Save The Professor

TEAM APEX

PBL Networking
project - Fall 2022

TABLE OF CONTENTS

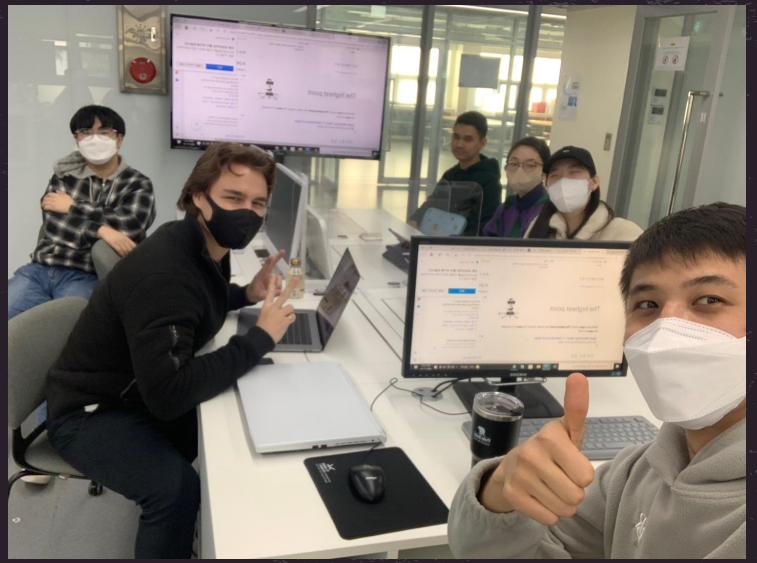
Instruction Professor

Professor Edward - Kim Young il

Team APEX

Sardor - group leader

Cavan
GIl YuJin
Samandar
Kim JuYoung
Go JeongHyeon



01

Project Introduction

Key achievements

We successfully:

1. Upgraded the existing network of W19
2. Created a new IoT based fire detection network
3. Saved professor’s life
4. Learnt many hard and soft skills

First: What we learned?

Learned of PBL

How to collaborate with colleagues, how to properly distribute and manage tasks efficiently

Learning Cisco

Machine knowledge, including how the server works and how to allocate addresses

Team Working

Honesty and integrity, motivation, strong work ethic, interpersonal skills, communication skill

PBL
What we learned
HARD SKILLS

2. **Networking - We learnt:**
   - Fundamentals
     - Routers, Switches etc..
     - DNS, FTP, DHCP, HTTP etc..
     - IP configs, servers, and LANS
     - And more
   - How HTTP servers work
   - How do many networking skills
     - Creating VLANS
     - Configuring IP addresses
     - FTP servers
     - IoT connection to MCU's
     - Python on MCUS
     - And more

2. **Management**
   - There were many tasks and works
   - Learnt to efficiently manage our tasks
   - Using tools like Notion, Google, and Kakaotalk

PBL - What we learned

SOFT SKILLS

1. **Work honestly and with integrity**
   - Everyone did their work
   - And always communicated
2. **Interpersonal skills**
   - If someone couldn't do a task, someone else did
3. **Team work**
   - Everyone was a team player
   - And wanted to get the project done
4. **Motivation**
   - Everyone took responsibility for the project success
5. **Work ethic**
   - Everyone displayed a strong work ethic and worked hard
6. **Team work skills**
   - All of the above came together to form great team skills
7. **Task delegation**
   - Everyone "owned" their responsibility
   - And made sure to get it done well
8. **Weekly reports**
   - This was a good experience
   - And learned the importance of keeping track of tasks and progress
9. **Communication and Collaboration**
   - We all spoke to each other
   - And we all got along like ***good friends***

Background
of this project

- Endicott Building's network speed has declined
- Need to improve:
  - Design the existing network
  - Replace and upgrade with latest products

- Additionally implement a fire detection network
  - Fire detectors
  - Sprinklers
  - Sirens
  - In order to save professors lives in the event of a fire.

Design limitations
-
Problems

Problems we faced

New to Cisco ecosystem

- Didn’t know anything about Cisco
- Its products
- Its software
- How to use its equipment

Hardware limitations (slow pc)

- Our machines started struggling with Cisco packet tracer
- Scope of W19 network is to much for average laptops

- Purpose built machines are required

02

Summary of Problem

Problem Definition

1. W19 network speed has severely decreased
2. There is no IoT based fire detection/prevention network
    - Which is interconnected across the whole building

Design Purpose

1. Improve network architecture via hierarchical approach
2. Implement IoT fire prevention network

Problem Resolution

1. We successfully upgraded the existing network of W19
    a. This increased speed
    b. And security(VLANs)

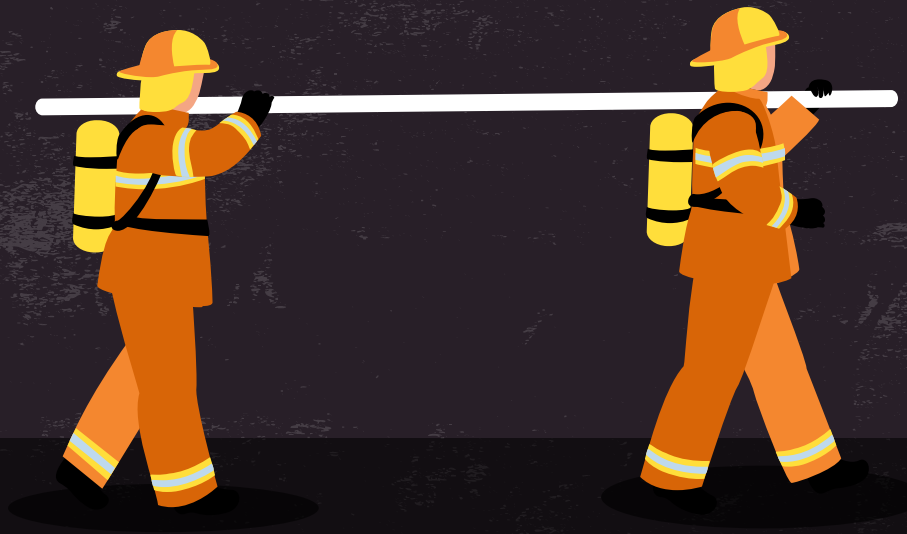
2. Created a new IoT based fire detection network
    a. Detect fires (monitors)
    b. Extinguish fires (sprinklers)
    c. Warn everybody (Turn on sirens)

