

## Introduction and Analysis

The model we have chosen is a residential home/work environment of 3 floors, 1 basement and a terrace. We are aiming to develop a smart home using a network design which is specifically optimized for working from home and thus supplying the perfect cross point of entertainment and productivity. Each area of the house will be given access from edge to edge and with no blind spots from zero to little loss in bandwidth. As it's a home there are many enclosed spaces and almost unreachable closures which may result in bad signal. We have provided a workaround to this problem by some methods which we will be discussed in detail in the next phase of this paper. The household consists of 3 workers and 2 students which are divided into separate workspaces on 3 floors. We have also kept in mind the guests they may have over, while designing the network. The terrace and basement will have limited access to the network as the former is primarily a resting area and the latter is a parking area. A smart home is usually defined as a system of networks which will control various features and utilities in house such as lighting, air conditioning and home security. There will be a bunch of both stationary smart devices i.e. TVs, refrigerators and portable devices like laptops and smartphones scattered throughout the network. The network consumption of each of the devices is taken into account when constructing the topology. We also have made a rough calculation to find out the recommended bandwidth of internet this model should access to have a stable and reliable connection. We tried to take the most cost effective approach without compromising QoS, and we think we have achieved that. The house security features such as remote access video streaming door webcams, accessible garage door, and door security. Room lightings are operable from any device on the same network and so on. There will be File Servers placed in accordance with the people who will need to use it.

### Hardware List

We will require the following materials to design the network;

Item	Devices and Equipment	Functions
1	Ethernet Cable	Hard Wire Connection
2	Cisco router (Cisco Catalyst 2911K9 Sec Router)	layer three switching (Routing)
3	Cisco switch (Cisco Catalyst 2960 switch)	layer two switching (Switching)
4	Wireless Access points	Wireless transmission of media
5	File Server	NAS (Network Attached Storage) which stores files to be shared in the whole network.
6	Video Stream enabled doorbell	Ring branded doorbell

7	Security Cameras	Cameras will be installed on every floor
8	A/C with a D2 slot	Air Conditioning unit
9	Motion Sensor	Alarms the homeowners in case of an intruder
10	Remotely controlled garage door	Garage door controlled from anywhere inside the network
11	Refrigerator	Remotely controlled refrigerators
11	UPS (Inform 3KVA Untreatable Power Supply)	Holds and supply the power for the above listed devices in data center for at least 30 minutes during the grid line off.

### Software List

- Ring Software for windows/android/ios
- Linux OS for the NAS
- Custom retail software for every appliance mentioned on the hardware list

### System Problem

- File Sharing: Hard to share files, there is no central storage device every user can access and thus making the file transfer process tedious. The NAS will be located in the basement with ample ventilation.
- No sharing of resources: Hardware components such as printers and copiers are not connected to the network and are only accessible from one device.
- Heavy traffic caused by every device being connected to the same switch.
- Having no clear boundaries between work devices and entertainment ones.
- Loss in internet bandwidth resulting from the conjunction.

