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COMPUTER NETWORK (CO3001)

Assignment 2

Computer Network Design For The Building H6 of HCMUT

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6.1	Total expected cost	25



Chapter 1

System requirement analysis

1.1 Functional requirements

The building H6 consists 7 floors. Each floor is the VLAN config and the system can connect to H6.

At each operating spread in each floor will be fitted 4 surveillance cameras.

The first floor is equipped with 1 server room 106H6 (for storing data received from cameras and IoT devices) with 10 computers.

There are computer rooms on 6th and 7th floor.

The computer rooms are equipped with air conditioner control

The classrooms are equipped with desktop computers. Two types of classroom are large theory room and small theory room.

- **Large theory rooms** have 6 temperature sensors, 6 light sensors, light control equipment.
- **The remaining rooms** have 3 temperature sensors, 3 light sensors and also light control equipment.

The measurement device will collect data continuously every 1 minute in real time and send it to the processing server every 5 minutes.

1.2 Non-functional requirements

The data format size of sensor is 32 Kb.

Sensors will collect data one-minute once and after 5 minutes they send this data to the central server over the WIFI network.

The operation system of 24/7 surveillance cameras will store the data directly to a central server with a data transfer rate of 100 Mbps.



The computers in the classrooms will download about 200MB per day (peak hours are 7:00 to 17:30).

Each device when connected to the WIFI network is used with 256 Kbps maximum speed in terms of time 7:30 to 17:30.



Chapter 2

Storage capacity, network traffic

2.1 Sensor

“A sensor will measure a different index but their data format size is 32 Kb. Sensors will collect data one-minute once and after 5 minutes they send this data to the central server over the WIFI network.”

- Number of sensor: $5 * (6 * 6 + 3 * 12) + 2 * (4 * 6 + 2 * 12) = 456$.
- Storage capacity: $32 * 456 = \mathbf{14592 \text{ KB}}$.
- Network traffic: $14592 / (5 * 60) = 48.64 \text{ KB/s} = \mathbf{389.12 \text{ Kbps}}$.

2.2 Camera

“The operation system of 24/7 surveillance cameras will store the data directly to a central server with a data transfer rate of 100 Mbps.”

- Storage capacity: **0**.
- Network traffic: **100 Kbps**.

2.3 Device connect WIFI

“Each device when connected to the WIFI network is used with 256 Kbps maximum speed in terms of time 7h30 to 17h30.”

- Storage capacity: **unknown**.
- Network traffic: **256 Kbps**.



2.4 Server in server room

“The measurement device will collect data continuously every 1 minute in real time and send it to the processing server every 5 minutes”

- Storage capacity: **unknown**.
- Network traffic: Sensors + Camera = $389.12 + 100 = 489.12$ Kbps.

2.5 Computers in the computer room

“The computers in the classrooms will download about 200MB per day (peak hours are 7:00 to 17:30).”

- Number of computer (32 computer each room): $2 * (32 * 3) = 192$.
- Storage capacity: **unknown**.
- Network traffic: $192 * 200 / (10.5 * 3600) = 1.015$ MB/s = **8.12 Mbps**.

