers and shall be 4-head, mono output, latest model by Panasonic, JVC, Sony or approved equal.

PART 3 - EXECUTION

3.1 CONNECTION AND INSTALLATION DIAGRAMS

A. Diagrams and Tests:

1. The Contractor shall furnish detailed connection and installation diagrams, and shall furnish a qualified technician to test and adjust the system after installation. This technician shall assist in final inspection of the system.

2. A comprehensive installation, operation, programming and instruction manual shall be supplied as part of the system. The manual shall provide complete service information, including schematics, layout drawings, and interconnecting diagrams showing the location of all the outlets, cable taps, cable routes, and other installed components. Include final "as built" one line system drawings. Include for this particular project parts lists to permit quick and efficient maintenance and repair of the equipment by qualified technicians. Manuals shall include 8-1/2" x 11" device location/cabling route drawings provided in CADD format (Autodesk-AutoCadd Release 14 or later). Manuals shall include a copy of the operations manuals. Manuals shall be indexed and neatly bound in a hardcover three ring binder. Three (3) copies of this manual shall be provided to the Owner upon project completion. Contractor shall retain a minimum of one (1) copy for their permanent records.

3.2 WARRANTY

A. At the completion of the job and before final acceptance, the Contractor shall guarantee in writing that the systems are properly adjusted and shall warrant the systems free from defects for a period of two (2) years from the date of Final Acceptance by the Owner. In addition, the Contractor shall provide a guaranteed service response time of not more than 48 hours from the time of receipt of a trouble call. Service and maintenance during the two-year warranty period shall include all parts and labor and shall be at no additional cost to the Owner.

END OF SECTION

SECTION 17410 – CONTROL AND HEADEND EQUIPMENT

PART 1 GENERAL

1.1 IT DRAWINGS

A. The Contractor shall provide the following described equipment as identified and configured on the IT drawings for specific schools.

1.2 QUALITY CONTROL

A. The contractor will warrant the equipment to be new and free from defects in materials and workmanship and will, within two years from the date of acceptance, repair or replace all or any part of the equipment found to be defective. The Contractor shall provide warranty maintenance during normal working hours at no expense to the owner.

B. The entire installation shall meet all applicable requirements of existing installation codes and especially that of the National Electrical Code.

C. The Contractor or his subcontractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization, capable of furnishing adequate inspection and service to the system, including standard replacement parts. He or his agent shall be prepared to offer a service contract for the maintenance of the system after the guarantee period.

D. All system equipment shall be limited to the products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature made available and in effect at the time of bidding.

PART 2 PRODUCTS

2.1 RACKS

A. Except where shown on the drawings, all video distribution system head end equipment and communications equipment and all equipment associated with the Media Retrieval System shall be installed within a freestanding, upright, steel rack. Racks shall be Scientific-Atlanta Model 567390, or approved equal.

2.2 SPLITTERS AND TAPS

A. Splitters shall be provided as shown on the drawings. Splitters shall be suitable for use from 5 to 1000 MHz and shall be the following model numbers of Scientific-Atlanta, or approved equal.

1)	Two-way splitter	Model SAS2G
2)	Three-way splitter	Model SAS3G
3)	Four-way splitter	Model SAS4G

B. Ceiling mounted directional coupler taps shall be provided as shown on the drawings. All taps shall be suitable for use from 5 to 1000 MHz and shall be equal in all respects to Scientific-Atlanta SAT2G-* series for two-way taps, Scientific-Atlanta SAT4G-* series for four-way taps and Scientific-Atlanta SAT8G-* series for eight-way taps.

2.3 COUPLERS

A. Directional couplers shall be provided as shown on the drawings, shall be suitable for use from 5 to 1000 MHz and shall be equal in all respects to Scientific-Atlanta model SADC8G for 8.5 dB tap loss, SADC12G for 12 dB tap loss and SADC16G for 16 dB tap loss.

2.4 AMPLIFIERS

A. Provide a broadband indoor distribution amplifier as shown on the drawings for incoming CATV amplification and distribution to head-end devices. Amplifier shall amplify the inbound CATV feed and present the output to the channel rejection filters and the combiner at the proper signal levels. Amplifier shall have a minimum frequency range of 47-750 MHz and shall be Blonder-Tongue model BIDA 750-30, number 5400-73, or approved equal, complete with pads and equalizers as required.

