LAB REPORT

Submitted by

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Under the Guidance of

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SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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KATTANKULATHUR-603203

BONAFIDE CERTIFICATE

Certified that this lab report titled **"Design a pre-sales proposal for network setup in a university"** is the Bonafide work done by Rishabh Singh Sahil (RA2011003011334) who carried out the lab exercises under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other work.

SIGNATURE

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INTRODUCTION TO PROJECT

Introduction to Networking

Each of the past three centuries was dominated by a single new technology. The highlight of the 18th century was the automation, bought about by the Industrial Revolution. The 19th century was the age of the steam engine, pioneered by James Watt 20th century, the key technology was gathering, processing, and distribution of information. Among other developments, we saw the installation of global telephone networks, the invention of both radio and TV, the birth and unforeseen (and exponential) growth of the computer, the launching of communication satellites, and, of course, the Internet.

As a result of technological progresses, differences between collecting, transporting, storing, and processing information are quickly disappearing. Organizations with hundreds of offices spread over a wide geographical area can examine the current status of even their most remote outpost at the push of a button. The demand for ever more sophisticated information processing is growing even faster.

Although the computer industry is still young compared to other industries (e.g., automobiles and airline industry), computers have made amazing progress in a (relatively) short time-frame.
During the first 20 years of their existence, computer systems were extremely centralized, usually within one large room. Not infrequently, this room had glass walls, through which visitors could gaze and marvel at the electronic wonder inside. A medium-sized company or university (for example, Dartmouth) *may* have had one or two computers, while very large institutions (for example, the Smithsonian Museum) had at *most* a few dozen. The idea that within less than 35 years, vastly more powerful computers smaller than the stamps used in postcards, would be mass produced by the *billions* was pure science fiction.

The merging of computers and communications has had a profound influence on the way computer systems are organized. The pre-dominant concept of the “computer center” as a single room with a large computer to which users brought their work, which an operator fed into the computer, is now obsolete. The old model of a single computer serving all of the organization’s

needs has been replaced by one in which a large number of separate, but still interconnected computers, do the job.

These systems are called ***computer networks***. Two computers are said to be interconnected if they are able to exchange information. The connection need not be via a copper wire - fiber optics, microwaves, IR, and even satellites can be used (and are in use). They are usually connected together to make larger networks, with the Internet being the most well-known example of a network of networks.

Introduction to Project

Have you ever wondered *how* the networks you use daily – the ones supplied by BSNL, MTNL, Airtel, Cyberoam, Reliance, and so on – work the way they do?

Not the *software* part (HTML, CSS, MySQL, JS, PHP, etc.). The *hardware* part.

If the reader has read the introduction provided for a basic and brief understanding of networking, he may wonder about the *devices*, and the way the devices are *arranged* to form a network.

The networks used in almost all the universities around India are extremely inefficient (cost-bandwidth ratio is very high). So, keeping this in mind, the project is a basic design, a *template*, if you may, that is cost-efficient, while at the same time, supplies a decent bandwidth to the network.

It can be used both for designing a small to medium-sized network, and can even be used for upgrading a network. In case it is not obvious, the design is provided free-of-charge, with lifetime updates, under the GNU General Public License v3 – which means that if you want to supply the project under your own company, you can, but just include this report with the design.

ABSTRACT

This project is based on the “trending” field of Networking and Data Communications. People nowadays use the term for almost new technology that comes out and slowly fizzles out.

But Networking is the only “real” trending field, along with Data Structures and Algorithms, and Machine Learning. Both have existed almost since the advent of Computer Science. Both have the best of the best in CS working in the fields, huge wads of cash are thrown at the fields, and even bigger wads of cash are the result.

I found, from various forums and site around India and abroad (for example – MNIT, UCB, Stanford, Dartmouth, BITS, etc.) that use up huge amounts of green paper on extremely inefficient networks, that could have been diverted elsewhere, for example, on purchasing commercial licenses for software (such as Packet Tracer, AutoCAD, Windows, etc.), improving the infrastructure, PR/Marketing, and so on.

This project is a result of not inconsiderable toil. I have attempted to create a template that can be applied to *all* universities that do not have a very large size. I have given all the basic information necessary for setting up a network – the devices used, the network topology diagram, requirement analysis and so on.

I hope that I have convinced the reader that the field is interesting, as is the idea behind the project. The rest, I leave up to you.

