MONASH University
Information Technology

Reporting: An Enterprise Network Design Report

A Request For Proposal (RFP) to Design Wired LANs, Wireless LANs and support Backbone Wide Area Network (WAN)

ASSIGNMENT-2 Specifications and Discussion:

LAN, WLAN & WAN Design

- Network Hardware
- Network Software
- Network Planning & Design

Reference:

"Local Area Network Management, Design and Security: a Practical Approach" by A. Mikalsen and P. Borgesen, John Wiley and Sons, 2002.

Link: http://library.monash.edu.au/vwebv/holdingsInfo?bibId=1850098

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Network Hardware

- Network services
- DHCP, DNS, Apps Servers
- Internetworking devices:
- Layer-2 Switches
- Layer-2 Wireless Access Points
- Layer-3 Building Routers
- Network Gateways
- Network Interface Cards
- Connectors
- Transmission Media Cables:
  - Structured Horizontal Cabling (Floor Cabling)
  - Structured Vertical Cabling (Within Building)
  - Structured WAN Cabling

Hubs(obsolete) or Switches?

- **Provide an easy way to connect network cables.**
- **Physically, the network is setup as a star.**
- **Reasonably easy to install.**
- **Hubs usually act as repeaters (amplifiers + retiming).**
- **Switch offers advantages:**
  - Each device may be allocated dedicated capacity.
  - Useful for supporting a large number of connected stations.
  - Allows network management and intelligent path selection.
  - Have become more affordable.

Servers

- **Small organizations can use a normal PC as a server.**
- **Large organizations usually use computers built as servers -- very powerful and can be specialized.**
- **A LAN generally has many servers (Services).**
- **The server runs on some network operating system.**
- **Type of server(services):**
  - Print
  - File
  - Database
  - Mail
  - Web etc.
  - DHCP services
  - DNS services
  - Print Services
  - Authentication Servers
  - Email Services
  - Security services

Server
www.monash.edu

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Network Cable Planning

- It used to be common practice to install a network cable wherever it was convenient.
- Now it is critical to plan for effective installation.
- Most buildings under construction have a separate LAN cable plan as they do for telephone cables.
- Structured horizontal cabling
- Structured vertical cabling
- Structured Backbone cabling

Software

LAN Host Operating Systems:

- **Peer- to- peer connection**
- **Server based connection**
- **Example: Windows Server, Novell Netware, Unix/Linux/BSD/Solaris etc.**

Network Application software – requires network:

- **Email, Web, FTP, SAP, SSH etc.**
- **Client server application, e.g., database with Web interface**
- **Groupware, SAN's, VM's, etc..**

Network Interconnections

Two similar LANs or LAN segments can be connected using a:

1. **Switch - operates at the data link layer**

Two dissimilar LANs or LAN segments can be connected using a:

1. **Router - operates at the network layer**
2. **Gateway - operates at the network layer**

Reasons for having multiple LANs

- Each part of the organization may need to implement different LANs.
- An organization is often geographically spread over several buildings separated by considerable distance.
- Spreading the load across the network is important.
- Isolating traffic within necessary areas only.
- Reliability planning is important – the failures in one LAN segment should not impact everyone.
- Security planning is important - parts of the network should have provisions to be isolated.

LAN Design and Planning

- **The basic process involves four steps that are performed iteratively:**
  1. Determining and quantifying current work load.
  2. Estimation and quantifying future load for LAN segments and interconnections.
  3. Design & planning new LAN-segment and interconnections; upgrade existing system.
  4. Installation of infrastructure and components.

- **New LAN design begins from Step 2, but usually involves some measurement of other sites to establish expected needs.**

Step 1- Current Load Analysis

- **Done by monitoring an existing system.**
- **The goal is to determine resource demand by applications and users, and processing demand for all servers.**
- **Must review the list of applications that currently use the network to determine the traffic mix.**
- **Today, much network traffic is produced by**
  - Web, email, FTP,… especially SPAM – and Internet services
  - Groupware business processes
  - Multimedia e.g., video-conferencing
- **Must assess the number and type of users**
- **Determine peak (busy) hours and traffic loads**
- **Network monitoring tools are useful; many open source and proprietary choices**