Development process & Final design

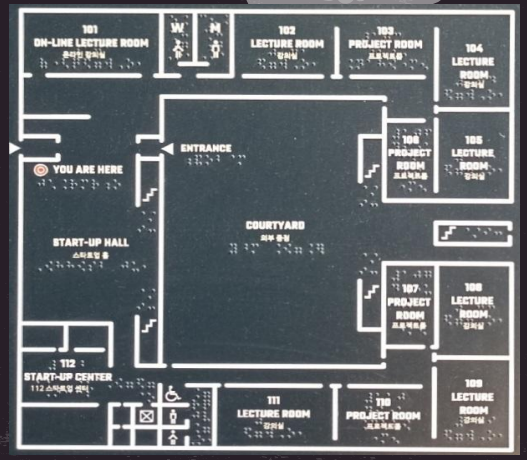
After finished homework

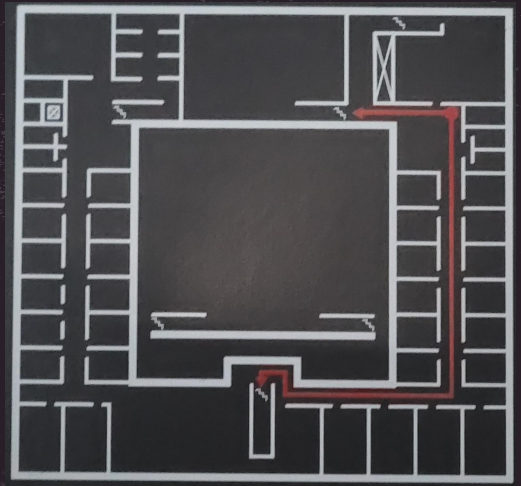
By finishing homework, we had a idea how to start the W19 network

Adventures



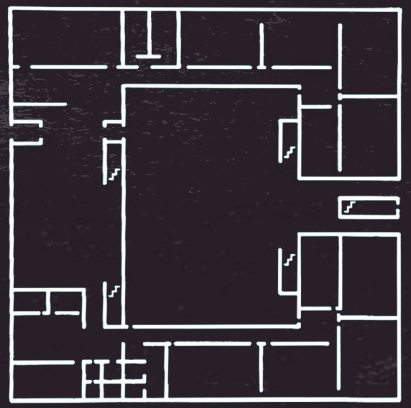
- We visited W19
- Get an idea what requirements
  - E.g 2 floors
  - How many offices
  - What devices are in the offices
  - How many Wireless AP etc..
- We looked for a network map
- There was a network map in W1 basement, but not network map for W19

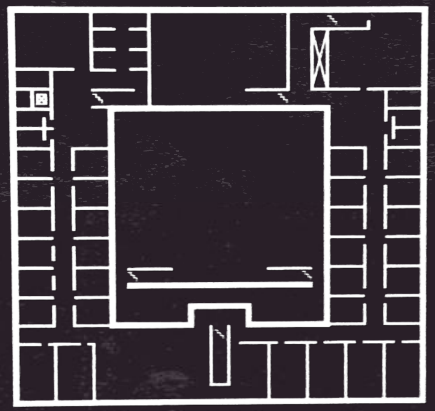




MAPS

- Using a picture of the guidance map, and emergency exit maps
- We created a outline for the floor design





Cisco Packet Tracer

- Now we ready to start creating network in Cisco

- First Challenge: **floors**
  - How to do multiple floors is challenging in Cisco
  - Figured out how to divide floors into 2 buildings
  - We used the same building method for multiple floors for IoT and Main network

Main Network

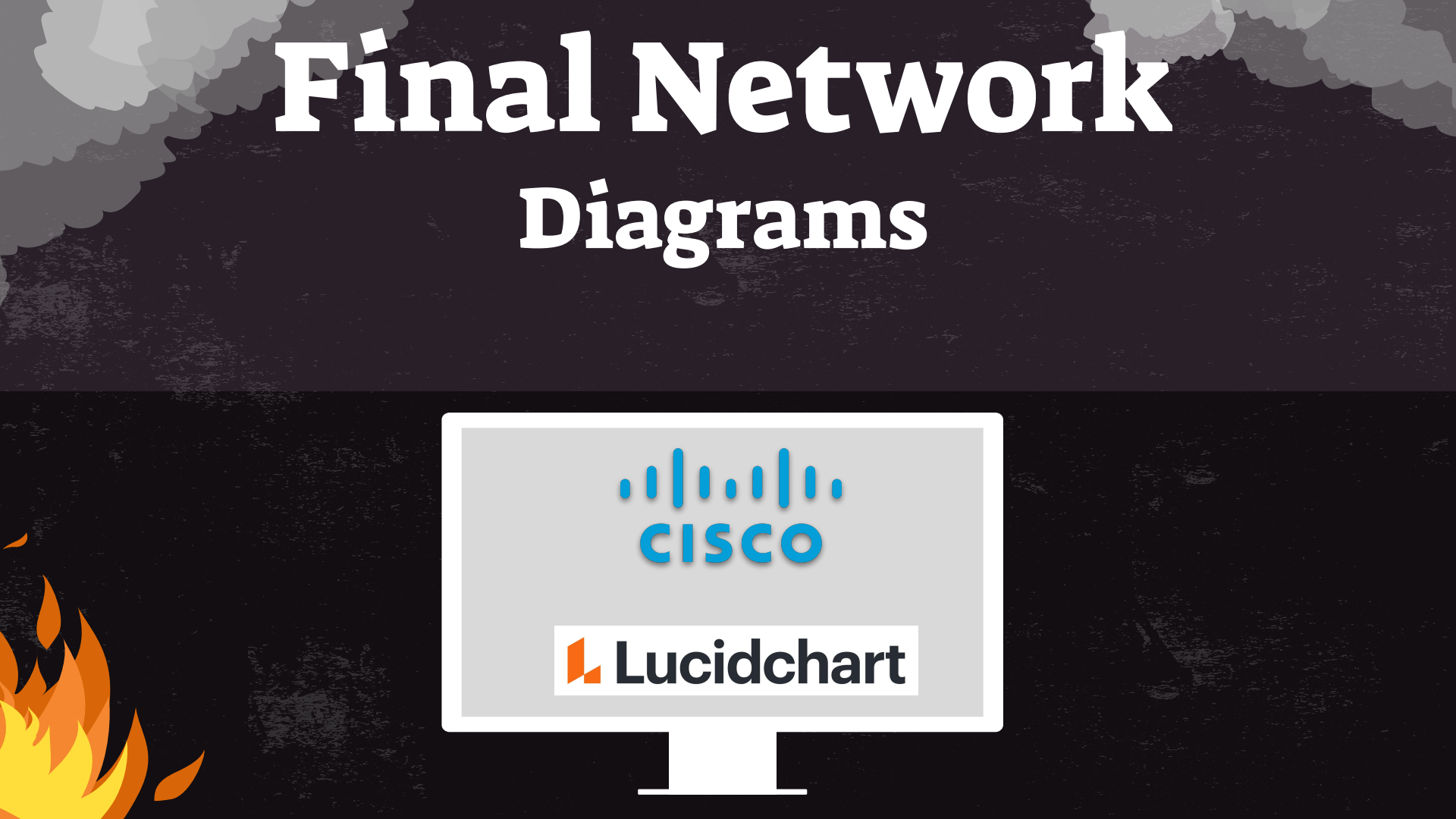
- First: main network
  - Create a diagram of the main network “architecture”
  - Divide architecture into layers
    - Core
    - Distribution
    - Access
- 🔁 **Iterative process**: add devices, test, learn, repeat, expand
  - Additionally:
    - Assign VLANs for access switches
    - Implement Wireless networks and Pinging devices
    - Add HTTP, DNS, DHCP, and FTP servers
- **Implement Map:** W19 map outline to place 100’s of items.
  - Special thank you 정현 for doing this.
  - Rename every PC, Printer, Switch, everything! and put in place. So specific

IoT Network

Save professors life!!!