B. Provide broadband indoor distribution amplifiers as shown on the drawings for headend output amplification and distribution to devices and amplification of sub-band signals from room outlets to the headend. Distribution amplifiers shall amplify the outbound headend signal and present the output to all outlets at the proper signal levels and shall amplify incoming sub-band signals from local origination equipment and present the output to the headend equipment. Provide distribution amplifiers as required to deliver specified signal levels at each outlet location. Provide amplifiers at locations indicated on drawings or as required. Amplifier shall have a minimum forward frequency range of 49-750 MHz, a return frequency range of 5-40 MHz and shall be Blonder-Tongue model BIDA 75A-43, number 5800-74, or approved equal, complete with pads and equalizers as required.

2.5 MODULATORS

A. Two (2) multiplexers, (sub/VHF diplexers) shall be provided. One unit shall be rack mounted for the sub-channel return feed band separation to the dedicated sub-channel processor. The second unit shall be mounted on the portable sub-channel A/V modulator for local band separation. Diplexers shall be suitable for use from 5-1000 MHz with low pass filter section from 5-42 MHz and shall be General Instrument model TF-30XHE-III, or approved equal.

B. Provide one (1) frequency-agile A/V modulator with sub-band output with a minimum of +60 DBM output level. Modulator shall be agile over the frequency range of 7 to 450 MHz and shall be Blonder Tongue model AM-60-450A-OPT 04, or approved equal.

C. Provide one (1), rack mounted frequency-agile RF processor dedicated to receiving and processing the sub-channel modulator and rebroadcast the signal on a standard forward channel. Processor shall accept input in the 7-43 MHz range and shall convert the input to any selected channel in the 50-550 MHz range. Processor shall be Blonder-Tongue model AP-60-550A-OPT 17, or approved equal.

2.6 ADDITIONAL EQUIPMENT

A. If required by the manufacturer of the media retrieval and bulletin board systems, provide an Audio/Video patch panel with "normal-thru" switch contacts. All VCR and bulletin board audio and video inputs and outputs shall be exhibited on the patch panel. A/V output of the LDPs, if any, shall be exhibited on the patch panel. All inputs to the modulators shall be exhibited on the patch panel with “normal-thru” connections to the respective assigned source device. Patch panel shall be utilized for editing, alternate device broadcast, copying, and other functions and shall be provided. Panel connectors shall be standard RCA female type.

B. Connectors shall be provided as required. Connectors shall be coaxial solder-less type, 75-ohm impedance and be designed for the specific type of cable used. All connectors shall be one-piece male w/attached crimp ring, type “F” for RG-6/U and RG-11/U cabling. Connectors shall be Blonder Tongue Model #BTF-56HEX (RG-6) and #BTF-110HEX (RG-11), or approved equal.

PART 3 EXECUTION

3.1 CONNECTION AND INSTALLATION DIAGRAMS

A. Diagrams and Tests:

1. The Contractor shall furnish detailed connection and installation diagrams, and shall furnish a qualified technician to test and adjust the system after installation. This technician shall assist in final inspection of the system.

2. A comprehensive installation, operation, programming and instruction manual shall be supplied as part of the system. The manual shall provide complete service information, including schematics, layout drawings, and interconnecting diagrams showing the location of all the outlets, cable taps, cable routes, and other installed components. Include final "as built" one line system drawings. Include for this particular project parts lists to permit quick and efficient maintenance and repair of the equipment by qualified technicians. Manuals shall include 8-1/2" x 11" device location/cabling route drawings provided in CAD format (Autodesk-AutoCadd Release 14 or later). Manuals shall include a copy of the operations manuals. Manuals shall be indexed and neatly bound in a hardcover three ring binder. Three (3) copies of this manual shall be provided to the Owner upon project completion. Contractor shall retain a minimum of one (1) copy for their permanent records.

3.2 INSTALLATION

A. All video headend equipment shall be installed as per the manufacturer’s recommendation and in strict compliance with local and national codes.

B. All video headend equipment shall be installed as per the Video Headend Detail and the Video System Schematic Design depicted on the individual school IT drawings.

