PERFORMANCE ANALYSIS OF STRUCTURED CABLING WITH ROUTER

A.K.M Fazlul Haque[1], Nur Md. Shamsuddoha[2] and S.M. Mostafizur Rahman[2]
[1]Department of Electronics and Telecommunication Engineering,
[2]Department of Computer Science and Engineering
Daffodil International University
Email: akm_haque@yahoo.com, shams76erf@gmail.com, mostafiz_diu2003@yahoo.com

Abstract: *This paper presents the proposed architecture of structured cabling. We introduced this structured cabling system for the purpose of using it in different locations. We focused on the advantages of using structured cabling rather than conventional cabling system. If this proposed cabling system is followed then the entire cabling system will be easier to running and maintaining, latency will be low and throughput will be high. It is also cost effective. The simulation has been tested by "Packet Tracer" Version 3. Measuring the overall things we see that the switching system, data management, controlling and traffic are more intelligent in structured cabling system.*

Keywords: *Structured cabling, conventional cabling, topology, routing, propagation delay, throughput.*

1. Introduction

Structured cabling is a multipurpose cable installation implemented as a unique system or a group of subsystems in one or more buildings, with the ability to be connected together [8]. It is a standards-based approach to cable plant installation (inside wiring) within a facility or group of buildings. It also integrates the voice, data, video, and various management systems of a building.

Structured cabling falls into the following six sub-systems:

- Entrance facilities are where the building interfaces with the outside world.
- Equipment rooms host equipment which serves the users inside the building.
- Telecommunications rooms are where various telecommunications and data equipment resides, connecting the backbone and horizontal cabling sub-systems.
- Backbone cabling as the name suggests carries the signals between the entrance facilities, equipment rooms and telecommunications rooms.
- Horizontal cabling is the wiring from telecommunications rooms to the individual outlets on the floor.
- Work-area components connect end-user equipment to the outlets of the horizontal cabling system.

In conventional cabling system data management and traffic control requires a high number of devices. The number of devices is interlinked with throughput, propagation delay and cost. The network exists with multiple backbones. For this reason the error reduction is a concerning issue in this cabling system.

In cabling system, routing is an important and significant term. Routing in an OSI layer 3 function. It is a hierarchical organizational scheme [2] that allows individual addresses to be grouped together. These individual addresses are treated as a single unit until the destination address is needed for final delivery of the data. Routing finds the most efficient path from one device to another. The primary device that performs the routing process is the router.

Our aim is to create an architecture that can sustain in any circumstances. It will also manageable to running and maintaining. It will also cost effective and moreover the throughput and propagation delay will take more effect in this system. These problems of Conventional cabling systems have been solved by implementing structured cabling system. The procedure described in the later part of this paper.

2. Design Requirements of a Structured Cabling System

An SCS consists of an open architecture, standardized media and layout, standard connection interfaces, adherence to national and international standards, and total system design and installation. Other than the structured cabling system, voice, data, video and building management systems (BMS) have nothing in common except similar transmission characteristics (analog or digital data signals) and delivery methods (conduit, cable tray, raceway, etc.) that support and protect the cabling investment.

2.1. Building Entrance

Building entrance facilities provide the point at which outside cabling interfaces with the Intrabuilding backbone cabling. The physical requirements of the network [8] [10] interface are defined in the EIA/TIA-569 standard.

2.2. Equipment Room

The design aspects of the equipment room are specified in the EIA/TIA-569 standard. Equipment rooms usually house equipment of higher complexity than telecommunication closets. An equipment room may provide any or all of the functions of a telecommunications closet.