- Second: IoT network
  - Research
    - How IoT devices work in CPT
    - How to connect IoT devices (MCU)
  - Design IoT diagram of architecture
  - ❌First tried built-in IoT Monitors in servers, but extremely slow
  - ✅Then we created a small IoT system using Microcontrollers
  - Scale that system up into the scale of a single floor
  - and then implement it into both floors and interconnected them
    - So both floors are alerted

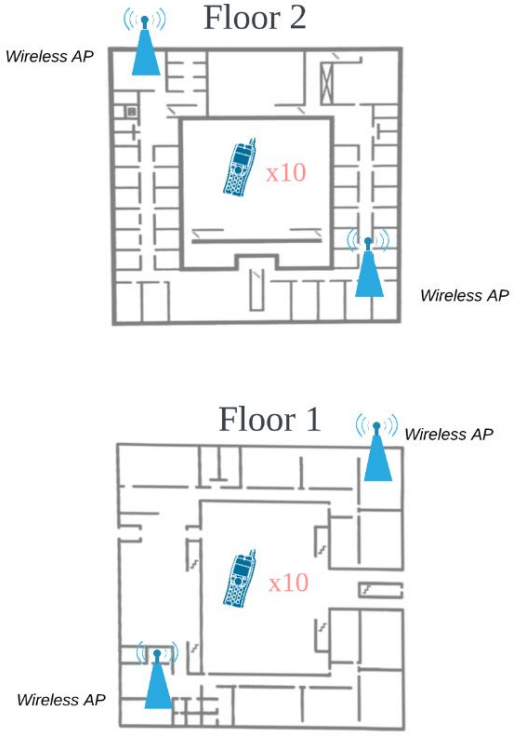
Final Network Diagrams

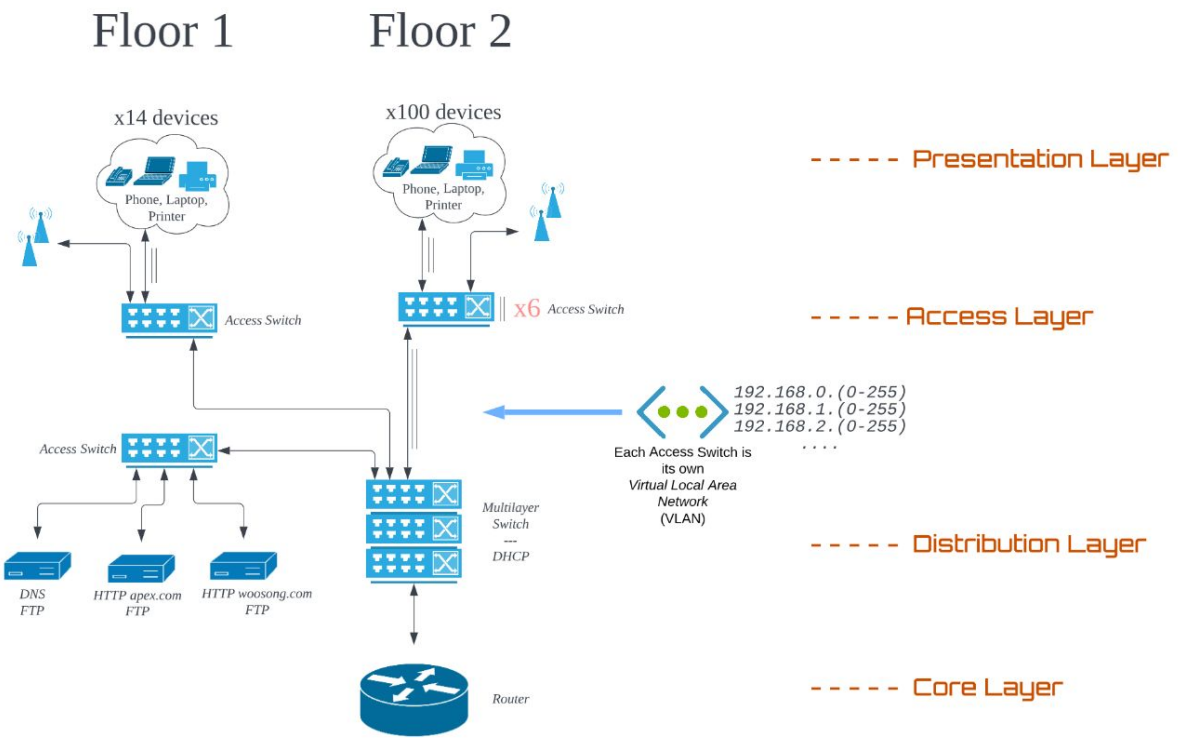


W19 Main Network