PROJECT SCOPE

The project is intended for small organizations, under the aegis of which both educational institutions, and corporate offices lie. Although the project boasts of only a small number of devices (both in quantity and variety), the project can easily be extended for a large number of client PCs and devices as well – just increase (proportionately) the number of devices used – add more devices attached to each router, switch, and so on.

The project has been made efficiently, keeping in mind the huge wads of cash small universities lack – the number of wires is kept to a minimum, which, due to their great amount of quantity, can cut a significant amount of the total budget – which is not at all desired.

Also, the project can be used both as a blank slate (when you are building the network of your university for the first time), and for upgrading the infrastructure of the network (or for upscaling).

So, one can safely say that the project is feasible, as well as cost-effective.

DEVICES USED IN PROJECT

The devices used in the design can be broadly divided into four categories:

1. Routers
2. Switches
3. Clients
4. Servers
5. Connecting wires

We'll shortly elaborate more on the (slightly) unfamiliar terms of "router" and "switch". First, we'll get the simpler components out of the way.

- Clients – This may include the PCs connected to the network through LAN wires. This may also include smartphones connecting to the network wirelessly, although that particular facet of information will not be mentioned here.

- Connecting wires – This includes
    - DCE/DTE wires – used to connect routers to each other.
    - Copper Straight-Through Wires – one of the most versatile wires ever invented, and are used for connecting
        - Router-to-Switch
        - Switch-to-Clients
        - Router-to-Clients

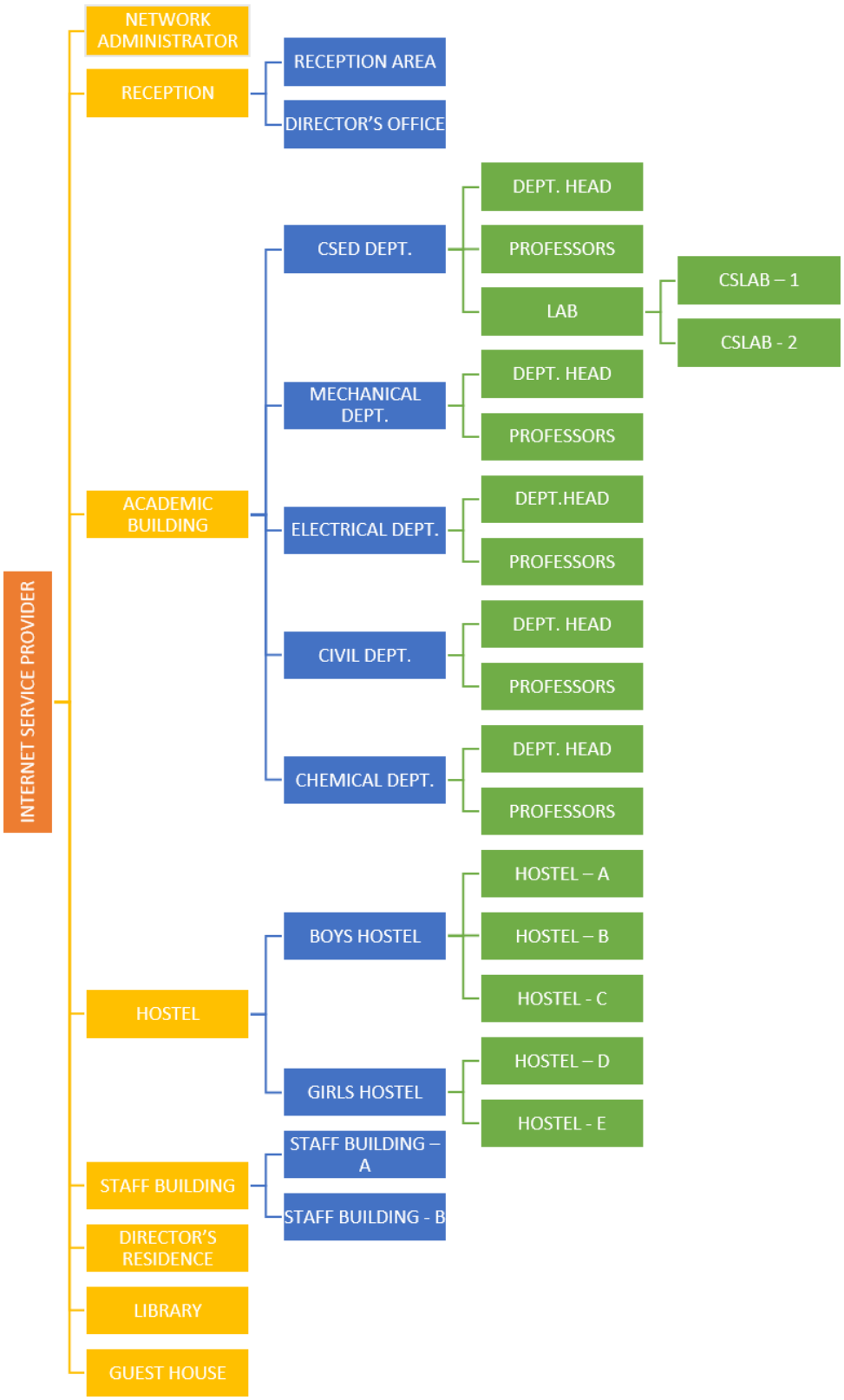
- Servers – Basically, a server is a specialized PC, with huge bandwidth, that hosts all the files for the network, and also enable Internet functionality, by maintaining a seamless connection to the World Wide Web (WWW) through the Internet Service Provider (ISP).