Step 2 - Estimation of future loads

- **Users identify the services they want to implement during a planning cycle.**
- **Users identify volume ranges for the services they are requesting.**
- **Network requirements should be organized into mandatory, desirable, or wish list requirements.**
- **Assess the relative amount of traffic generated in each segment, based on some rough assessment of the relative magnitude of network needs.**
- **An aggregate resource demand is calculated.**
- **The aggregate results have to be extended by:**
  - Overhead
  - Contingency workload reserves

Step 3 - Design & planning of LAN components

- **From the study of the previous steps, categorize the clients, servers and devices as typical or high volume.**
  - **Typical users** are allocated the base level client computers, as are servers supporting typical applications.
  - **High volume users** and servers are assigned more powerful computers.
- **In designing LANs, practical channel utilization limits are considered:**
  - Fast Ethernet - up to 95% utilization
  - Gigabit Ethernet - up to 95% utilization

Step 3 - Design & planning of LAN components

- **There are two interrelated decisions in designing network circuits and devices:**
  1. the fundamental technology and protocols
  2. the capacity of each circuit
- **Designing for circuit capacity means capacity planning, estimating the size and type of the standard and advanced network circuits for each type of network.**
- **Assessment based on current and future loads.**
- **Although no organization wants to oversize its network and pay for more capacity than it needs, in most cases, going back and upgrading a network significantly increases costs, in equipment and downtime.**

Step 3 - Design & planning of LAN components

- **The internetworking decision depends on:**
  - The location of the LAN segments and processing entities
  - Level of distributed processing
  - Traffic concentration

- **The LAN designer faces these alternatives**
  - Centralized processing and support of a few LAN sites.
  - In most cases, private networks are used.
  - Distributed processing and support of fewer LAN sites.
  - Local LANs are linked to a site backbone and then to network backbones.

Step 3 - Design & planning of LAN components

- **Design includes the wiring concentrators and wiring connections to NICs (network interface cards) in server and client stations.**
- **First, a logical network design is prepared, then it is mapped into a physical network design.**

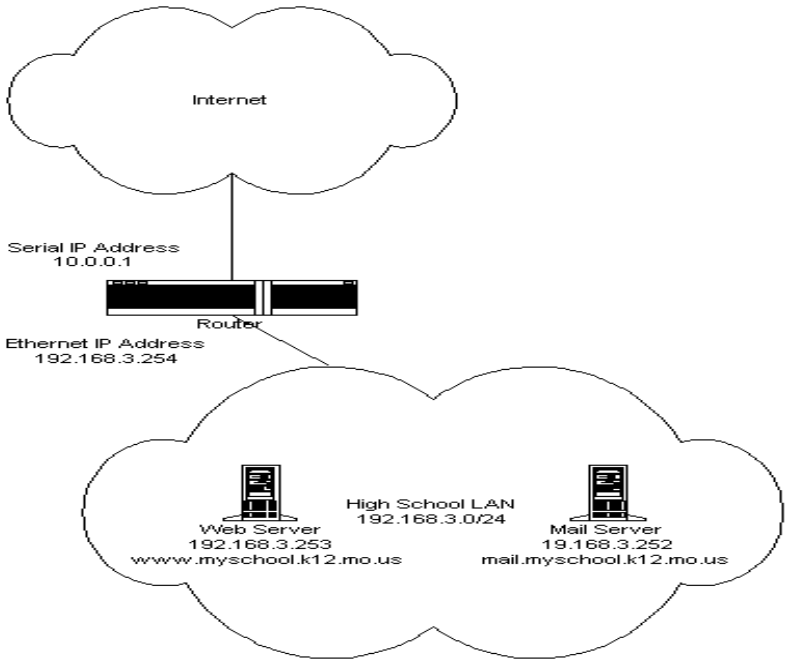

Image source: http://www.more.net/technical/netserv/diagrams/documenting/

Step 3 - Design & planning of LAN components

- **Network modeling and design tools can perform a number of functions to help the design process:**

– Using data on expected network traffic, we can run simulations to see if the network can cope.

– Simulation results will show the estimated response times and throughput.

– The use of design tools can also help in revising the existing network design.