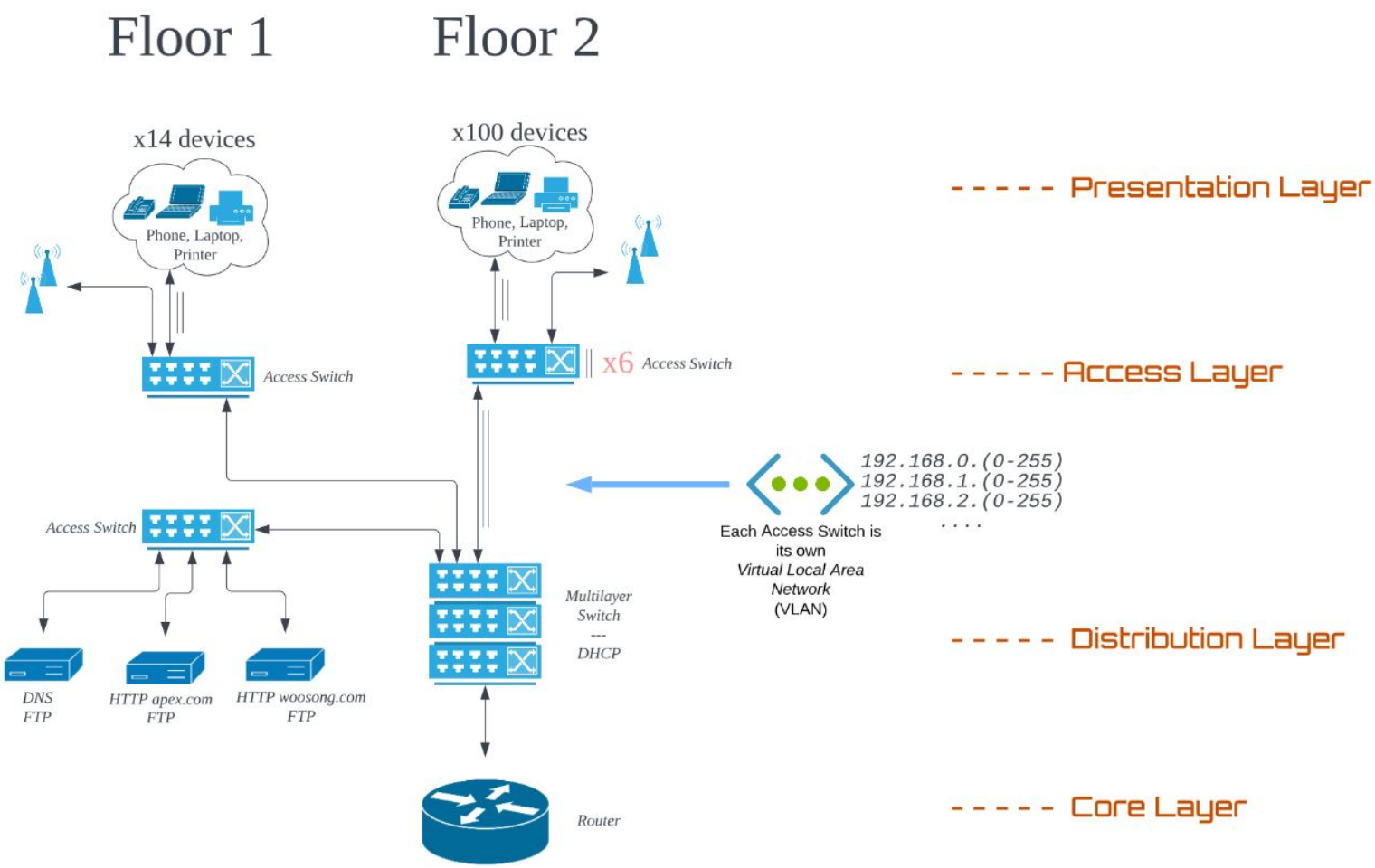
Logical layout

Wireless

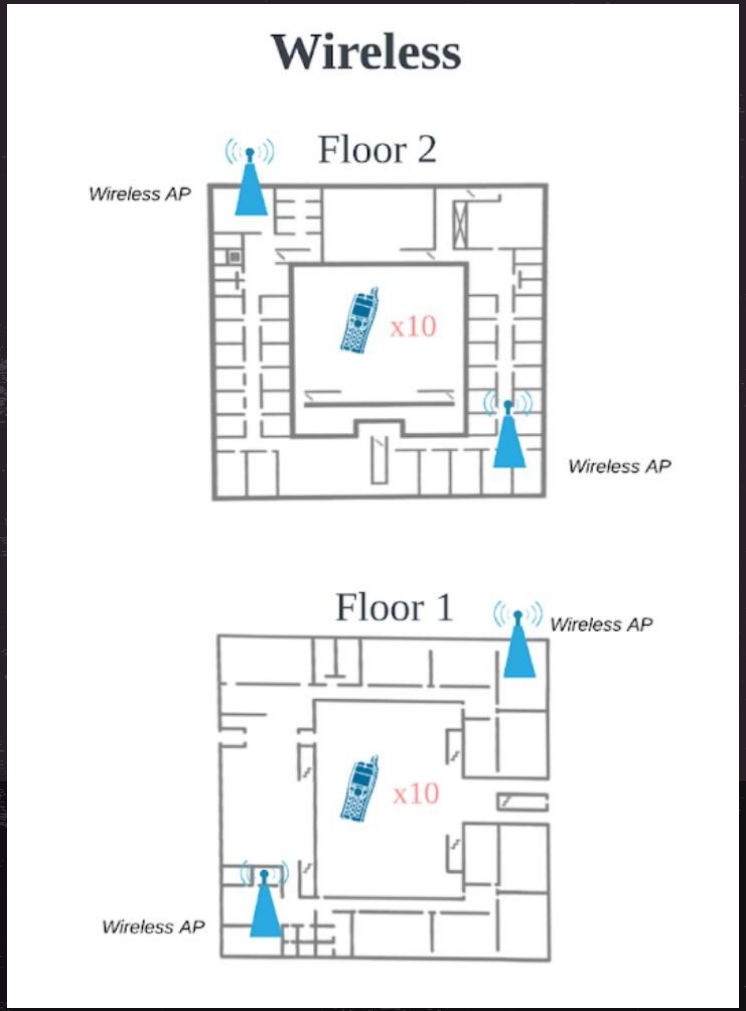




NETWORK


Floor 1
Floor 2
x14 devices
x100 devices
Phone, Laptop, Printer
Phone, Laptop, Printer
Access Switch
x6 Access Switch
Access Switch
192.168.0.(0-255)
192.168.1.(0-255)
192.168.2.(0-255)
....
Each Access Switch is its own Virtual Local Area Network (VLAN)
Multilayer Switch

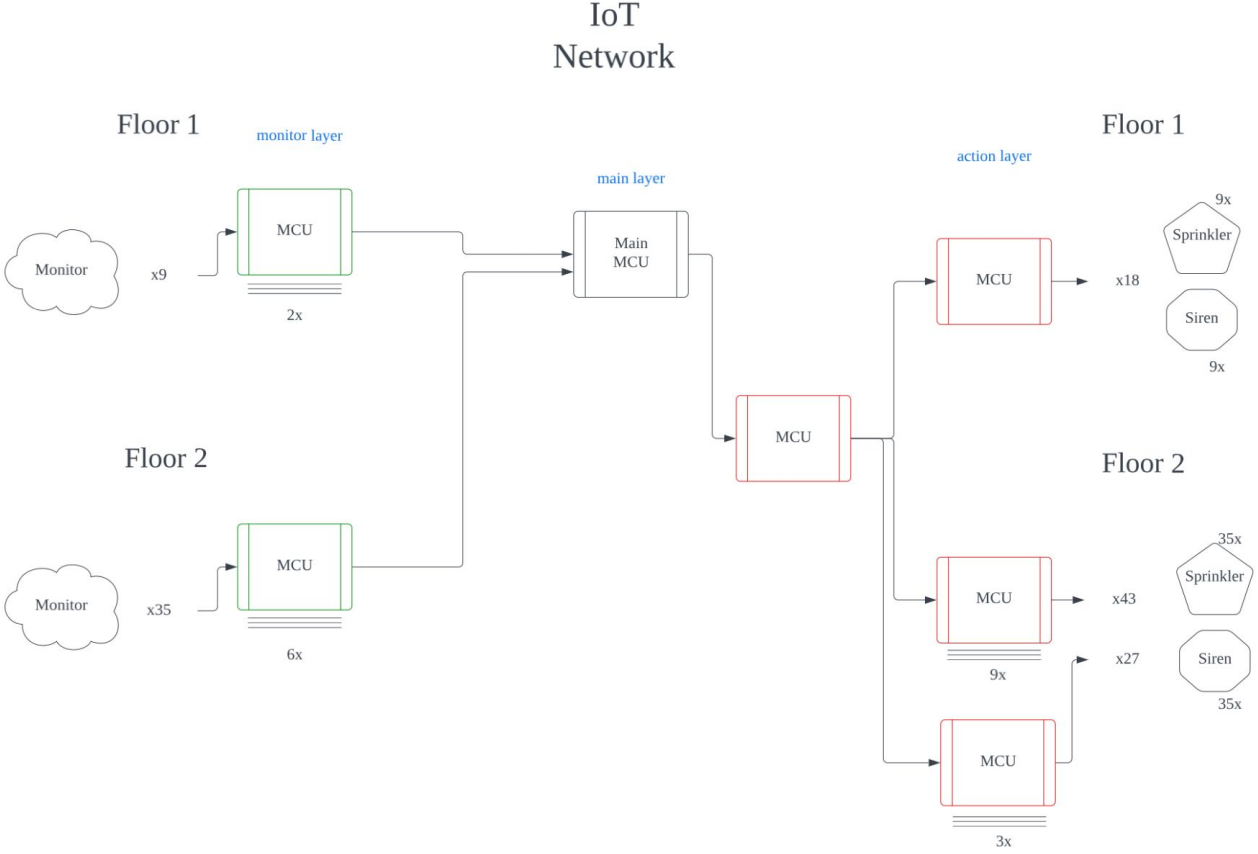
DHCP
DNS
FTP
HTTP apex.com
FTP
HTTP woosong.com
FTP
Router
----- Presentation Layer
----- Access Layer
----- Distribution Layer
----- Core Layer