2.3. Backbone Cabling

The backbone cabling provides interconnection between telecommunications closets, equipment rooms and entrance facilities. It consists of the backbone cables, intermediate and main cross connects mechanical terminations and patch cords or jumpers used for backbone-to-backbone cross-connection. This includes:

- Vertical connection between floors (risers)
- Cables between an equipment room and building cable entrance facilities
- Cables between buildings (inter-building)

Cabling Types Recognized and Maximum Backbone Distances:

100 ohm UTP (24 or 22 AWG) 800 meters (2625 ft) Voice

150 ohm STP 90 meters (295 ft) Data

Multimode 62.5/125 µm optical fiber 2,000 meters (6560 ft)

Single-mode 8.3/125 µm optical fiber 3,000 meters (9840 ft)

Backbone distances are application dependent. The maximum distances specified above are based on voice transmission for UTP and data transmission for STP and fiber. The 90 meter distance for STP applies to applications with a spectral bandwidth of 20 MHz to 300 MHz. A 90 meter distance also applies to UTP at spectral bandwidths of 5 MHz - 16 MHz for CAT 3, 10 MHz 20 MHz for CAT 4 and 20 MHz100 MHz for CAT 5.

TIA Backbone Cable Distance (MC to HC):

-Singlemode Fiber…………………..3000m (9840ft) 62.5/125um

-Multimode Fiber…………2000m (6560ft)

-UTP Copper Applications<5 MHz………..800m (2625ft)

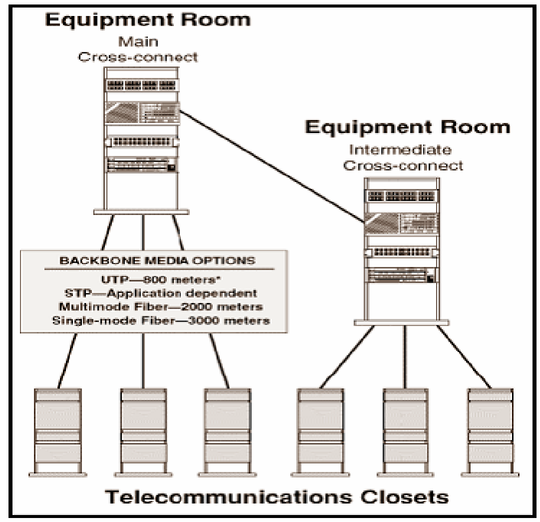

Fig. 1 Backbone media option of Telecommunications closet

2.4. Telecommunications Closet

A telecommunications closet is the area within a building that houses the telecommunications cabling system equipment. This includes the mechanical terminations and/or cross-connect for the horizontal and backbone cabling system

2.5. Horizontal Cabling

The horizontal cabling system extends from the telecommunications outlet in the work area to the horizontal cross-connect in the telecommunications closet. It includes the telecommunications outlet, an optional consolidation point or transition point connector, horizontal cable, and the mechanical terminations and patch cords (or a jumper) that comprises the horizontal cross-connect.

- Customer premises equipment
- HC equipment cord
- Patch-cords/cross-connect jumpers used in the HC, including equipment cables/cords, should not exceed 6m (20ft)
- Horizontal cable 90m (295ft) max. total
- Telecommunication Protocol or Control Protocol (TP or CP)
- Telecommunications outlet/connector(TO)
- Work Area Equipment cord

An allowance is made for WA equipment cords of 3m (9.8ft). An allowance of 10m (33ft) has been provided for the combined length of patch cords/cross connects jumpers and equipment cables/cords in the HC, including the WA equipment cords.

Some points specified for the horizontal cabling subsystem include:

- Application specific components shall not be installed as the part of the horizontal cabling. When needed, they must be placed external to the telecommunications outlet or horizontal cross-connect (eg. Splitters, baluns)
- The proximity of horizontal cabling to sources of EMI shall be taken into account.

The horizontal cabling shall be configured in a star topology; each work area outlet is connected to a horizontal cross-connect (HC) in a telecommunications closet (TC)

2.6. Work Area

The telecommunications outlet serves as the work area interface to the cabling system. Some specifications related to work area cabling include:

- Equipment cords are assumed to have the same performance as patch cords of the same type and category.
- When used, adapters are assumed to be compatible with the transmission capabilities of the equipment to which they connect.
- Horizontal cable lengths are specified with the assumption that a maximum cable length of 3m (10ft).