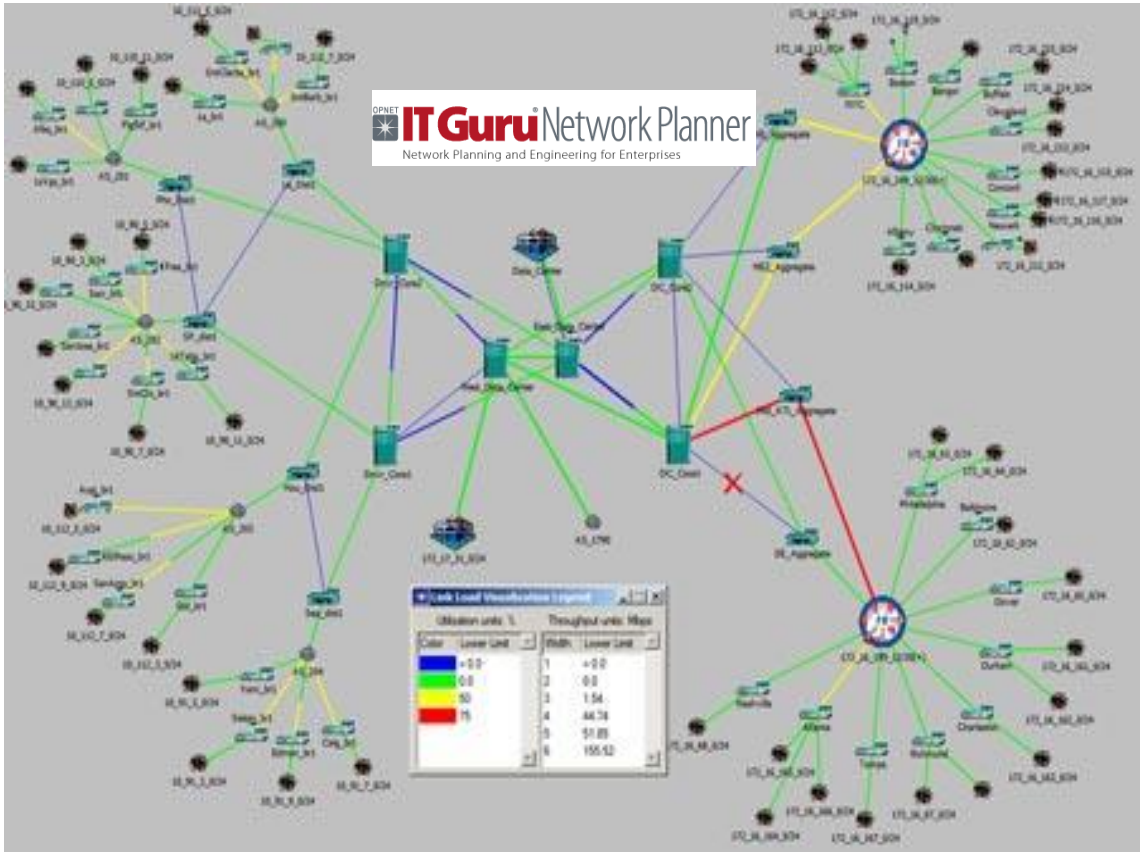

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Image source: http://www.opnet.com/solutions/network_planning_operations/itguru_net_planner.html

Step 3 - Design & planning of LAN components

- **The purpose of cost assessment is to assess the costs of various network alternatives produced from the previous step.**
- **Some of the costs to consider are:**
  1. Circuit costs
  2. Internetworking devices
  3. Hardware costs
  4. Software costs
  5. Network management costs
  6. Test and maintenance costs

For Assignment – ignore costs

Step 4 - Implementation

The following activities are involved in this case:

1. RFP (Request for Proposal)
   - > While some network components can be purchased *off-the-shelf*, most organizations will use the RFP process.
   - > Vendor proposals are evaluated, and the winner(s) is selected.
2. Conversion planning
   - > Current network (if any) should be operational until the new one has been thoroughly tested and proven.
3. Contingency plan for restoring services in case of failures
   - > to deal with ways for temporarily reconfiguring the network to allow for continued operation while conducting repairs
4. Recovery plan
   - > defines methods to restore either a single component of the network or the entire network to operational status
   - > should take into account that system failure may result from device malfunction, natural disasters, fires, sabotage etc.

Fast Ethernet Designations

Designation	Description
100Base-FX	100 Mbps baseband Ethernet over two multimode optical fibers.
100Base-T	100 Mbps baseband Ethernet over twisted pair cable.
100Base-T2	100 Mbps baseband Ethernet over two pairs of Category 3 or higher unshielded twisted pair cable.
100Base-T4	100 Mbps baseband Ethernet over four pairs of Category 3 or higher unshielded twisted pair cable.
100Base-TX	100 Mbps baseband Ethernet over two pairs of shielded twisted pair or Category 4 twisted pair cable.
100Base-X	A generic name for 100 Mbps Ethernet systems.