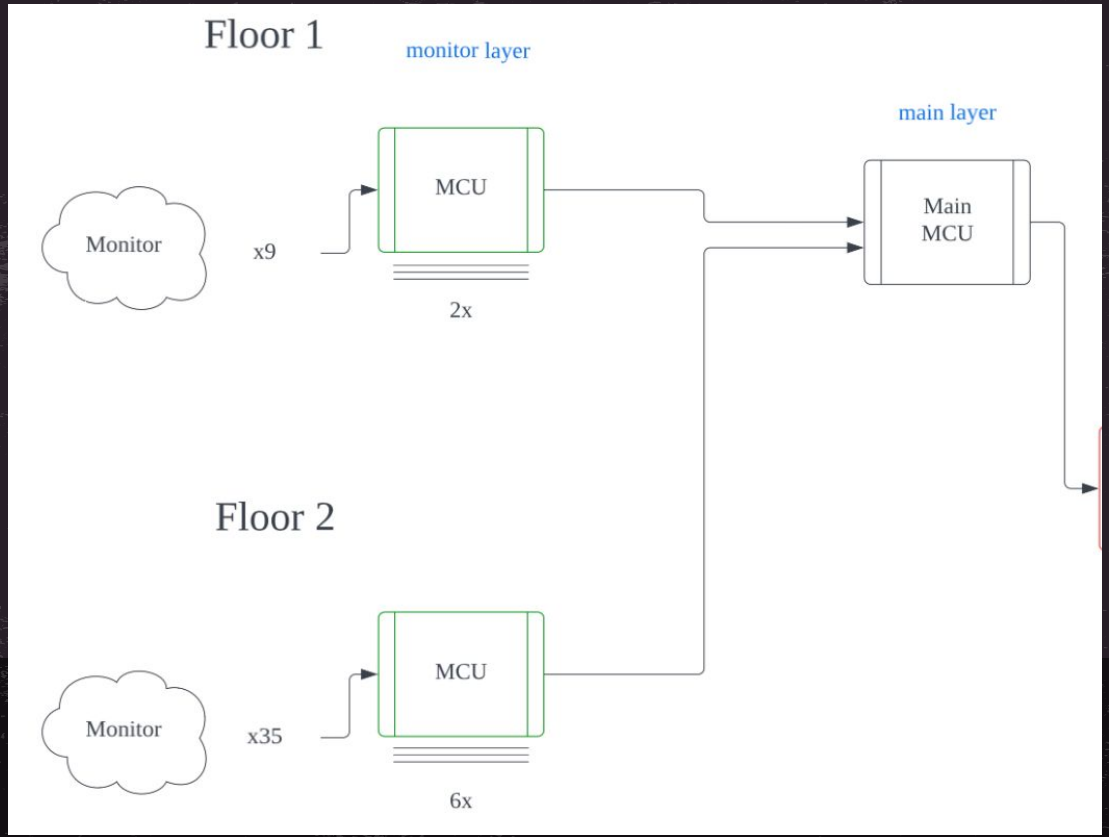
Wireless AP Network

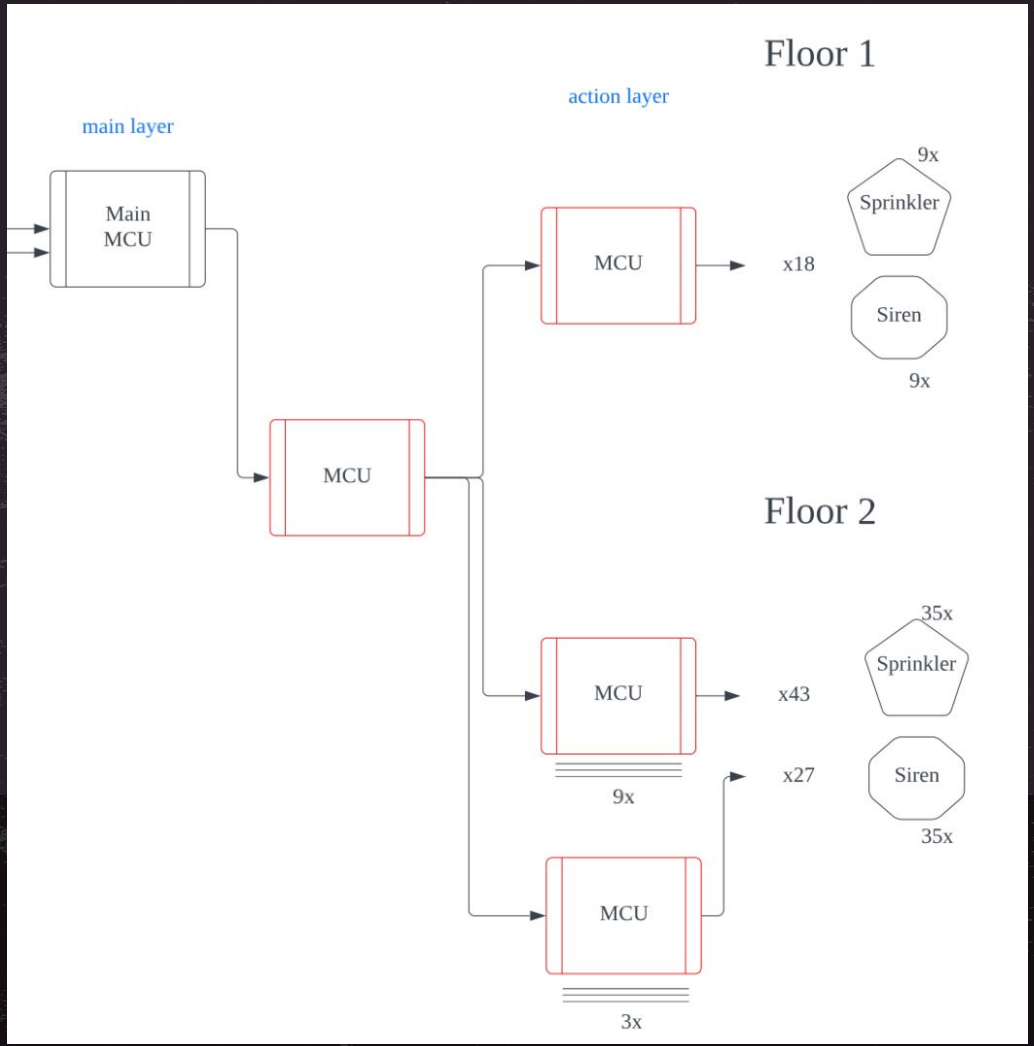
W19 IoT Network

Logical layout



Detection System

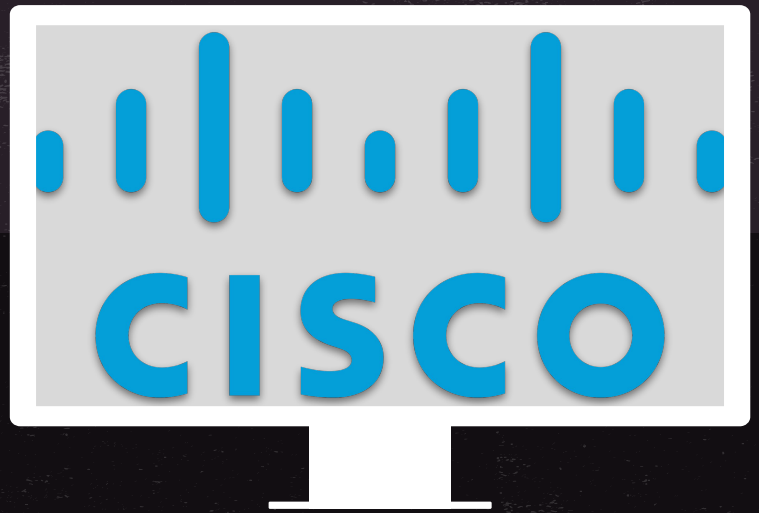




Prevention System

Challenging Design problems

And how we solved them

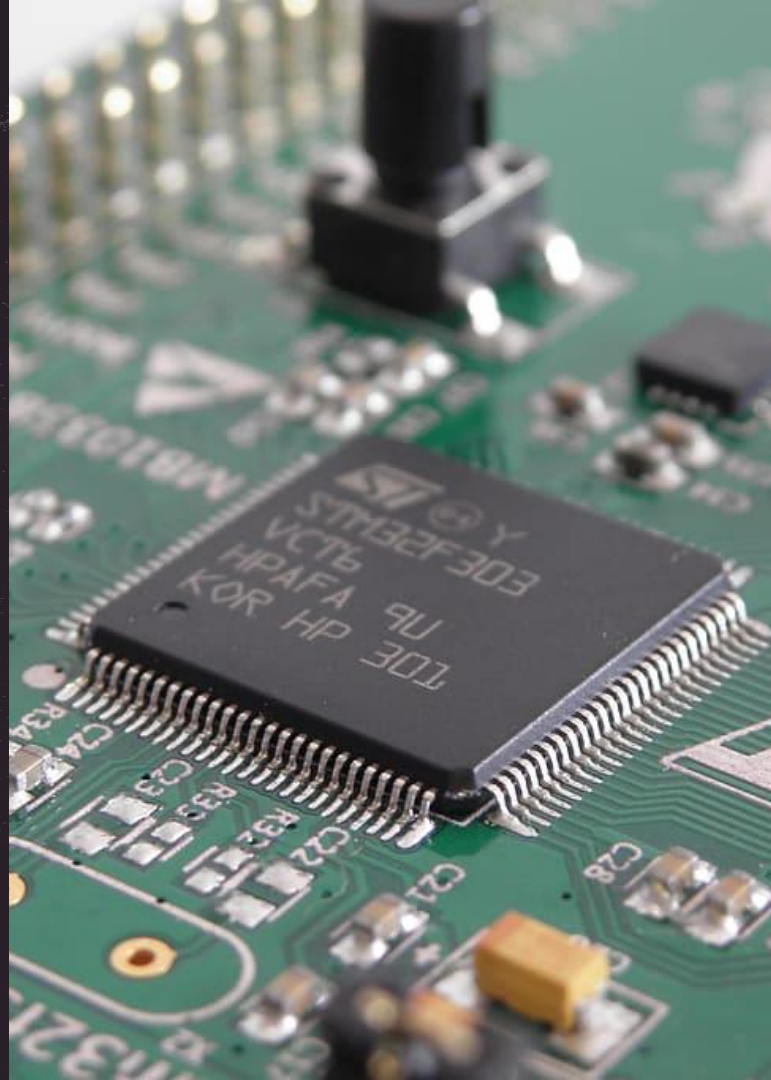


Existing Network

- **P:** Could not find the current network map
- with IP address and other components
- **S:** So we presumed many things
- such as:
    - 2 PC and 1 printer per office.
    - In lecture rooms 1PC and 1 Printer.
    - We assume that each floor has 2 Wireless APs diagonally situated.

Python in microcontrollers