Now we'll see more about the other devices we mentioned earlier –

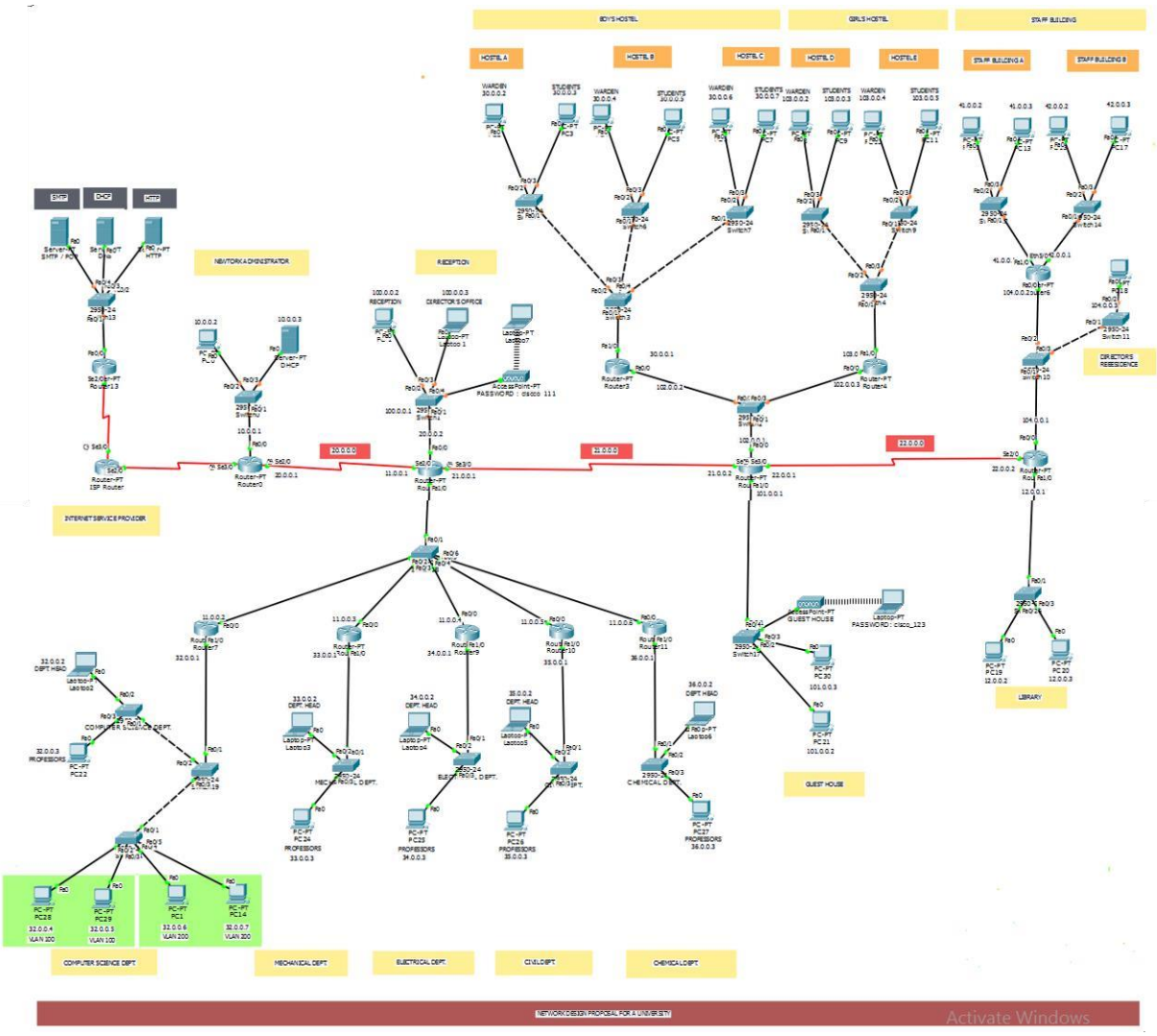
- Routers – To be concise, a router is simply used for inter-connection of devices – for example, a PC to a PC. In our design, a router performs the job of inter-connecting a department to another department.