### System Requirements

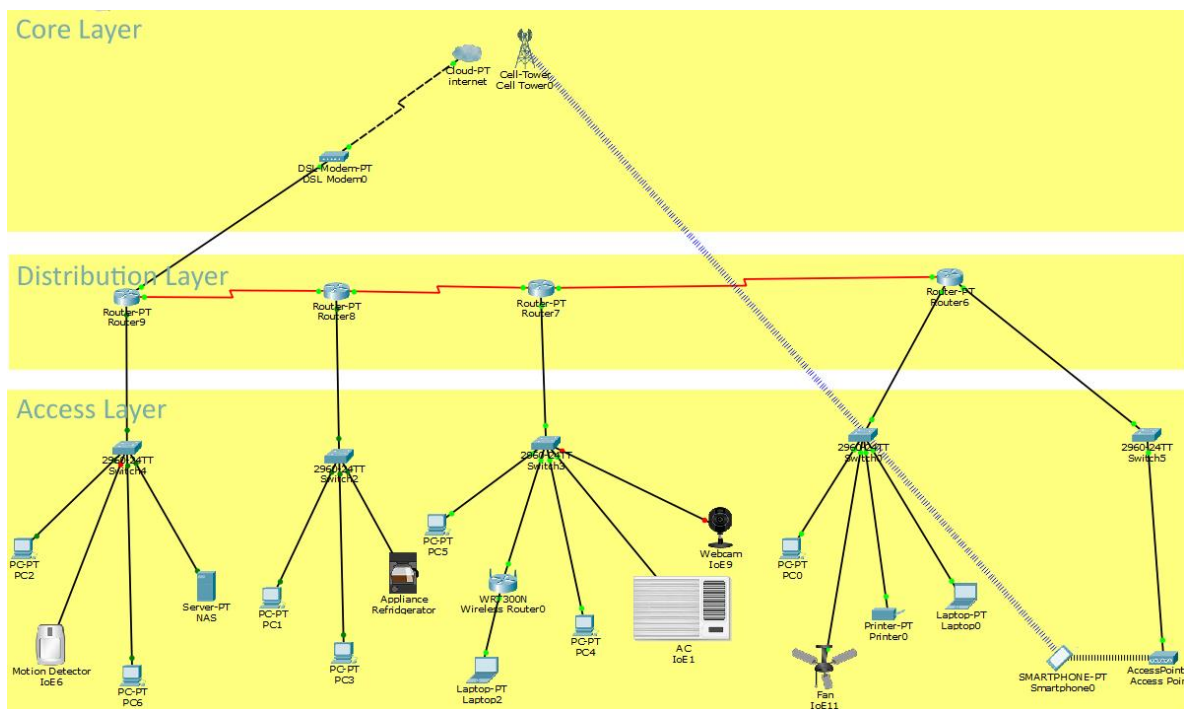
No.	Floor	Hardware	Expected number of users	Focus area
1	Basement	Server	Server will be simultaneously used by many users, hard to predict	Will only be physically accessed in the case of maintenance
		Ring doorbell		
		Motion Sensor		
2	Ground	TV	3 users	Family area
		Refrigerators		
		Wireless Router		
		Other Appliances		
3	1 <sup>st</sup> Floor	Printer	3 users max	Office Area
		AC Unit		
		Other Appliances		
4	2 <sup>nd</sup> Floor	Printer	3 users max	Office Area
		Cable internet		
5	Terrace	Wireless Router	Hard to predict	Relaxation area

## Objective and Scope

The main aim of this project is to construct a clear and aesthetically pleasing network design which is also fast and efficient. We tried to avoid unnecessary expenses by using reasonable material (such as lower cat Ethernet cables) and distances between endpoints. The Scope includes wireless and hardwired connections. We tried to minimize the wiring by only using cable for devices that require it such as printers and appliances. We are well aware that these devices have Wi-Fi enabled versions but we chose these ones due to cost efficiency reasons.

## Proposed Network Design

### Hierarchical Design









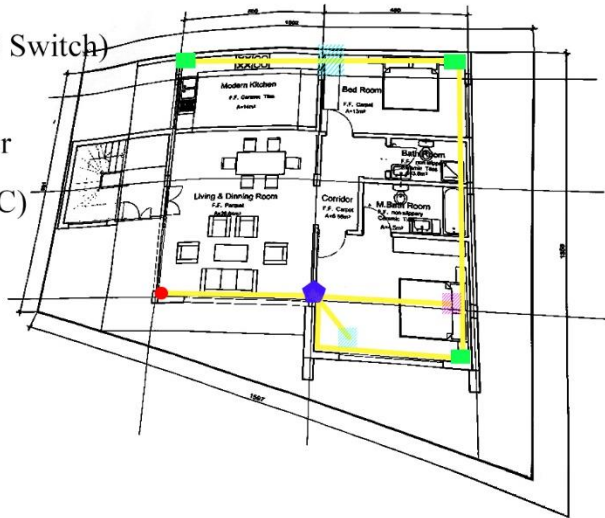
### Cost Specification

Type	Quantity	Price	Details
Router	4	24000 Br	NetGear JG55
Switch	5	20000 Br	Cisco SG300 24 port
1m Ethernet cable 5e	200	6000 Br	Average 50mb/s speed
NAS	1	15000 Br	WD 4TB 8 Hard Disk array
Wireless Router	4	4800 Br	Cisco Dual Band 2.4GHz & 5 GHz
Garage Door	1	3000 Br	Nexx Smart Garage
Webcam	1	7500 Br	Doorbell Ring Elite
<b>Total</b>		<b>80300 Br</b>	

