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## The Construction of Infrastructure for Library's Digital Document Telecommunications


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## *Abstract:*

*The construction of infrastructure for library's digital document's telecommunications is one of the most difficult and headache problem, which is lying in front of our librarian. For solving this problem, the author tries to analyze the library's work in this knowledge age. In this paper, the author emphasizes on the topologies of library LAN cabling system, using the PDS system for the library's LAN cabling work, selecting the transmission media for library's electronic document's transportation, and distributing the outlets for library's digital document's transportation. The conclusion is that the librarian should follow the scientific innovations in this knowledge age, otherwise it would be abandoned by the society.*


### On the Cross Road of the Library's Work in the Knowledge Age

We had entered into the new century with unprecedented changes. The social production forces of the world had been tremendously increasing then ever before. So the libraries had been greatly influenced by the constant upgrading and expansion of the information and communications technologies. It is

becoming more sophisticated diverse and wide spread means of communication and proliferation of the information formats. Anyhow, if we look back the changes in the library world in the past century, we can experience a certain stability and continuity throughout the greater part of the 20th century. In China, since the paper replaced the bamboo slip, wooden tablet and silk, the printed matter had still dominated the library for more than 1,500 years. In the most time of the last century, it is still continuing in spite of the scientific innovation of the microform, photography, telecommunication, Xeroxing, faxing etc. By the end of the last century, the creation of computer, the electronic networking, the electronic data, multimedia, etc. had appeared in front of our librarian. These will lead us to consider the electronic service, and electronic consultation. The library users will be no longer requested to visit library building in person for their consultation or borrowing the library materials. They can access the information and library materials from the comfort and convenience of their home or offices. For more changes on the horizon will not only affect the library's services, but also the library's users. There is a Chinese saying of "Survival of the fittest". That is to say: if the library will not catch up with the scientific development, it would be abandoned by the society. Therefore, we should be aware that the trend of the scientific creation. At least, we have to follow closely the social development in this knowledge age.

The important factors can be pointed out one after another, but we have to face the facts of the most difficult problems of the construction of infrastructure for the future library's digital document telecommunication. So, I would like to emphasize on this matter, which include: the topologies of the library LAN cabling system, using the PDS for the library's LAN cabling work, the transmission media for library's electronic documents' transportation, the distribution of outlets for library digital documents' transportation.

**The Topologies of the Library LAN Cabling System**

Modern library buildings require an effective telecommunications infrastructure to support the wide variety of services that rely on the electronic transportation of the information. The infrastructure can be treated as the collection of those components (telecommunication spaces, cable pathways grounding wiring and terminal hardware, etc) that provide the basic support of the distribution of all information within the library building. Therefore, we have to build the LAN (Local Area Network) to meet all these new functions.

LAN is a pre-planned communication system in a library building. It allows all the users to share the same device, and information. The LAN's typically range in size from a small group of users to thousands of users in a multi-story building or in a campus environment.

The main characteristics of the LAN are as following:

(1) The limitation of the data transport distance from 0.1-25km.

(2) The speed of data transportation is quite high, from 1-10mbps.

(3) The lower mistake rate, from $10^{-8}$ to $10^{-11}$.

Moreover, there are three classical topologies typically used with Local Area Network.

**Bus Topology:** In this topology, all the workstations are attached to a single cable, and each end is terminated with a signal dampening device call a terminator. Taps are attached to the bus where drop cables are required and the drop cable interconnected to bus to the hardware device. The distinguishing feature of the bus topology is that the data from any of the station will be transported in this cable and will be received by all other stations. The strong points of this bus topology are easy cabling, high reliability and easy expanding.

**Star Topology:** This topology is characterized by a central hub with each workstation connected to the central hub by a dedicated line. The central hub may be in the form of a mini-computer or the mainframe, or an active concentrator, or multi-port repeater. The strong point of this star topology is easy to establish the networking and easy to control it, but the reliability is not so high.