- Switches – A switch is used for handling selective data units, termed as packets. For example, suppose a client from the Human Resources Department (say PC1) wants to send some confidential data to a client in the R&D Department (say PC9) – this is accomplished through a switch, since a router would forward the packets everywhere without rhyme or reason – hence breaking the confidentiality of the data.

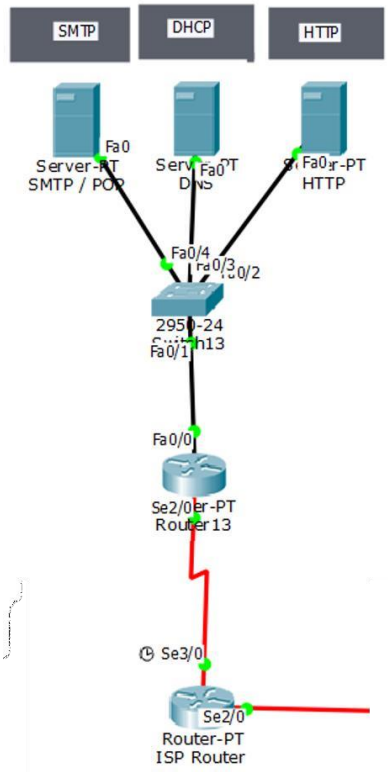
To put it more simply, a department will consist of a group of computers (the PCs) to a switch, which will be connected to other departments through routers. This is a simple and easy-to-understand design.

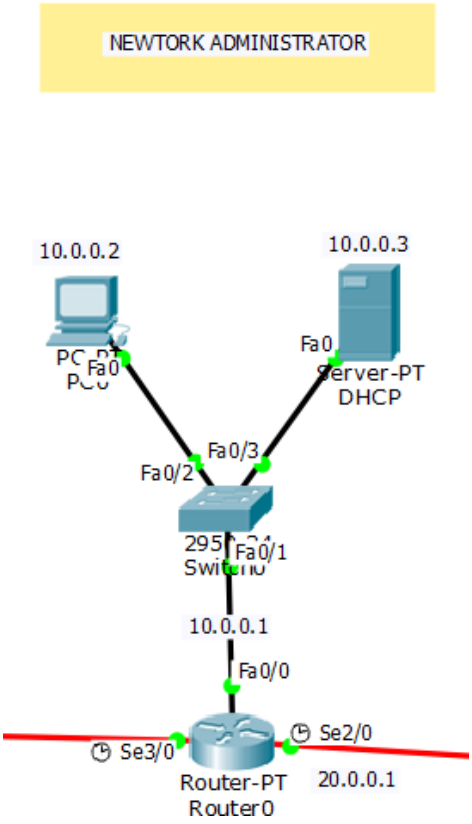

INTERNET SERVICE PROVIDER
NETWORK ADMINISTRATOR
RECEPTION
RECEPTION AREA
DIRECTOR'S OFFICE
ACADEMIC BUILDING
CSED DEPT.
DEPT. HEAD
PROFESSORS
LAB
CSLAB – 1
CSLAB - 2
MECHANICAL DEPT.
DEPT. HEAD
PROFESSORS
ELECTRICAL DEPT.
DEPT.HEAD
PROFESSORS
CIVIL DEPT.
DEPT. HEAD
PROFESSORS
CHEMICAL DEPT.
DEPT. HEAD
PROFESSORS
HOSTEL
BOYS HOSTEL
HOSTEL – A
HOSTEL – B
HOSTEL - C
GIRLS HOSTEL
HOSTEL – D
HOSTEL - E
STAFF BUILDING
STAFF BUILDING – A
STAFF BUILDING - B
DIRECTOR'S RESIDENCE
LIBRARY
GUEST HOUSE