Gigabit Ethernet Designations

Designation	Description
1000Base-CX	1000 Mbps baseband Ethernet over two pairs of 150 shielded twisted pair cable.
1000Base-LX	1000 Mbps baseband Ethernet over two multimode or single-mode optical fibers using longwave laser optics.
1000Base-SX	1000 Mbps baseband Ethernet over two multimode optical fibers using shortwave laser optics.
1000Base-T	1000 Mbps baseband Ethernet over four pairs of Category 5 unshielded twisted pair cable.
1000Base-X	A generic name for 1000 Mbps Ethernet systems.

Designation	Description
10Gigabit Ethernet	Ethernet at 10 billion bits per second over optical fiber. Multimode fiber supports distances up to 300 meters; single mode fiber supports distances up to 40 kilometers.

Assignment WLAN Design

- **Structured horizontal Cabling**
  - Each floor
    - > Topology
    - > Cabling
    - > Switch location
    - > Cable distance limitation, data rates
- **Structures Vertical Cabling**
  - Switch for each floor
  - Backbone Cabling
  - Router or Layer-3 switch

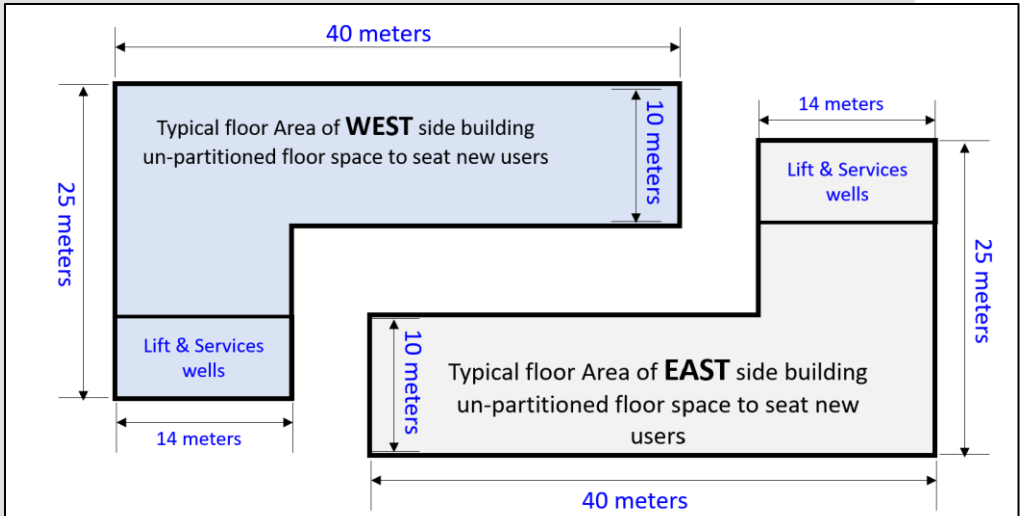


Figure 1: A Typical floor plan for structured cabling for LAN and WLAN (Building(East + West) is 2-storey high)

Note: Lift & Services wells area is the space used for Lift service, Wells used for running vertical network cables between floors.

Assignment WLAN Design

- **Building to Building Link design**
  - Examine the anticipated traffic profile for all the two new buildings
  - Estimate peak volume of data in the **new building**.