Work area components:

- Station Equipment computers, data terminals, telephones, etc.
- Patch Cables modular cords, PC adapter cables, fiber jumpers, etc.
- Adapters, baluns, etc. must be external to telecommunications outlet is used for equipment cords in the work area.

For establishing maximum horizontal link distances, a combined maximum length of 10m (33ft) is allowed for patch cables (or jumpers) and (or equipment cables in the work area and the telecommunications [8][12].

Other Design Requirements

- Star topology
- Bridge and taps are not allowed
- Main and intermediate cross-connect jumper or patch cord lengths should not exceed 20 meters (66 feet)
- Grounding should meet the requirements defined in EIA/TIA 607
- Equipment connections to backbone cabling lengths of 30m (98ft) or less.
- The backbone cabling shall be configured in a star topology. Each horizontal cross-connect is connected directly to a main cross-connect or to an intermediate cross-connect, then to a main cross-connect.
- The backbone is limited to no more than two hierarchical levels of cross-connects (main and intermediate). No more than one cross-connect may exist between a main and a horizontal cross-connect and no more than three cross-connects may exist between any two horizontal cross-connects.
- A total maximum backbone distance of 90m (295ft) is specified for high band-width capability over copper. This distance is for uninterrupted backbone runs. (No intermediate cross connect).
- The distance between the terminations in the entrance facility and the main cross-connect shall be documented and should be made available to the service provider.
- Recognized media may be used individually or in combination, as required by the installation. Quantity of repairs and fibers needed in individual backbone runs depends on the area served.
- Avoid installing where sources of high levels of EMI/RFI may exist

3. Network Setup

To enable networking, we must configure network [9] interface card or cards with an IP address and net mask. The kernel must have support for cards compiled in, either as modular support or direct support. Determine the machines IP address from the network administrator and know the network mask. This determines which portion of the IP address specifies the subnetwork number and which portion specifies the host.

3.1. Node Locations

Having selected which PC's, printers and dumb terminals are to be connected to the network initially or in the future, all such network "nodes" must be located on a plan of the building, which is approximately to scale.

3.2. Locating Hubs

It is desirable to have hubs/switches in rooms or closets, which are secure from unauthorized access. It is also desirable to have such hubs/switches at least 1 m away from any switchboards. Looking at the site node map, make an initial selection of potential hub/switch locations, such as offices, store rooms, preferably close to larger concentrations of computers. In a multi-storey building, the hub will generally be near the building core.

Select one hub as the campus hub. This should be located at a point within easy reach of the person likely to be responsible for network administration, but it should also be readily accessible for adding future backbone cables, and preferably towards the centre of the campus. On large sites it is generally the computer room.

Hubs may serve more than one building, providing a viable cable path can be found between buildings and both buildings share the same electrical earth and distribution. Possibilities include:-

- Install underground in existing or new conduits. New conduit usually required, and most easily installed if route is grass or garden. Special underground cat 5 cable must be used to guard against moisture damage.
- Run in conduit or clip on cover rectangular duct under covered walkways Overhead catenaries between buildings (probably the only practical approach with transportable buildings).

3.3. Selecting Backbone Routes

Having located hubs, a means of connecting all the workgroup hubs back to the campus hub must be found. In the past, this was achieved by running a Thin or Thick Ethernet coaxial cable in a daisy chain manner between all hubs. However, this approach has the limitation that all the network [13] traffic is carried on one wire, and a break anywhere in that wire can potentially bring the whole network down. The coaxial sheath can also cause the power supply in buildings to be linked in an unintended manner, which causes surge voltages on the LAN (Local Area Network) [1] if any electrical fault occurs or a fuse blows in one of the buildings.