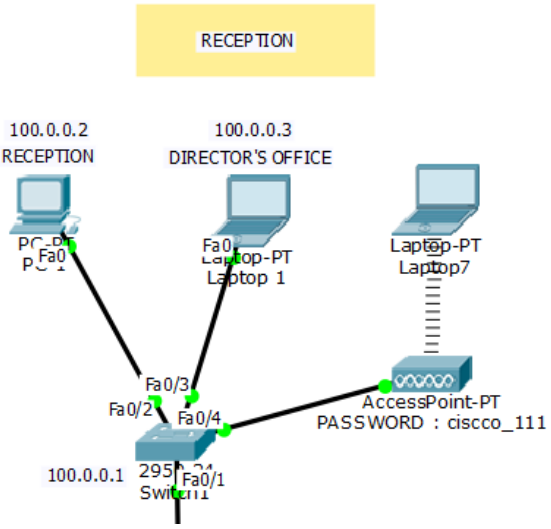
SCREENSHOTS

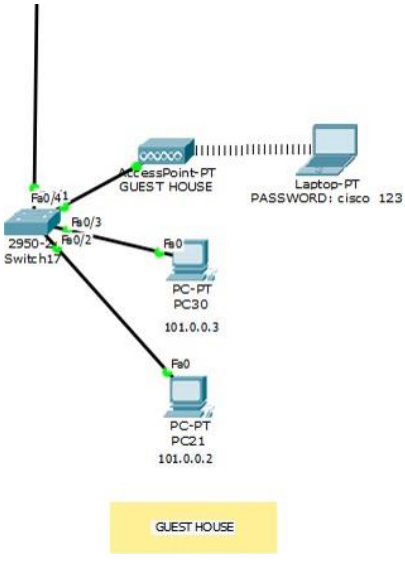


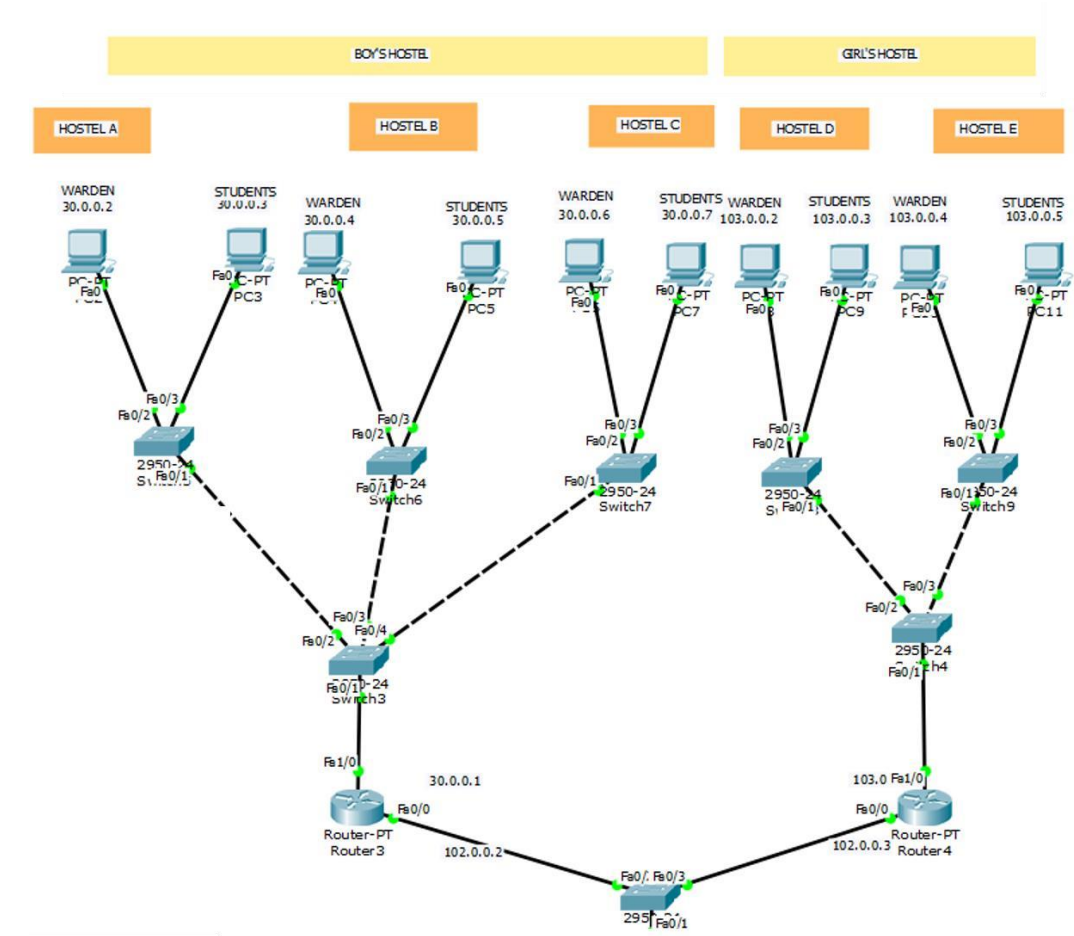
Complete Network Diagram

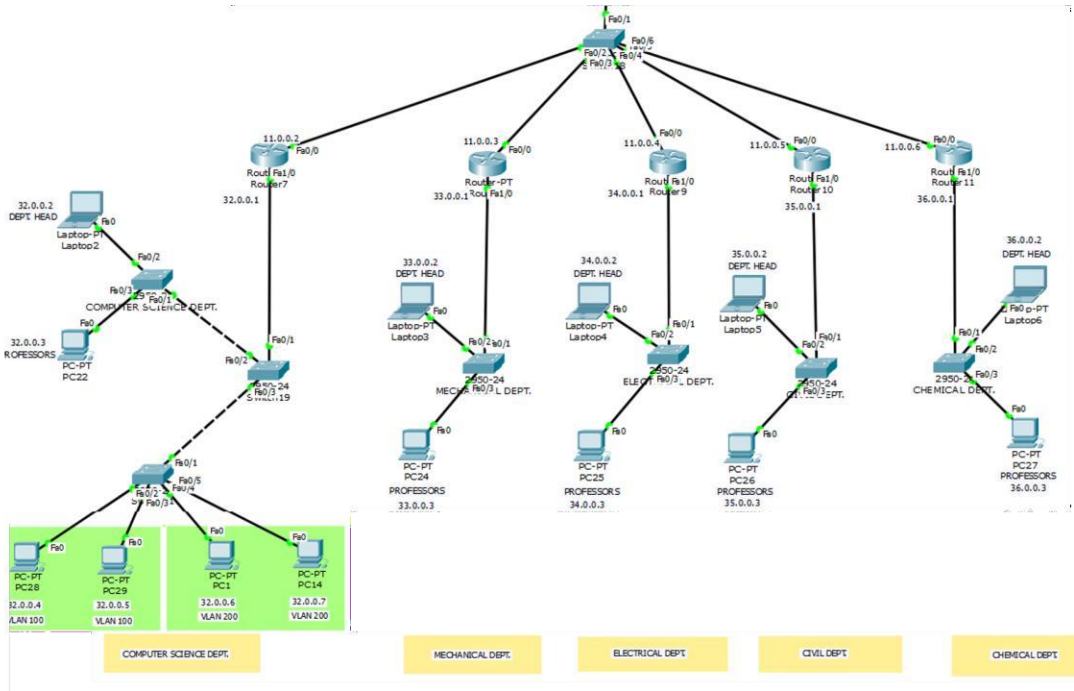

SMTP
DHCP
HTTP
Server-PT
SMTP / POP
Server-PT
DNS
Server-PT
HTTP
Fa0
Fa0
Fa0
Fa0/4
Fa0/3
Fa0/2
2950-24
Switch13
Fa0/1
Fa0/0
Router13
Se2/0
Se3/0
Router-PT
ISP Router
Se2/0
INTERNET SERVICE PROVIDER


NEWTORK ADMINISTRATOR
10.0.0.2
10.0.0.3
PC-PT
PC0
Fa0
Server-PT
DHCP
Fa0
Fa0/3
Fa0/2
Fa0/1
10.0.0.1
Fa0/0
Se3/0
Se2/0
Router-PT
Router0
20.0.0.1


RECEPTION
100.0.0.2
RECEPTION
100.0.0.3
DIRECTOR'S OFFICE
PC-PT
PC1
Fa0
Laptop-PT
Laptop 1
Laptop-PT
Laptop7
Fa0/3
Fa0/2
Fa0/4
AccessPoint-PT
PASSWORD : ciscco_111
100.0.0.1
Fa0/1