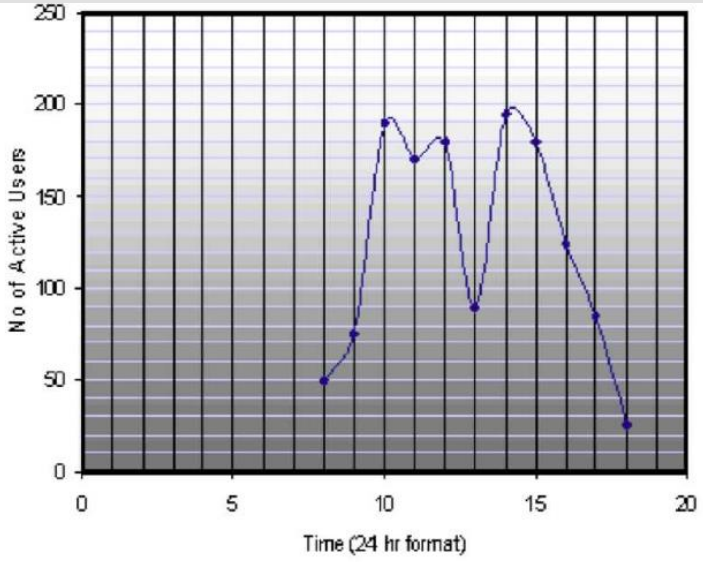
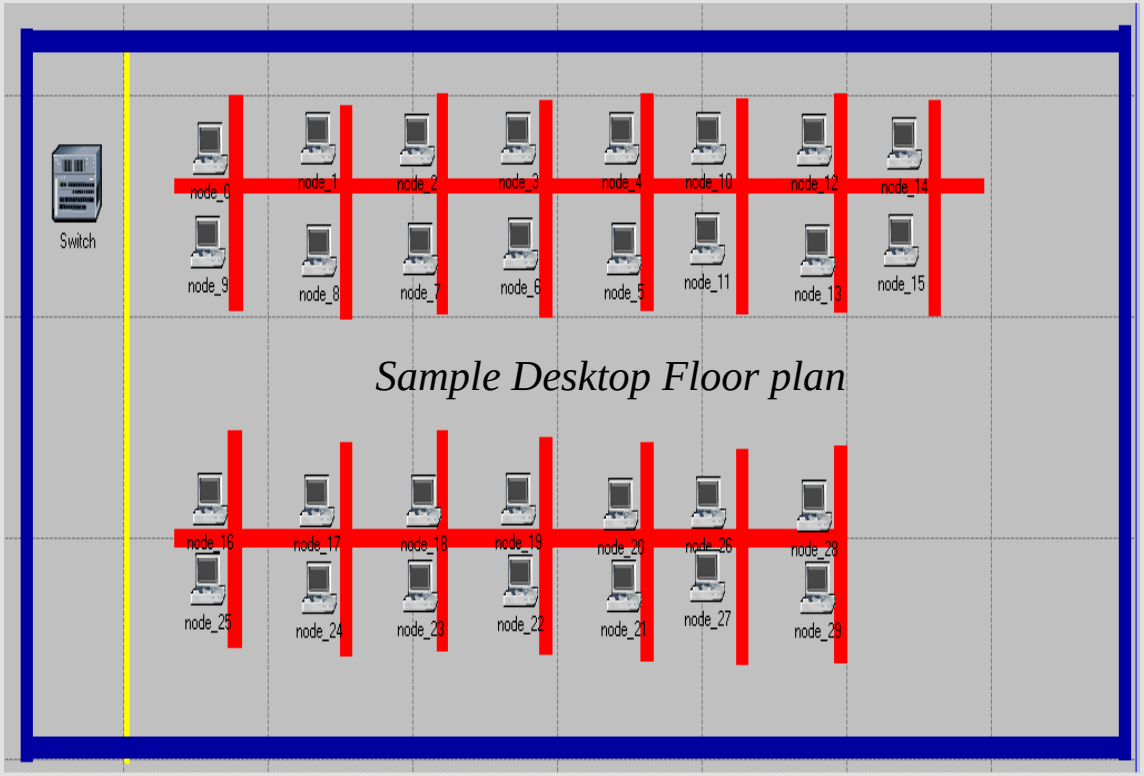