The structured cabling system approach is to provide separate fiber optic cable pairs (one for transmit and one for receive) [3] radiating out from the campus hub to each workgroup hub. Where voice traffic (telephone, ISDN, etc) is also reticulated through the scheme, multi-pair cable is also provided for this purpose from a PABX frame/patch panel or MDF (Main Distribution Facility) to a patch panel or "pair management frame" at each hub location. Usually one or more spare fiber pairs would be provided to each hub location in case segmentation of the network occurs in the future, or to make direct connections to remote file servers.

If hubs are in the same building, it might be possible to link them using Cat 5 cable providing equipment at either end is suited to it and there are no lightning protection, surge, or earthling issues which could cause problems (generally more applicable to multi-storey buildings).

The way the fiber optic cable is laid depends on the topology [5] of the campus, and the staging of network implementation. Possibilities include:-

- Cluster style campus: - Individual cables radiating out from campus hub like spokes on a wheel.
- Ring style campus: - Cables radiate around the ring, possibly all being laid in the same conduit or duct until they exit to a workgroup. A multi-fiber cable may be laid along part of the route to a workgroup patch panel, which is then patched to smaller individual cables continuing on to other hubs.
- Straight line type campus: - As for ring, except cables are laid in a straight line along the campus.

3.4. Linking Workgroups at the Campus Hub

Although literature gives the impression that fiber will handle very high data speeds, in reality, , the speed of data on a fiber is governed by the available data interface to it.

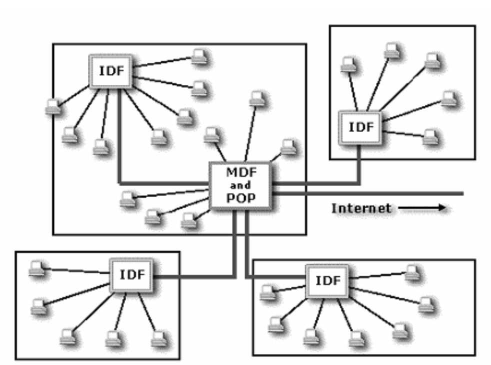

Fig. 2 Extended Star Topology in a Multi-Building Campus

The standard interfaces are 10 Mb/sec just like twisted pair or coax. Higher speeds can only be achieved by purchasing Fast Ethernet (100baseFx, 100Mb/s), Fiber Distributed Data Interface (100 Mb/sec) or ATM (155 Mb/sec) network equipment, which are generally only economic if the network has hundreds workstations [11]. Here in the figure2, the Intermediate Distribution Facility (IDF) of different workgroups linked through Extended Star topology with the Main Distribution Facility (MDF) and Point of Presence (POP). All network traffic between workgroup hubs passes through the campus hub. A means of connecting all the fiber radiating out to the hubs is required. The connection can be made in a number of ways:-

- Multi-port fiber optic repeater: - Broadcasts data from any connected workgroup/fiber to all others. Unless bridges are located elsewhere, all parts of the network will carry the entire campus traffic.
- Multi-port switch or bridge: - Only allows traffic from workgroup connected to any particular port intended for other workgroups to pass between ports (stops local workgroup traffic from slowing down the campus network). Some switches/bridges can filter traffic to prevent nodes from accessing selected other nodes or have VLAN capability (distinct virtual LANs). At a switch or bridge, traffic is regenerated, so in terms of network rules, the bridge is the start of a new network. The market is predominantly for switching these days. Switches are most effective when used with centralized file servers connected directly to switch ports (eg all file servers in one room or area) and on large networks (over 50 PC's).
- Multi-port Router: - Decodes source and destination node addresses of data packets incoming [7], and forwards them to intended work-group and node. Can have very complex restrictions on the type of traffic which can pass through, and who can talk to whom. As for switch, traffic is regenerated, but with some time delay. It can also change network data speed for connection to lower speed outside links. Usage as for switch/bridge.
- The minimal installation for any site with more than two hubs is a multiport repeater. Two hubs can be linked by cascading one hub off a single repeater port on the other hub.