## Physical Design

### Legend





-  Ethernet Cable
-  Router(Layer 3 Switch)
-  Switch
-  Wireless Router
-  End Device (PC)
-  Printer



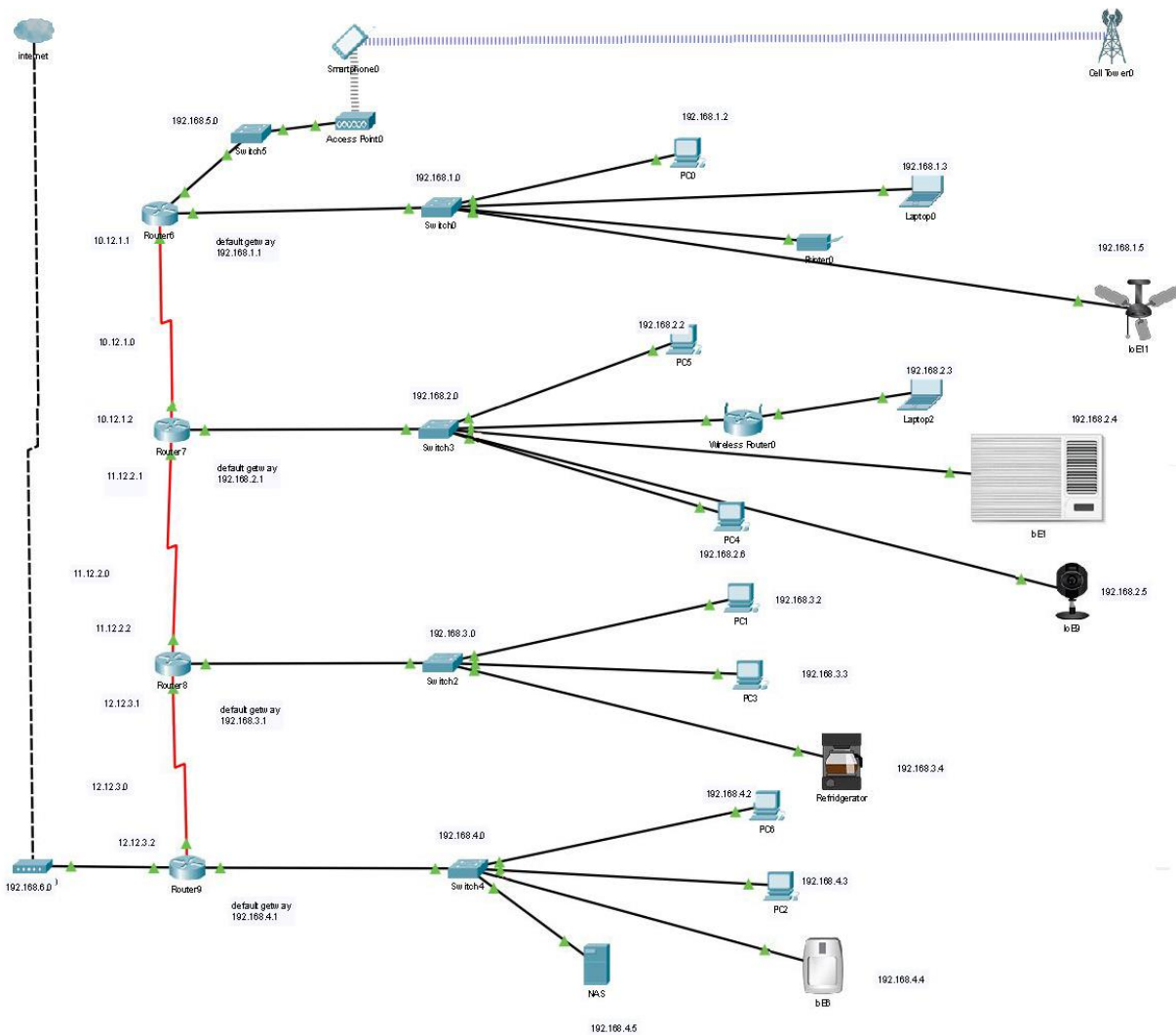
The above design will be applied to every floor of the house with little to no variations. The backbone cable connecting the routers and/or layer 3 switch will take the following route.