2.6 Computers in administrative office

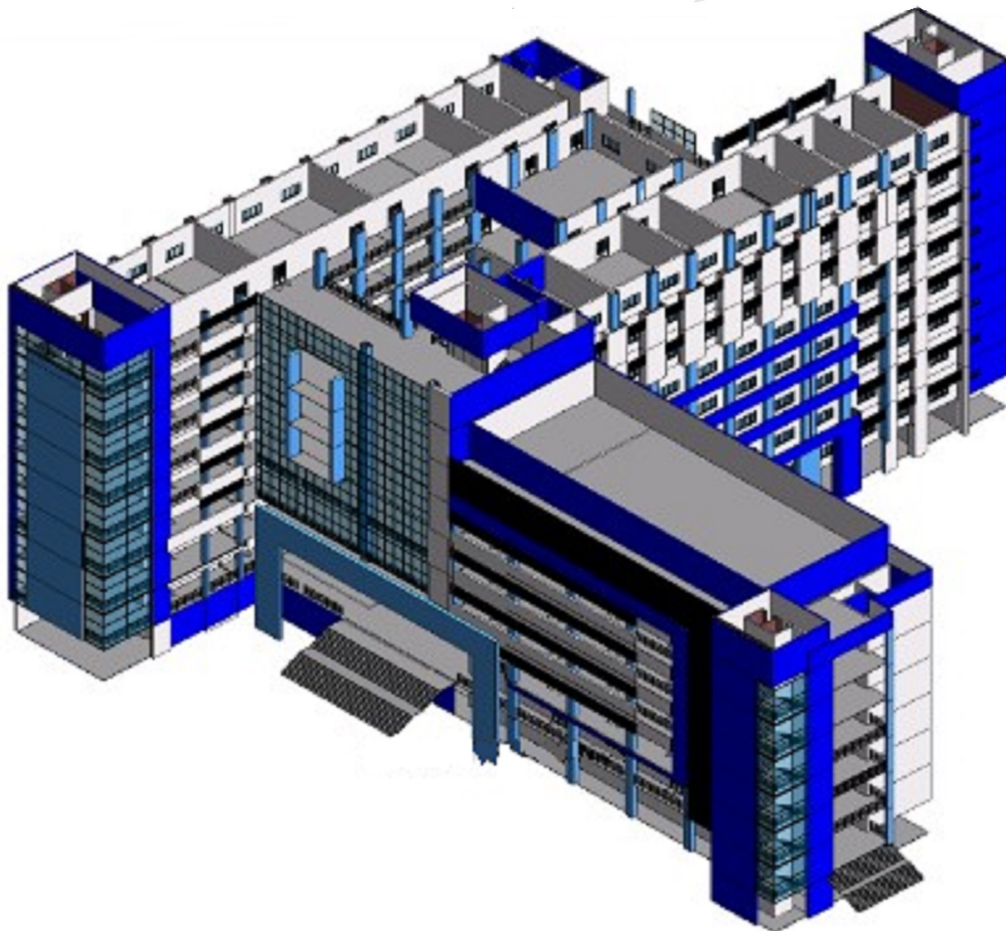
“The building H6 has an administrative office with 10 computers. The computers download about 200MB per day (peak hours are 8:00 am to 11:40 pm, 13h to 16h30) and send 10 emails per day with a maximum capacity of 10 MB per email”

- Number of computer: 10.
- Storage capacity: **unknown**.
- Network traffic: $10 * (200 + 10 * 10) / (7.167 * 3600) = 0.116$ MB/s = **0.93 Mbps**.



Chapter 3

Physical Design





3.1 Overview

The physical design of computer network as below:

- The second to fifth floor have 6 small rooms and 3 large rooms.
- The sixth and seventh floor have 4 small rooms, 2 large rooms and 3 computer rooms.
- Each floor has 4 cameras.
- Each computer room has 32 computers.
- Each room has an access point for device to connect to Wifi network.
- The Administrative office has 10 computers.

The physical design of each room as below:

Room	Sensor		Computer	Switch	Access Point
	Light	Temperature			
Computer	0	0	32	2	1
Small	3	3	1	1	1
Large	6	6	1	1	1
Server	0	0	1	1	0
Office	0	0	10	1	0