AccessPoint-PT
GUEST HOUSE
Laptop-PT
PASSWORD: cisco 123
Fa0/41
Fa0/3
Fa0/2
Switch17
Fa0
PC-PT
PC30
101.0.0.3
Fa0
PC-PT
PC21
101.0.0.2
GUEST HOUSE


BOY'S HOSTEL
GIRL'S HOSTEL
HOSTEL A
HOSTEL B
HOSTEL C
HOSTEL D
HOSTEL E
WARDEN
30.0.0.2
STUDENTS
WARDEN
30.0.0.4
STUDENTS
30.0.0.5
WARDEN
30.0.0.6
STUDENTS
30.0.0.7
WARDEN
103.0.0.2
STUDENTS
103.0.0.3
WARDEN
103.0.0.4
STUDENTS
103.0.0.5
PC3
PC5
PC7
PC9
PC11
Switch6
Switch7
Switch9
Switch3
Router3
Router4
30.0.0.1
102.0.0.2
102.0.0.3


Router7
Router8
Router9
Router10
Router11
32.0.0.1
33.0.0.1
34.0.0.1
35.0.0.1
36.0.0.1
Laptop2
Laptop3
Laptop4
Laptop5
Laptop6
PC22
PC24
PC25
PC26
PC27
PC28
PC29
PC1
PC14
COMPUTER SCIENCE DEPT.
MECHANICAL DEPT.
ELECTRICAL DEPT.
CIVIL DEPT.
CHEMICAL DEPT.
VLAN 100
VLAN 200

REQUIREMENT ANALYSIS

The analysis for the requirements are as follows:

- Network access for the hostels – this is implemented through a separate switch being implemented for the boy's hostel, and similarly for the girl's hostel. A separate switch is implemented for each of the hostels (for example, 3 switches for three boys' hostels) – to ensure that the students of one hostel cannot access the Internet services of another hostel. This reduces system traffic.
- Unlimited network access for the Director's Office – a reasonable proposal. The Director's Office will not have any sites blocked, but will be provided the same speed by the ISP even after fair usage limit. This proposal is extremely simple to implement – just erase the rules that restrict some sites being opened.
- Network access only for all the departments – For all departments other than CSE, one PC is shown as the "HOD PC" – the one specifically reserved for the Head of the Dept. All other PCs are collectively shown as "Other". For CSE, due to the number of labs, multiple switches are created, each switch providing access to one lab where devices in each lab are connected to a vlan.
- Unlimited network access for the staff – we have implemented this by assuming that although the staff will not get their speeds reduced after the fair usage limit, there will be still some restricted sites (the same sites restricted for the students).
- Network access for the library – Simply attach a switch to one of the main routers to enable Internet access.
- Network access for the campus – As above, but Wi-Fi access needs to be provided instead of a wired connection, so a DSL modem is a must.
- Network access for the guest house – Simply attach a switch to one of the main routers to enable Internet access.

SERVICES AND FEATURES

The various services provided by the network are detailed as follows:

- Instant network access –

  We are not adding a portal for login – we felt it was too cumbersome. Instead, we are adding two Wi-Fi routers – one is for the guests (open access, 1/3rd the normal speed), and one for the students, staff, etc. (password protected WPA2/PSK, normal speed).

- Security –

  We have also enabled a selective example to showcase the security measures we could possibly undertake in the future – for example, we have enabled a 256-bit password in the console for the router.

- The Internet Service Provider provides speed at a rate of 8 MB/s.

- There is also the provision for a Network Administrator added – the person(s) who can

  - Decrease, increase or otherwise modify the speeds of the network,
  - Shutdown or restart the entire network (only in cases of severe eventualities),
  - Add more sub-networks to the main networks (example – adding more users to a VLAN, in case a new department is established),
  - Sub-netting – although not done in our network due to complexity issues, it is possible for the network administrator(s) to establish sub-netting in case of lack of IP addresses.
  - It is also possible for the routers to get their firmware replaced, updated, etc. by the network administrator(s).

There may be other features added (or deleted) in the future which will be updated as necessary.

CONCLUSION

We are of the firm opinion that the template provided by this is applicable for *any* network – provided it is *not* large enough.

The network is fully featured with ISP, network administration, interconnection of various departments, VLANs for connection of Department Heads and wardens, network access for library, guesthouse, and an open Wi-Fi too.

This is the template that universities look for when building their first network. We hope you will too.

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