**Ring Topology:** The ring topology has network devices connected via a closed loop with data packets travelling completely around the network. So, each user can access the data from any other on the ring. There are also a counter-rotating ring, primarily use in backbone applications, provides a secondary ring as a back-up path as a level of redundancy to the primary. If the primary ring fails at any point, the failed device is by passed and the data can flow in the opposite direction on the secondary ring to include all the remaining devices. In the ring topology, there is only on path within the neighbor taps. So, it will simplify the control of the path selection. The ring topology has two shortcomings. One is that if the quantity of the taps is too much, the speed of the data flowing will be slowed down and will be prolong the data travelling. The other problem is that the loop structure is closed and it will not be easy to be expanded.

**Using the PDS (Premises Distributing System) for Library's**

**LAN (Local Area Network) Cabling Work.**

In today's increasingly complex telecommunications environment, the library work is enhanced by the use of computer-based system. Further more, it should be comprised not only traditional voice, data, and video telecommunications, but also with the building's other signal systems, including the security, alarms, and energy management, etc. Therefore, we have to use the PDS to accomplish this task.

The PDS (Premises Distributing System) includes six subsystems. There are: the working area subsystem, the horizontal subsystem, the management subsystem (or the telecommunication closet), the backbone subsystem, the equipment subsystem, and the entrance subsystem.

**The Working Area Subsystem:** The working area cabling extends from the telecommunications outlet/ connector end of the horizontal cabling to the working area equipment. The equipment can be any device including, but not limited to telephone, data terminals and computers. The cabling is known as drop cable. The working area cabling is critical to a well management distribution, however, it is generally non-permanent and designed, so that it is relatively easy to change. The working area cabling may vary in form depending on the applications. A cord with identical connectors on both ends are common used. When application specific adaptations are needed at this area, they shall be external to the telecommunications outlet or connector.

Some of the most commonly encountered adaptations are:

(a) A special cable or adapter is required when the equipment connector is different from the telecommunication outlet or connector.

(b) A "Y" adapter is required when two services run on a single cable.

(c) Passive adapters may be needed when the cable media in the horizontal cabling is different from the cable media required by the equipment.

(d) Active adapter may be needed when connecting devices used different signaling schemes.

(e) Some telecommunications equipment (e.g. ISDN terminals) requires termination resistors in the working area.

(f) In some cases, pair transposition may be necessary for compatibility.

Some of the cabling adapters in the working area may harm the effects on the transmission performance of the telecommunication. So, it is important that their compatibility with premises cabling and equipment be considered before they are connected to the telecommunications network.

**The Horizontal Subsystem:**

The horizontal cabling runs the cable horizontally along the floors or ceilings in the building. It extends from the working area to the horizontal cross connect in the management subsystem (or telecommunication closet). It includes the horizontal cables, the telecommunications outlet/connector in the working area, the mechanical termination, and patch cords or jumpers located in the telecommunication closets.

The following considerations must be taken into account when applying the horizontal cabling work.

(a) Image, voice, data communication service.

(b) The buildings' switching equipment

(c) To accommodate the future equipment and service changes.

(d) The choice and layout of horizontal cable types is very important to design in the building cabling work.

(e) It is necessary to accommodate a diversity of user applications in order to meet the requiring changes to the horizontal cabling as user needs involved.

(f) The electrical facilities that generate high levels of electromagnetic interference (EMI) should be taken into account for the metallic cabling. Motors and transformers used to support the building mechanical requirements and Xerox machines used in the working area are examples of these types of sources.

**The Management Subsystem (or Telecommunication Closet):**

The primary function of this telecommunication closet is for the termination of horizontal cable and

backbone cable distribution. The horizontal cables of all recognized types are terminated in this closet on compatible connecting hardware. Similarity, the recognized types of backbone cable is also terminated in this closet on the compatible connecting hardware. The cross-connection of horizontal and backbone cable termination using jumpers, or patch cords allows flexible connectivity when extending various services to telecommunications outlet/ connectors. Connecting hardware, jumpers, and patch cords used for this purpose are collectively referred to as "horizontal cross-connect"

This subsystem telecommunication closet may also contain the intermediate cross-connect or the main cross-connect of different portions of the backbone cabling system. Sometimes, backbone-to-backbone cross-connections in the telecommunication closet are used to the different telecommunications closets together in a ring, bus, or star configuration.