- Due to inefficiencies with IoT monitor system (>5m)
- We implemented MCU method to trigger alarm system with the help of python.



Cost Savings

- We put DHCP server in multilayer switch, but for DNS/HTTP/FTP we put separately.
- Put VLAN in MLS(multilayer switch)

Server rooms

We don't know where the servers are actually situated
so we put 2 server rooms on the second floor and 1 server on first floor.

Cisco PT limitations

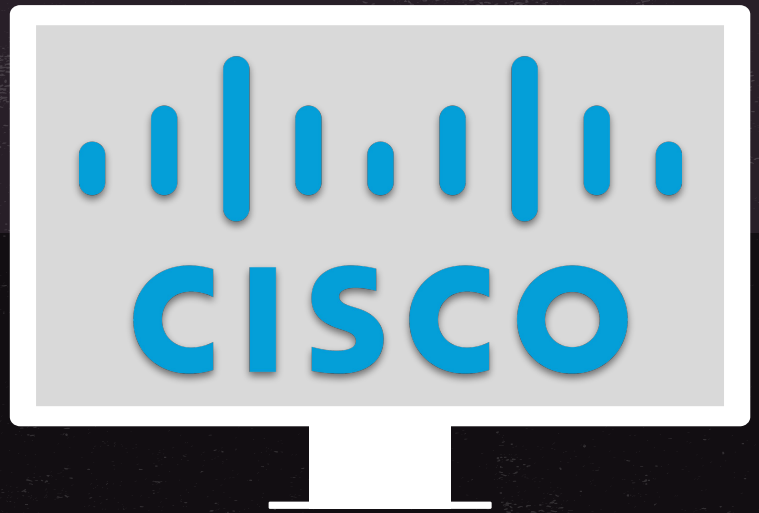
- W19 is 2 floor building, however Cisco doesn't have multiple floor support.
- We create 2 buildings in cisco packet tracer to assume these buildings are like floors.