Table 3.1: Numbers of network devices

3.2 Classroom

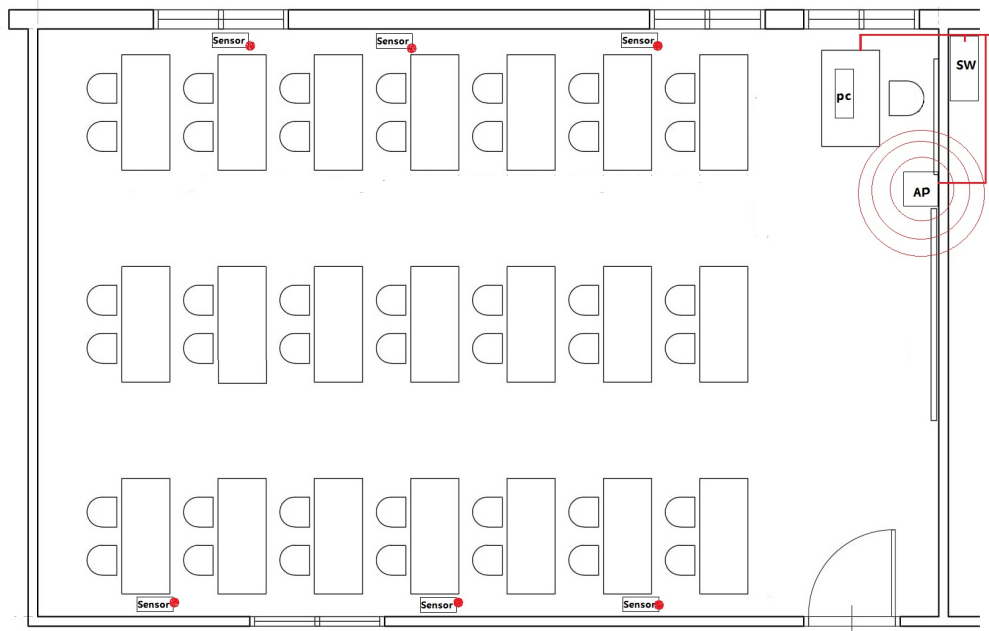


Figure 3.1: Classroom

Classroom contain:

- Sensor (12 for large room and 6 for small room).
- 1 Desktop computer.
- 1 Switch.
- 2 Access Point.

3.3 Computer Room



Figure 3.2: Computer room

Computer room contain:

- 32 computers.
- 2 Switch.
- 1 Access Point.

3.4 Administrative office

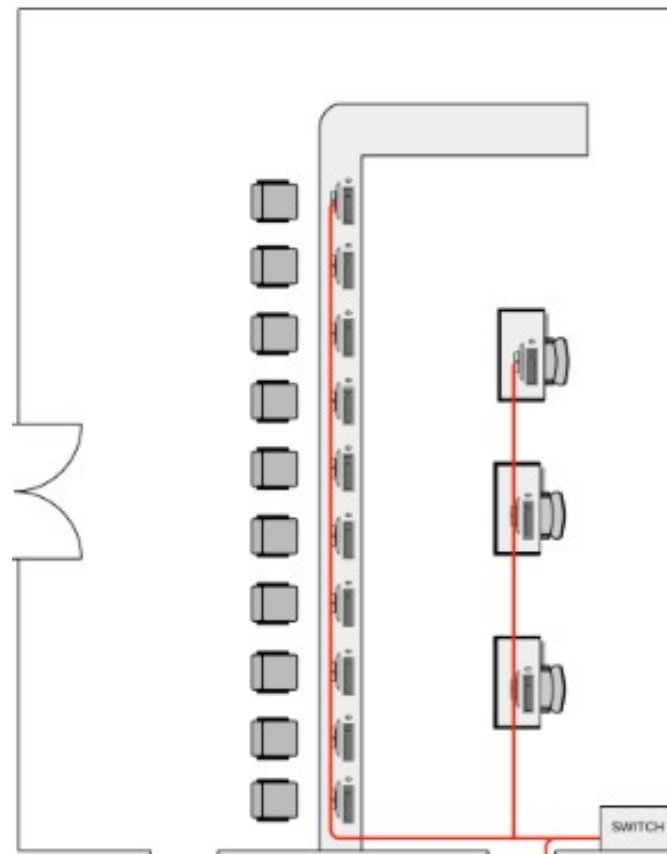


Figure 3.3: Administrative office

Administrative office contain:

- 10 computers.
- 1 Switch.