The telecommunications closet also provides a controlled environment to house the telecommunication equipment, connecting hardware and splice closures serving a portion of the building.

**Backbone Subsystem:**

The function of this subsystem is to provide interconnections between telecommunications closets, equipment rooms, and entrance facilities in the telecommunications cabling system structure. The backbone cabling consists of the backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection. The backbone cabling also includes the cabling between the buildings.

Some special care should be taken when planning this subsystem.

(a) For the telecommunications closet in each floor, the equipment room and entrance facility, maximum quantity of connections should be estimated.

(b) In planning the routing and support structure for the backbone copper cabling, care should be taken to avoid the areas where sources of high levels of electrical magnetic interference (EMI), such as motors, and transformers may exist.

**Equipment Subsystem:**

Equipment subsystem may be considered to be a distinct from the management subsystem because of the nature or complexity of the equipment they contain. Any or all of the functions of the management subsystem can be alternately provided by this equipment subsystem.

**T**he equipment subsystem provides a controlled environment to house telecommunication equipment, connecting hardware, splice closures, grounding and bonding facilities and protect apparatus where applicable.

The equipment room may also house equipment terminations (it may contain horizontal terminations for a portion of the building). In many cases, the equipment room contains network trunk terminations and auxiliary terminations that are under the control of the building's cabling administrator.

**Entrance Facility Subsystem:**

The entrance facility consists of the cables, connecting hardware, protection devices, and other equipment needed to connect the outside plant facilities to the building's cabling. These components may be used for the public network services, private network customer's house services or both. The electrical protection is governed by the applicable electrical codes. Inter-building's backbone cables and antennas may require protection devices. Service providers should be contacted to determine the needs and policies..

**The Transmission Media (Cable) for Library**

**Electronic Document's Transportation**

The transmission media is the cable on which the library electronic documents' data is transported. Unshielded twisted pair, shielded twisted pair, fiber optics and coaxial cable are examples of the media.

Twisted-pair cable may support a wide range of applications- from simple voice up to the large bandwidth of ATM-which makes it very versatile transmission medium. There are different types of twisted-pair cable, including unshielded twisted-pair (UTP) and shielded twisted-pair (STP).

**Unshielded Twisted-Pair (UTP):**

100 ohm UTP is generally constructed with stranded conductor, a thermoplastic conductor insulation, and a thermoplastic jacket (for either plenum or non plenum applications). The transmission rates increase and users migrate require the higher performance UTP cabling. It is important that the mechanical properties and transmission categories of components used in the same cabling system be properly matched to assure a consistently high level of dependability and transmission performance.

The recognized categories of UTP cabling are:

*** Category 3**: This designation applies to 100 ohm UTP cables and associated connecting hardware, whose transmission characteristics are specified up to 16 MHz.

*** Category 4**: This designation applies to 100 ohm UTP cables and associated connecting hardware, whose transmission characteristics are specified up to 20 MHz.

*** Category 5:**. This designation applies to 100 ohm UTP cables and associated connecting hardware, whose transmission characteristics are specified up to 100 MHz.

All cable and connecting hardware shall meet the requirements of the applicable codes in that jurisdiction.

**Shielded Twisted-Pair (STP):**

Shielded Twisted pair is primarily constructed of two individually twisted pairs of thermoplastic conductors, covered with foil, enclosed by an overall shielded and an overall thermoplastic jacket. 150 ohm STP cable originally designed to be the transmission media for the IBM cabling system. Therefore, it is also called IBM "Type" cable. The construction and performance differs depending upon which type of cable it is, and different types maybe constructed with stranded conductors, either plenum or non-plenum.