To overcome these issues

- We watched many Youtube tutorials -
  - Cisco Triangle
  - learn IT with VENKAD
  - And more
- We reviewed professor`s slides W1 to W7
- Reviewed and used the Boosting-campus-network Paper

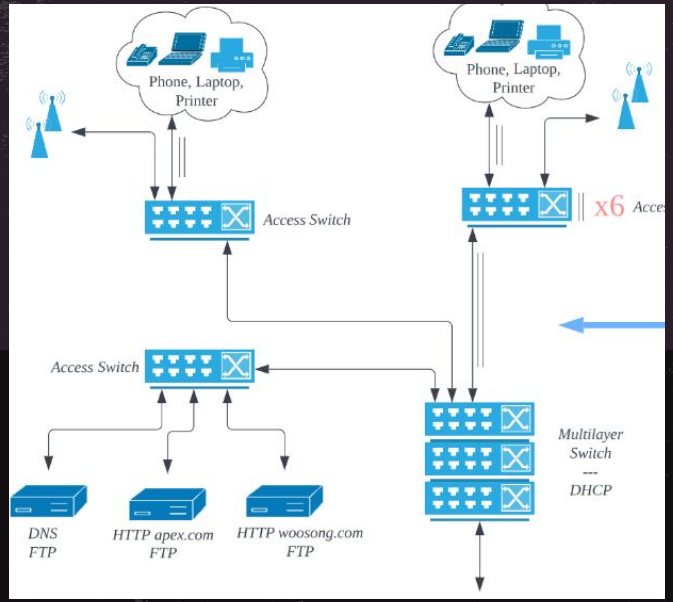
NETWORK DETAILS

Insights into our network



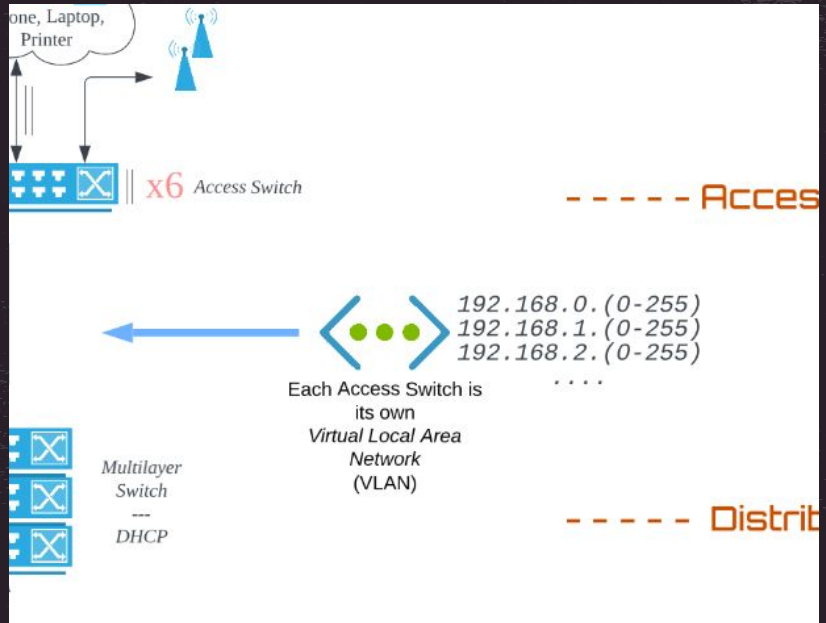
All cables are gigabit twisted pair ethernet

All cables are Gigabit twisted pair Ethernet. We will explain this and the mechanical devices we used.



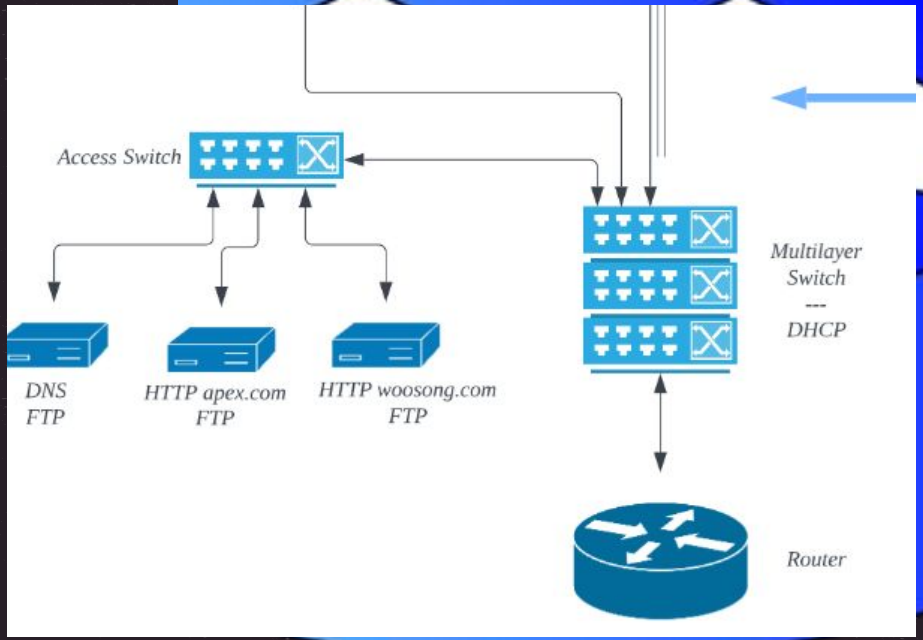
VLAN

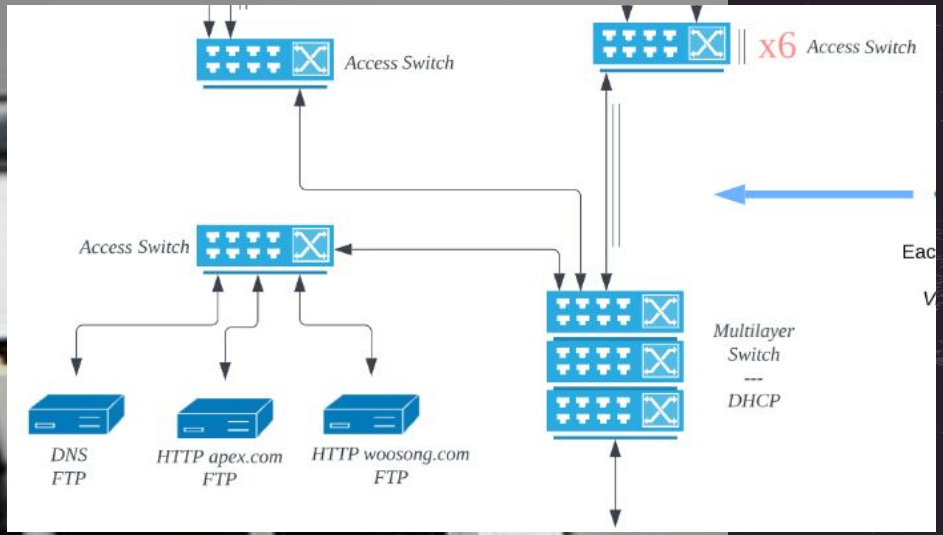
- Each switch has is own LAN via the VLAN setup on the ML Switch
- Ip range is 0 to 255 (192.168.x.0-255)