4. Simulations and Testing

The following figures show the model of conventional cabling and structured cabling. In conventional cabling system switch, router and hub are in different locations. There is no central controlling system in conventional cabling system. Moreover, the administrator will have to check all the grounds to solve any errors. We see that the number of devices in conventional cabling is more than structured cabling system. It requires more number of devices to control and manage. For this reason the latency will be high and the throughput will be low. As the propagation delay from one node to another is more, crosstalk may occur. For this reason the actual data from one location might not be delivered to the destination. Some part of the data may be lost. Here we find (by simulation) that the propagation delay in Conventional cabling system is 8 (unit) whereas in structured cabling it is 4 (unit); which is half of the time of Conventional Cabling System.

The problem can be solved by using structured cabling. We have tried to introduce structured cabling system because of its simplicity. If we want to connect different networks [6] in a single backbone we can use this cabling system. With SCS, problems are less likely to down the entire network. If the cable length is less than 100 meter we may use generally UTP cable otherwise Fiber Optic cable [4] is suitable to comparison. We have selected three locations Administrator, location A and location B. A system administrator can control, manage and guide itself and Location A and Location B of the entire network.

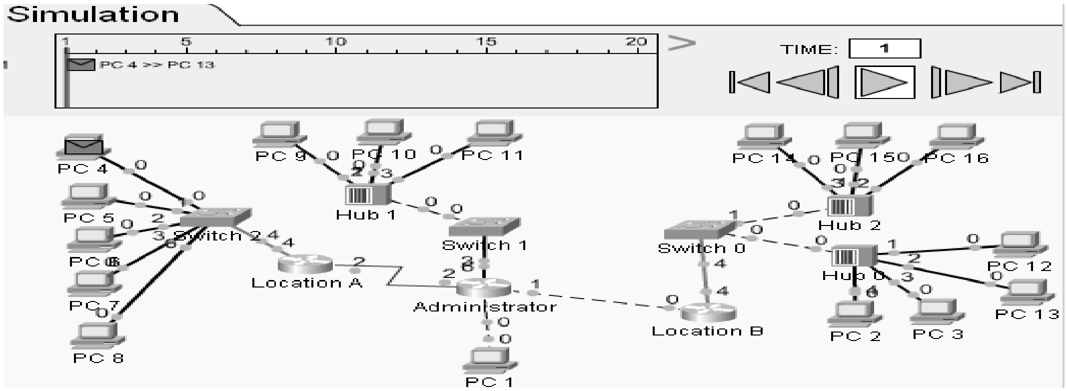

Fig. 3 Data has been sent to PC 13 from PC 4

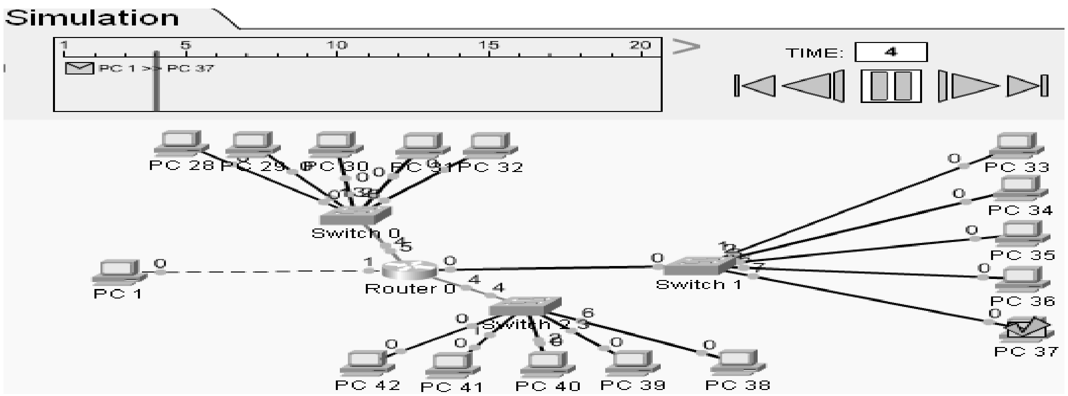