Chapter 4

Logical diagram

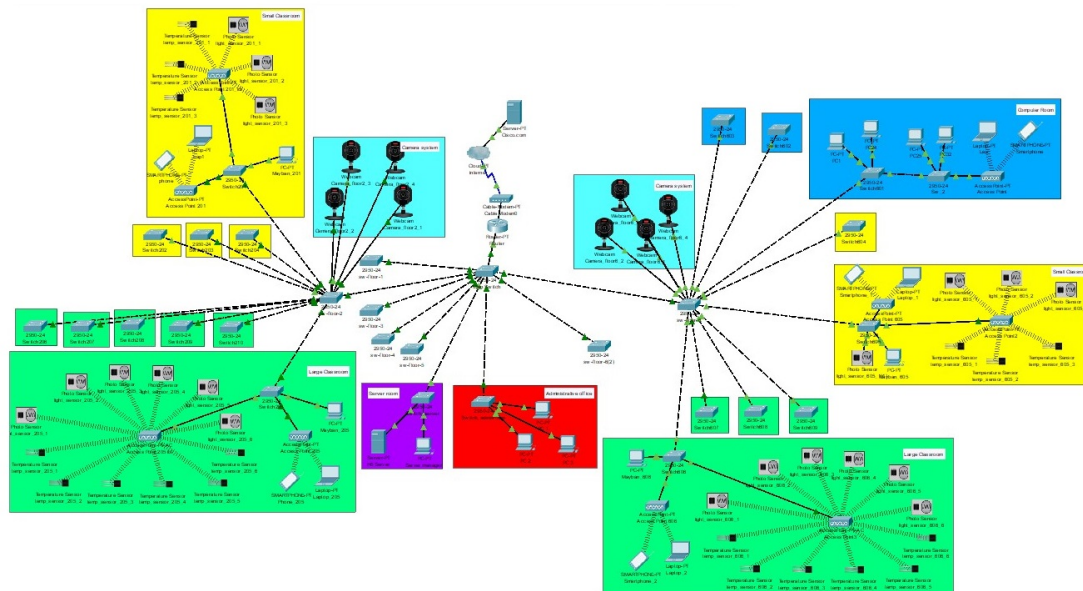


Figure 4.1: Whole Logical Diagram

4.1 Diagram

4.1.1 Camera System

“At each operating spread in each floor will be fitted 4 surveillance cameras.”

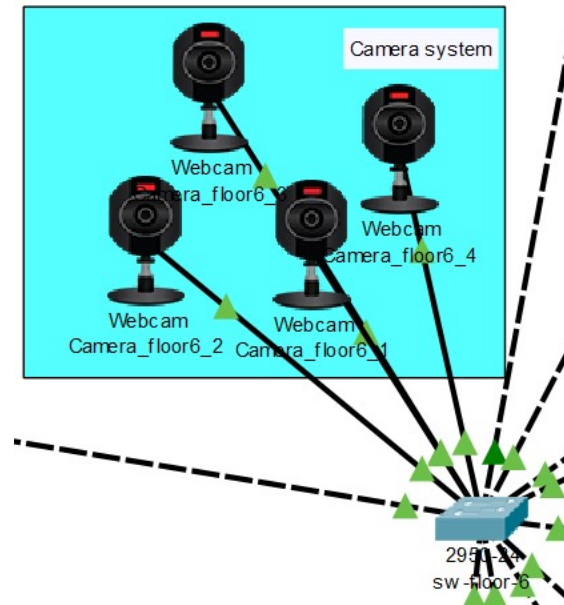


Figure 4.2: Camera System

- Four cameras on each floor will send data directly to the server on the 1st floor.
- Data transfer is used on vlan 3 (iot).

```
FastEthernet0/20  Up    3    --
FastEthernet0/21  Up    3    --
FastEthernet0/22  Up    3    --
FastEthernet0/23  Up    3    --
```

- All fa0/20-23 for cameras.

4.1.2 Large classroom

“6 temperature sensors, 6 light sensors for large theory rooms (an area larger than 60 m2), the light control equipment.”