Some considerations should be taken care to install the STP cable.

(a) Maximum tensile load for STP installation is 55 lbf.

(b) The cable bend radium shall not be less then7.5 cm for non-plenum and 15 for plenum.

(c) The cable's braided shield shall be grounded at the telecommunications closet to the telecommunication grounding bus bar.

**Fiber Optics:** **A** typical fiber optic cable consists of the fiber, with a protective coating, the protective buffer, the strength members, and the outer jacket. The fiber also consists of the core and cladding, constructed of glass or plastic. In most fibers used in the building applications, this coating is 250 microns in diameter.

There are two type of optical fibers, multi-mode optical fiber and single-mode optical fiber.

The *multi-mode optical fiber* will allow many modes of light to propagate. The fiber may be either a graded-index or step-index fiber. Multi-mode step-index is manufactured with a definite step between the core and the cladding. Since the core is made-up of one refractive index, the modes travel at the same speed, with the lower order modes reaching the end before the higher order modes causing the pulse to spread out. The graded index of multi-mode has a core, which is made up of many layers of different refractive index materials. The inner layers have a higher refractive index and the outer layers have a lower refractive index. The light travels in an arch due to passing slower through the higher index material, and passing faster through the lower index material. The multi-mode means that it will accept many modes of light because of its large numerical aperture, and it will support both 850 and 1300 nanometer wavelengths.

There are two common sizes of the multi-mode fiber. 62.5 micron core and 125 microns cladding are the most popular multi-mode fiber. From 50 microns core to 125 microns cladding are typically seen in older LANs and commonly installed in Europe during the last decade.

*Single-mode optical fiber* will allow only one mode to propagate. This fiber is typically a step index fiber. The only axial mode is transported through a small core diameter (7-10 microns). It is used for higher data rate and longer distance requirements.

**Coaxial Cable:**

The coaxial cable is the copper cable type typically consisting of two insulating payers and two conductors. A central conductor wire surrounded by a layer of insulation is then surrounded by an outer shielding conductor, which is then covered with a second layer of insulation. Some special points should be taken care when making installation.

1) When cable with different impedance is used in a continuous cable bus, impedance mismatches may occur at every point. Where the impedance for each cable is different and where connectors and other components do not match the cable impedance, the mismatches cause reflection (signal reflected back to the source) resulting in attenuation. The effects of impedance are mismatches can result in numerous problems that are detrimental to the operation of the network.

2) For each segment use only one solid-splice cable, or if cable is spliced, use all segments from the same manufacturer and lot.

3) To avoid laying the cable near noise sources, such as electric motor, power cables, fluorescent lighting, and other non-compatible equipment and cable.

4) The bend radius should be no less 10 times the diameter of the cable.

5) Using the proper stripping and crimping tolls and die sets and be careful not to nick or bend the center conductor.

**The Distribution of Outlets for the Digital**

**Document's Transportation**

The distribution of outlets for library electronic document's transportation should be designed in accordance with modern library's different functions. The following suggestions can be referred for the library's designers in making the digital document transportation.

1. **The electronic bibliographic access service work**. Normally, this section is designated in the bibliographic room because of the important function for the readers when they enter into the library building. Anyhow, the following factors should be considered when designing the access outlets in this section.

(1) The open stack service will reduce the bibliographic users.

(2) The readers can use the terminals in reading area in the library.

(3) The users can access the library's materials at home or office through MAN( Metropolitan Area Network)

(4) The scale of the library, especially the approximately quantity of readers everyday.

(5) Other factors.

2. **Circulation counter:** There are several functions should be taken into account.

(1) Making the readers' registration cards.

(2) The library's books ' check in and check out.

(3) Recalling the lending books

(4) Easy reference work.

(5) The quantity of the outlets designing should also be considered by the approximately quantify of this library's readers daily.

(6) Other factors.

3. **The reading the reference service area;** Some suggestions can be taken for the electronic outlets distribution in these area.