### Legend

-  Serial DTE Cable
-  Router or Layer 3 Switch
-  Modem
-  Ethernet Cable

## Logical Design



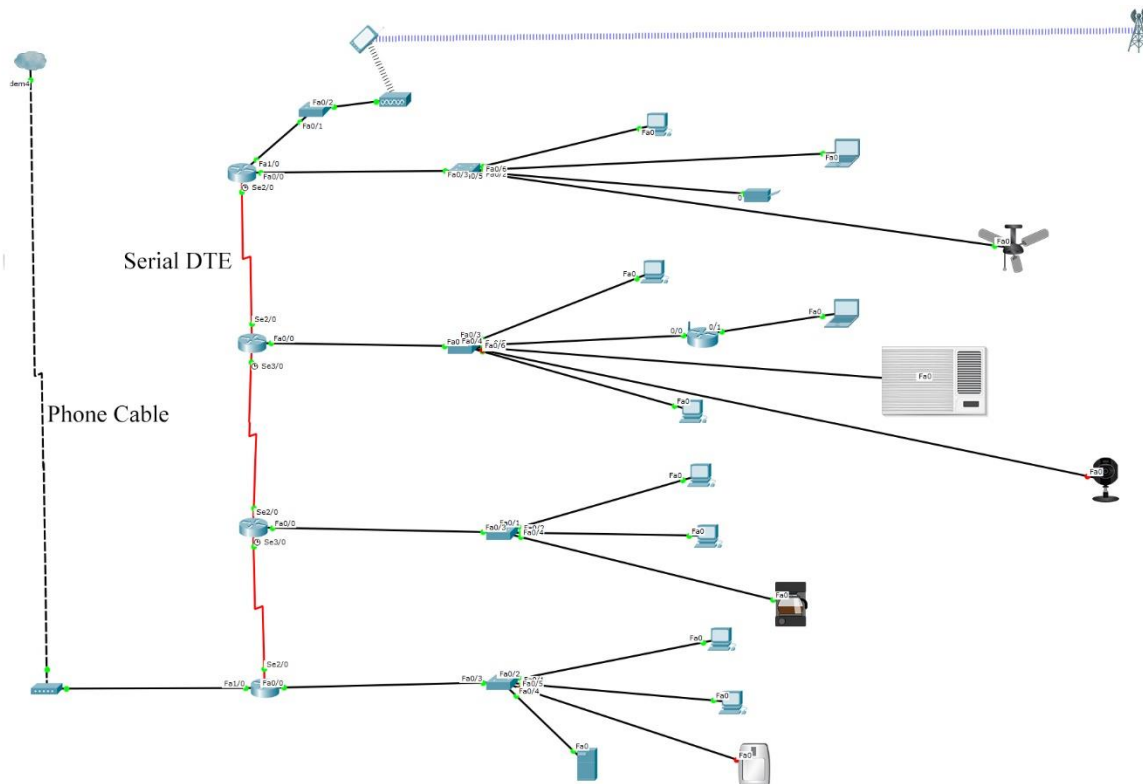
Local networks are represented by 192.168.x.x

Networks between routers are represented by 10.12.x.x (private);

11.12.x.x;

12.12.x.x;

## Port map



## Security Measures

This particular network is very sensitive as any security breach may result in a lot of damage. The home security is connected to the internet and so are the internal appliances. And as any system, this system is prone to attack. So we have the next proposal to minimize security risk.

### 1. Separate Wi-Fi network for guests

Guests cannot access the network which the network's sensitive apparatus are on. This also means we can limit the bandwidth the guest network gets so that they don't generate heavy traffic.

### 2. Firewalls

Software and Hardware firewalls (found in the routers) will be used to separate the outside network from the intranet. Each device will have the default firewall settings so that a malicious device can't attack the other devices on a network. The firewall will be placed between the router and the switch and also an external firewall protecting the whole network found between the modem and the router in the basement. Routers and wireless points will be password protected so that any intruders can't make any changes to the network.

## **Conclusion**

As you have seen we have tried to create the perfect smart home/ office workspace with minimal cost and no compromise on network security and performance. We have estimated that the whole system will cost about 80,000 birr excluding labor and technical works. That is a fair price considering that how this functionality the system offers. On the maintenance front, its easily upgradable and fixable because of the simple yet efficient network structure. Almost all the connections root from the basement and so any errors in the network are easily traceable. Finally, we know there are a few misfits here and there but we have tried our best and we hope you understand. Thank You.