END OF SECTION

SECTION 17470 – TESTING, IDENTIFICATION AND ADMINISTRATION

PART 1 GENERAL

1.1 COMMUNICATIONS DESIGN (IT) DRAWINGS

A. Communications Design (IT) drawings show video CNO locations, cable routing, video headend detail and video system schematic design.

B. Dress and permanently label all cables at each end using approved labels to ensure a neat and organized appearance.

1.2 TOOLS AND TEST EQUIPMENT

A. The Contractor will provide all tools and test equipment required for installation and testing work. Test equipment will be maintained in accurate calibration and will display the dates of the last calibration and next scheduled calibration.

B. The Contractor is responsible for performing all tests indicated at the end of each section and submitting results to the Owner for review and approval prior to continuing installation.

C. For all tests, the Owner or its agent must be present at the beginning of testing and at such times, as the Owner deems appropriate.

D. The Contractor shall be responsible for correcting any problems or defects discovered during testing.

1.3 CONNECTOR IDENTIFICATION NUMBERING SYSTEM

A. Video Cables

1. The video Contractor shall provide machine-printed labels for each control and jack installed under this specification section.

2. The first (left most) two digits of the six digit identification number will identify the corridor tap number to which the cable is run and the next four digits will identify the room number.

3. Labels shall be permanently affixed to the respective control or jack and printing of labels shall use non-smearing and indelible ink.

1.4 VIDEO SYSTEM PROOF OF PERFORMANCE

A. Upon completion of the system installation, it shall be the responsibility of the Contractor to perform the necessary adjustments to achieve the system design parameters. All equalizers shall be adjusted so that all signals across the band are equal, plus or minus 3 dB, at the input to each amplifier. Amplifier gain shall be adjusted to designated output level.

B. Each cable feeder line shall be tested for proper termination.

C. The Contractor shall conduct an operating test for approval. Prior to the operating test, the Contractor shall submit to the Engineer system level

measurements for each outlet in the system which show the level in millivolts or dB mv (1 mv = 0 dB mv) of the picture carrier of the channel with the highest signal level and the channel with the lowest signal level. The data shall list the channels, their level and the location of the outlet. Levels shall be measured across 75 ohms.

D. The meter used in signal level measurement shall be a calibrated signal strength meter having an accuracy of +/-1.5 dB, an input impedance of 75 ohms and a tuning range covering at least 5- to 750 MHz. The meter shall have been calibrated by the manufacturer or other approved calibration service within 12 months prior to the measurements. The make, model, serial number and date of last calibration shall be included with the measured data.

E. The testing agency making the measurements shall be identified, and the data must be signed and dated by the testing technician.

F. The system shall be tested and demonstrated to operate in accordance with the requirements of these specifications. The test shall be performed in the presence of an authorized representative of the Engineer.

G. The Contractor shall furnish all equipment and personnel required for the test.

H. The minimum operating test observations shall be as follows:

1. Using a suitable field strength meter, measure the signal level at any ceiling taps selected by the above representative of the Engineer. The signal on each channel shall match, within plus or minus 2 dB, the level listed for the selected tap as shown on the drawings.

2. Using a suitable field strength meter, measure the signal level at any room taps selected by the above representative of the Engineer. The signal on each channel shall be within the range hereinbefore specified in paragraph 2.02.A.2.o.

3. A signal to noise ratio test shall be made using a field intensity meter (tuned RF voltmeter) having a 75 ohm input and the capability of making measurements at 10 microvolts (-40 dB mv). Measurements shall be made at the output of the last amplifier in the system. With normal levels in the system, the field strength meter shall be tuned to the picture carrier of each channel on the system and the reading obtained on the meter noted in dB mv. The signal shall then be removed by disconnecting the coaxial from the first ("headend") amplifier(s) input and terminating the amplifier(s) with shielded 75-ohm loads. The field strength meter will now indicate the remaining noise in the absence of signal. The meter shall be read while tuned to each channel on the system. The reading shall be noted in dB mv. The algebraic difference between the two readings on each channel is the effective loaded signal to noise ratio in dB. This shall not be less than 43 dB.