(1) To set 2-4 outlets for the service counter are necessary in this area.

(2) Near the service counter, about 10 or more outlets can be considered for the new comers because it will be easy for librarian to help them.

(3) If it is possible, reach column in this are can set one outlet for the future.

(4) The quantity of the outlets designed should be done in accordance with the reading and reference area.

4. **Outlets for close stack rooms of books, periodicals and newspapers:** Although the library's closed stack is not for the readers to use, it is still necessary to set the outlets for librarian to do the work of bibliographic control. It is no need to design too much outlets for this area; 2-3- outlets in the closed stack management area will be enough, but don't forget the telephone sets' outlets.

**5. The technical Service Department:** It is no need to mention how important of the technical service department in a library. The full automation in this section is one of the important sign in a library. Therefore, we have to make careful designing for this section. Several points can be considered in this area as the following:

(1) To pay more attention to the functions in this department, for instance, the library materials purchasing, cataloguing, bibliographic controlling, management of serial publication, purchasing the non-book materials (including the audio-video materials, CD-Rom, multi-media materials) etc.

(2) The floor planning in this department, the most important thing is to make it flexible.

(3) The quantity of the outlets should be decided by the quantity of the whole library's service readers, the amount of the budget per year, and the staff in this department.

(4) The union catalogue and other regional or local library's professional cooperation work should be considered in the area.

(5) The library's stored materials digitization.

(6) Other factors.

**6. The Service Area of AV and Multi-media Materials:** The quantity outlets of this room will be decided by the coverage area. This area is decided by the location of this library and the quantity of the service readers. Quantity of young adult and the students are the main factor for considering the average area in the AV and multi-media.

**7. The office automation:** This is one important part of library management modernization. Different function in different office should be aware. But one thing we want to remind that each staff has better to have one terminal except the manual labor. Telephone sets should never be forgotten to be included.

**8. Firestopping and Security Alarm:** For the safety of the library's readers and its staff, and for the security of the library materials and equipment, the designing system the firestopping and the security alarm should never be omitted. Therefore, we have to equip the video camera, monitor, thief detector,

smoking sensor (or transducer) and others.

***The subsystem of security alarm:*** The library security alarm should be considered and equipped the applications in the area, which includes the rare books stack room, the sample book stack room, the host computer room, and the storeroom for multi-media, etc. In this area, video camera, thief detector, emergency switch etc. are needed. If anyone enters illegally, the security alarm system will work automatically and it will also start the control system. The video camera will start shooting. In the meantime, the detectors are also needed to build-in the electric left, staircase, public passageway and the entrance area. Therefore, all these should be designing in planing the PDS (Premises Distribution System).

***The subsystem of firestopping:*** The library is categorized the first class of Fire Control Building. The most important areas are included the different stack rooms for rare books, periodicals, newspapers, AV and multi-media materials, the host computer room, as well as the technical service department. So, it is necessary to install the smoking sensor, temperature sensor, fire extinguisher, etc. One important thing we would like to point out is that the lightening arrester should never be forgotten to install in the proper place in order to protect the computer sets and all other library equipment.

*The infrastructure for library's digital document's telecommunications may include the hardware, software, platform, and others. For the length of this paper, we hope to have the opportunity to discuss in the future.*

**Conclusion**

Library may not be so important then some of the government's organization, but it would be remained in the social position of the human history because of its function. As we showed the above, the modern science and technology would force the library to change the traditional function. If we, the librarian, refuse to adapt the new scientific innovation, the disaster for the library work is obviously. Therefore, it should never be regarded idly as of no important. This paper is try to help our colleagues to know, to understand, and how to apply the new technology into our library's work of renovation. Actually, it is only like one of the Chinese saying: "Casting Away a Brick in Order to Attract a Jadestone" or " A Modest Spur to Induce Others to Come Forward With Valuable Contributions". So any comment or criticism is always welcome from all of our colleagues and friends.