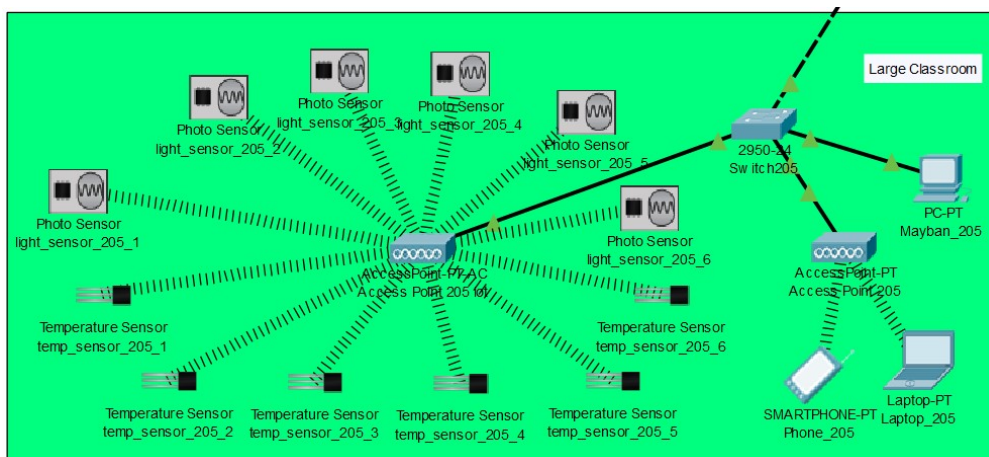


Figure 4.3: Large classroom

- Sensors from each room will send data after 5s to the server on the 1st floor.
- Data transfer is used on vlan 3 (iot).
- A desktop computer directly connected to the switch and devices connected wirelessly through the Access Point will be connected to the system via vlan 2 (computer).

```
FastEthernet0/21    Up      2      --
FastEthernet0/22    Up      --     --
FastEthernet0/23    Up      3      --
FastEthernet0/24    Up      2      --
```

- fa0/21 and fa0/24 for desktop computer and devices connected wirelessly.
- fa0/23 for sensors.
- fa0/22 for connect to other switch (by trunk).

4.1.3 Small classroom

“3 temperature sensors, 3 light sensors for the remaining rooms (the smaller area of 60 m²), light control equipment.”

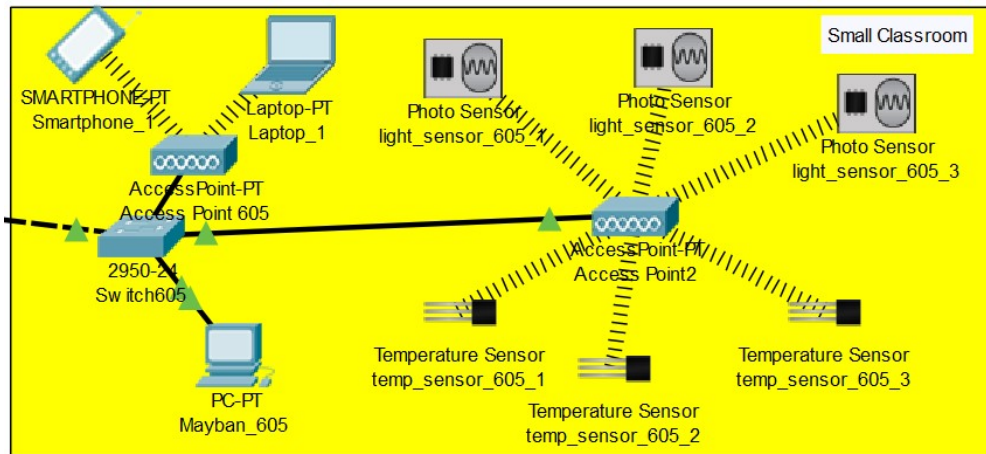


Figure 4.4: Small classroom

- Sensors and other devices work like large classroom.
- Fewer sensors than large rooms.

4.1.4 Computer room

“In floor 6,7 will have 6 computer rooms, each room will have 32 computers.”

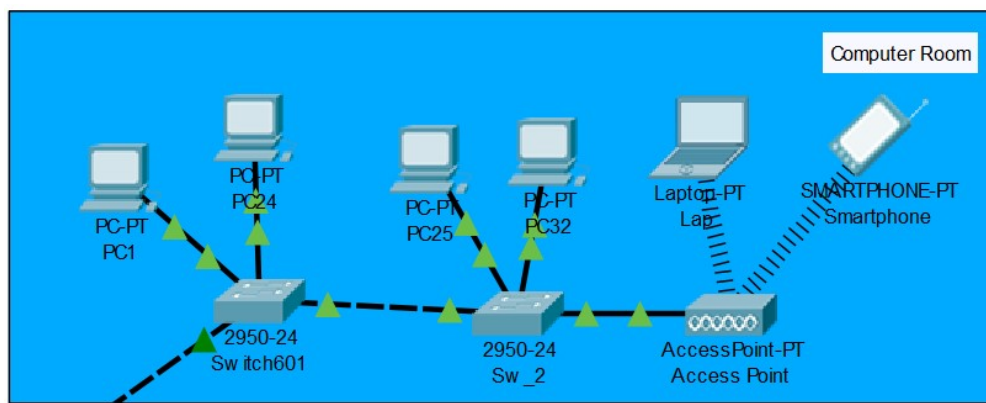


Figure 4.5: Computer room

- There are 32 computers that each switch has only 24 ports. So, team decided to use 2 switches.
- Computers connect to the network via vlan 2.
- Wireless devices also use vlan 2.