4. Connect a standard color TV receiver to any outlet and observe picture quality. No visible components of cross channel inter-modulation (windshield wiper effect), ghosting or beat interference shall appear on the screen of the receiver when tuned to any channel being carried on the system.

5. Should the demonstration of performance show that the Contractor has not properly balanced the system and that picture degradation is present or that the output is not as specified, the Contractor shall immediately make all necessary changes or adjustments at no additional cost to the Owner and a second performance demonstration conducted.

1.5 INSPECTION AND INSTRUCTION

A. Final Check-out:

1. A trained and factory accredited engineer shall do all final connections and testing. It shall be the responsibility of this engineer to check and inspect this installation to the Owner's approval. He shall also train the Owner's operating personnel in the proper operation of the equipment. Provide sixteen (16) hours of training.

2. Upon completion of the installation of the equipment, the video Contractor shall provide to the Engineer a signed statement from the equipment supplier that the system has been wired, tested, and functions properly according to the specifications.

B. Diagrams: The Contractor shall furnish three complete sets of operating instructions, including cable diagrams, and other information necessary for proper installation, operation and maintenance of the system components. As-built drawings of the system shall be supplied. These drawings shall include signal levels measured throughout the TV/video system as they were at the acceptance date of the system.

SECTION 17490 – SUPPORT AND WARRANTY

PART 1 - GENERAL

1.1 GENERAL REFERENCE STANDARDS AND CODES

A. The installation shall also comply with the following

1. National Electric Code (NEC), NEPA 70
2. State and Local Building and Electrical Codes
3. Maryland Building Performance Standard (MBPS)
4. Code of Maryland Regulations (COMAR) 0502.02
5. National Fire Protection Agency (NFPA) No. 101
6. BOCA national Building Code
7. ADA The Americans with Disabilities Act
8. FCC47 CFR68 and 15 – Code of Federal Regulations (FCC regulations regarding broadband video distribution)
9. The most recent requirements of EIA/TIA-568A, Commercial Building Telecommunications Cabling Standard, ANSI EIA/TIA-569A Commercial Building Standards for Pathways and Spaces, ANSI EIA/TIA-569A Commercial Building Standards for Grounding and Bounding Requirements, and EIA/TIA-606, Administration Standard for the Telecommunications Infrastructure in Commercial Buildings and applicable Federal Communications Commission (FCC) Rules including Part 68 and Subpart J of Part 15, including required FCC registration and numbering.

1.2 STANDARDS FOR MATERIALS

A. Furnish and install new and undamaged materials conforming to the applicable standard. The standards and publications of the following entities are applicable to materials specified herein

1. Underwriters Laboratories (UL)
2. Institute of Electrical and Electronic Engineers (IEEE)
3. IEEE 802.3 CSMA/CD Access Method – Carrier Sense Multiple Access with Collision Detection access method and physical layer specifications.
4. IEEE 802.7 Recommended Practices for Broadband Local Area Networks
5. IEEE 802.11 Standards for Wireless netoworking
6. American National Standards Institute (ANSI)

7. Electronics Industry Association (EIA)

8. Telecommunications Industry Association
    a. TIA/EIA-568A
    b. TIA/EIA-569A
    c. TIA/EIA-606
    d. TIA/EIA-607
    e. TIA/EIA TSB 67
    f. TIA/EIA TSB 72
    g. TIA/EIA TSB 75

9. Electronics Testing Laboratories, Inc. (ETL)

10. BICSI

1.3 COMPLETENESS OF WORK

A. Furnish all material, labor, transportation, tools, equipment, and supervision to install and leave ready for operation a complete communications systems in accordance with these specifications and the accompanying drawings.

B. All offsets, bends fittings pull boxes, stems and supports for the complete installation are not indicated on the drawings. It is the Contractor's responsibility to furnish and install all such equipment for the complete installation.

1.4 COMPATIBILITY

A. Provide products, which are compatible with other components in the system with which they must interface. Components must fit into the confines indicated, leaving adequate clearance as required by applicable codes or manufacturer for adjustment, repair, or replacement.

B. All work shall conform to the requirements of the authorities having jurisdiction over this work and latest editions of the following codes, regulations and specifications

1. National Electrical Code

2. Underwriter's Laboratories

3. Applicable Local Codes

4. National Fire Protection Association

END OF SECTION