Fig. 4 Data has been traveled nodes and delivered to PC 13

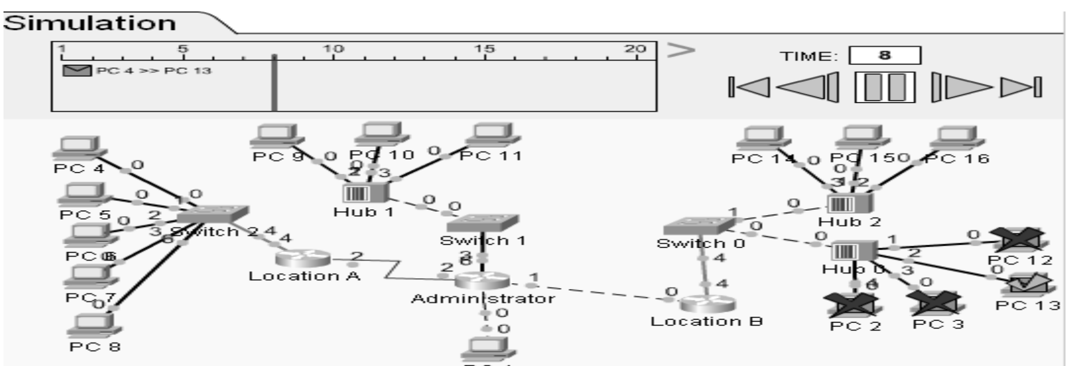

Fig. 5 Data has been sent to PC 37

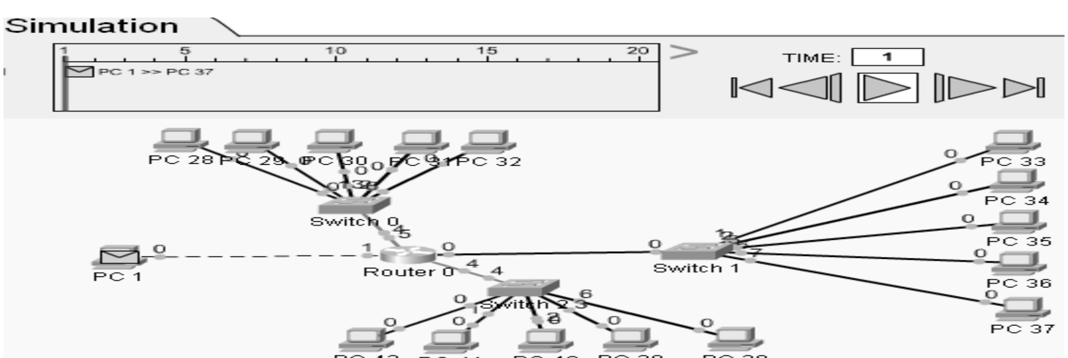

Fig. 6 Data has been traveled nodes and delivered to PC 37

5. Conclusions

The current status of the work is that structured cabling appears to be a suitable technique for high performance Networking. This paper tries to illustrate all the steps of structured cabling system. By gathering strong knowledge and compared the cabling systems we can reach to a conclusion that it is more strong than other cabling systems. In addition, structured cabling also provides administrative and management capabilities. Another underlying factor is management of change. It must be realized that system architectures keep changing as the system evolves and the cabling architecture should be able to change with minimal inconvenience. The provision of a central administrative panel provides the flexibility to make additions, moves, and changes. Structured cabling is also technology independent. Another advantage of structured cabling is fault isolation. By dividing the entire infrastructure into simple manageable blocks, it is easy to test and isolate the specific points of fault and correct them with minimal disturbance to the network.

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A.K.M Fazlul Haque is a senior Lecturer in the Department of Electronics and Telecommunication Engineering, Daffodil International University. Currently he is pursuing his Ph.D. in the CSE Department of Jahangir Nagar University in the field of Telemedicine. Mr. Haque's areas of interest include Biomedical Engineering, Communication Engineering, and Digital Signal Processing.