Figure 2: The number of expected users active during the business hours

Structured Horizontal Cabling



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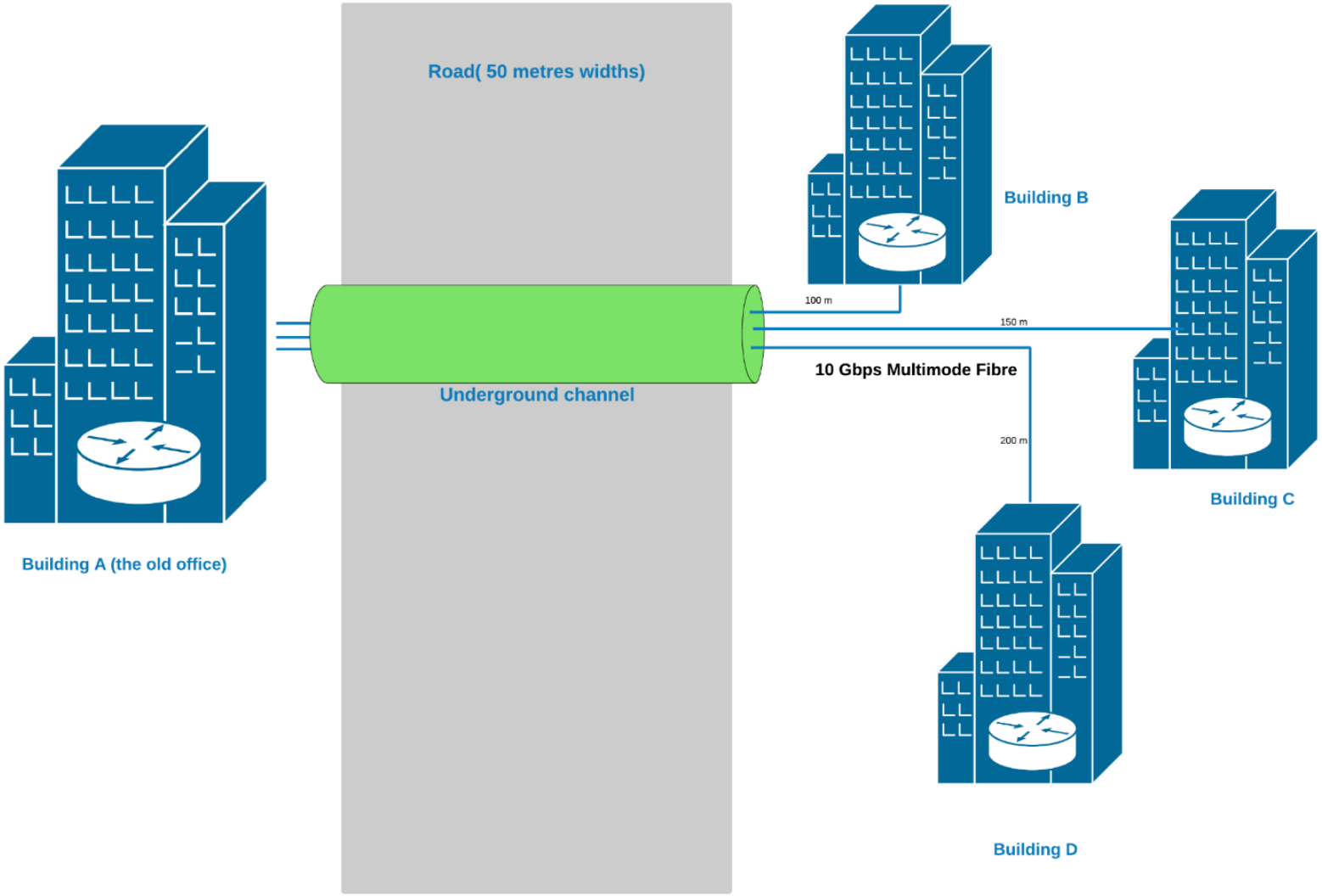
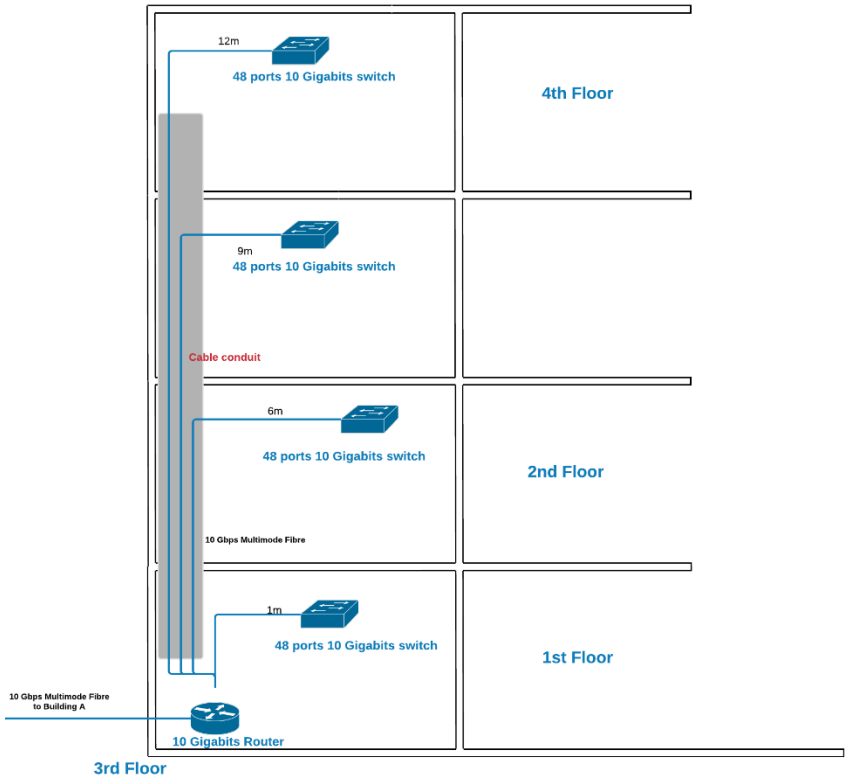
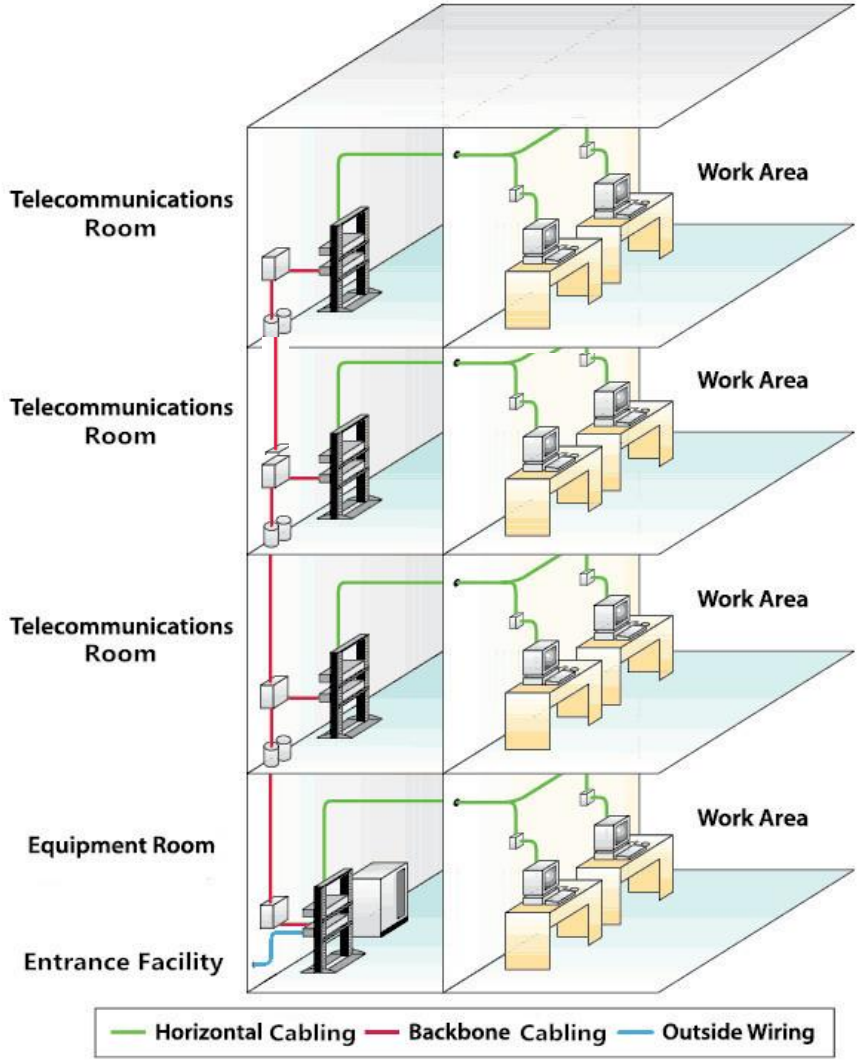

Road(50 metres widths)
Building B
100 m
150 m
10 Gbps Multimode Fibre
Underground channel
200 m
Building C
Building A (the old office)
Building D


12m
48 ports 10 Gigabits switch
4th Floor
9m
48 ports 10 Gigabits switch
Cable conduit
6m
48 ports 10 Gigabits switch
2nd Floor
10 Gbps Multimode Fibre
1m
48 ports 10 Gigabits switch
1st Floor
10 Gbps Multimode Fibre to Building A
10 Gigabits Router
3rd Floor


Telecommunications Room
Work Area
Telecommunications Room
Work Area
Telecommunications Room
Work Area
Equipment Room
Work Area
Entrance Facility
Horizontal Cabling
Backbone Cabling
Outside Wiring