Core layer - Router

- Connection to main campus
- and internet
- Gigabyte into multi switch
- ML Switch is connected to port with the name of GigabitEthernet0/2
- Internet



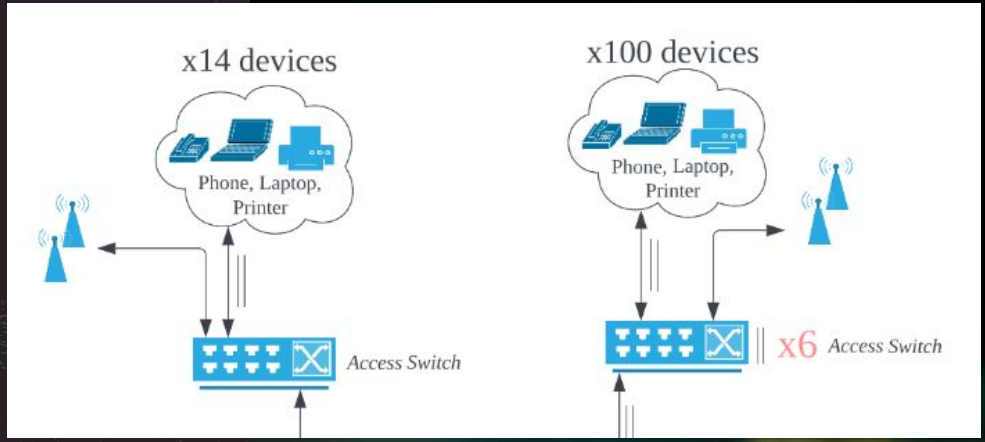


Distribution layer - ML Switch

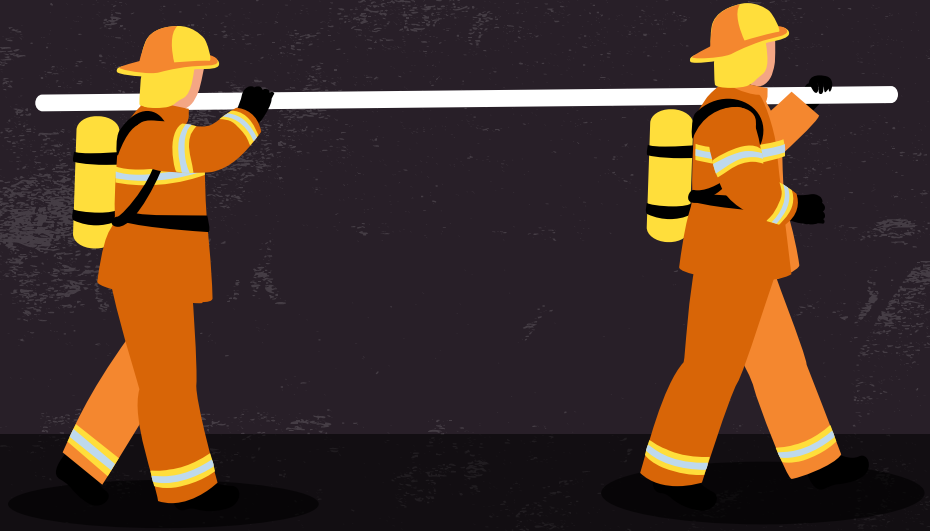
- Has 24 fast internet ports
- and 2 gigabyte ethernet ports
- Has a DHCP server inside it
- Each port is a VLAN
- A switch is connected to each port
- All our access switches are connected to the fast internet ports

Access layer
- Access Switches

- Same switch as the ML switch
- Has 24 FE ports and 2 GE ports
- On average each switch has used 20 ports
- With 4 ports open which allows extra capacity for future usage
- Fast internet to ML Switch. and fast internet to devices
- Ip range of each switch VLAN is 192.168.x.0-255



How Main network was it implemented



- Understand the structure of W19 Building
- Divide the floor into two buildings
- Microcontrollers implement one small IoT system
- Create main network architecture
  - Divide into tiers
    - core/distribution/access
- Assigning VLANs to Access Switches
- Implementing a wireless network
- Adding HTTP, DNS, DHCP, and FTP servers

Background - of project problem

Miscellaneous details on our development process

1. Youtube videos from LMS
2. Issue with Youtube tutorials
3. They create small networks for us (1pc, 1 printer, 1 switch, 1 IoT etc..) so they useless
4. W19 has more than 100 devices
5. Papers, advanced network concepts(VLANS layer, core/distribution/access layer, etc)
6. We tried be creative with IoT monitors
7. However, IoT monitor did not work well, and had very late response (>5min)
8. We were not defeated, we found another way
9. We figured out how to connect MCUs together, in python, without tutorials (very pleased)
10. We implemented MCUs - which resulted in a fast and reliable IoT network responses
11. Thanks to our programming skills we could do advanced connection

04

Conclusion and Recommendation

Conclusions and Findings

CPT is feature full and robust - awesome software
MCUs can connect to each other via Python
We can put HTTP/DHCP/DNS server components inside a router for cost savings
Keep a Hierarchical design for networking architecture to avoid confusion, and achieve efficient network
VLANs are great technique for network isolation, and access control

What we would have improved with more time

- ***improve security system***
  - Adding password protection to access certain ports or PCs.

- ***Improve/changed the HTTP server index page***
  - Making it more attractive
  - Add more links etc..

Cost

Upgrade network
&
New IoT network

Cost of devices for FIRE SYSTEM

Device	Device model	Number of devices	Price	Overall
Fire Sprinkler	*FH 751-EQR*	44	₩5,500	₩242,000
Fire Monitor		44	₩3,500	₩154,000
Siren(small)		44	₩4,500	₩198,000
Access Point	*C9105AXI-A*	4	₩115,026	₩4,604,104
Multi Switch	*C9200L-24T-4G*	1	₩3,522,362	₩3,522,362
Switch	*C9200-24T-1E*	6	₩599,930	₩3,599,580
Router	*C8300-1N1S-6T*	1	₩16,955,598	₩16,955,598
MicroController Unit	*CTI-5310-MCU-K9*	25	₩1,163,500	₩29,087,500

₩58,363,144

The total cost of devices for implementation
of our PBL network into W19

THANKS!

Thank you for your attention.

Now: Demonstration