4.1.5 Administrative office

“The Administrative office will have 10 computers.”

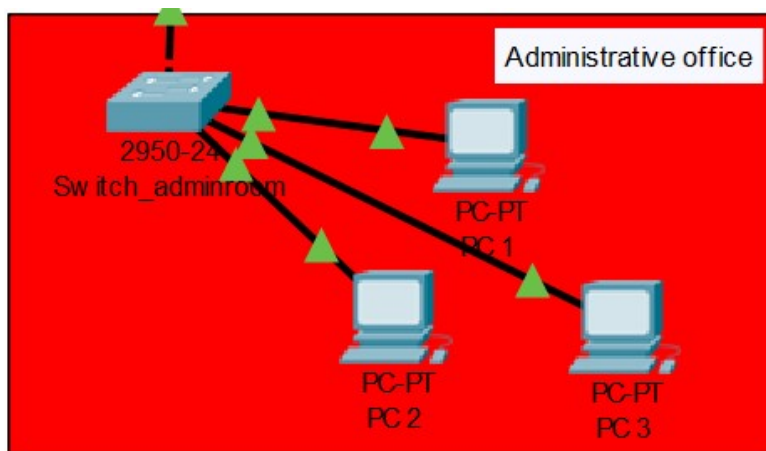


Figure 4.6: Administrative office

- The computers here serve for sending mail and for other important work.
- Because of security issues, computers in Administrative office use a separate vlan (vlan 5).

```
FastEthernet0/1    Up      5      --
FastEthernet0/2    Up      5      --
FastEthernet0/3    Up      5      --
FastEthernet0/4    Up      --     --
```

- Fa0/1-3 for computer use vlan 5.
- Fa0/4 for connect to other switches.

4.1.6 Server Room

“H6 building will implement a system of surveillance cameras at some point and the camera’s data will be stored centrally in a server room 106 H6.”

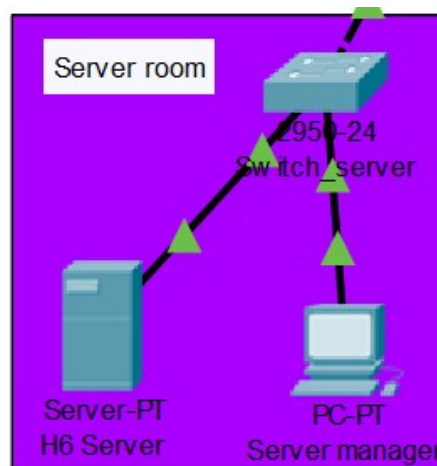


Figure 4.7: Server room

- Server receives data from cameras and sensors. Therefore need vlan 3 (iot).
- The server also needs to be managed by a computer to be able to view the camera and calculate the data from the sensor vlan 4 (server).

FastEthernet0/22	Up	4
FastEthernet0/23	Up	--
FastEthernet0/24	Up	--

- Fa0/22 for management computer vlan 4.
- Fa0/23 use trunk (vlan 3 + vlan 4) to server.
- Fa0/24 connect to other switches (trunk).



4.2 Technologies usage

4.2.1 VLAN - Virtual local area network

- **VLAN** (virtual local area network) is a subnetwork which can group together collections of devices on separate physical local area networks.
- In this design, the team divided the system into 5 main VLANs:
 - Vlan 1 (default) for port non setting.
 - Vlan 2 (computers) for computer and wirelessly devices.
 - vlan 3 (iot) for iot system (camera and sensor).
 - vlan 4 (server) for mangement computer.
 - vlan 5 (admin) for computer in Administrative office.

4.2.2 Configuring VLAN Trunks

- A **VLAN trunk** is an OSI Layer 2 link between two switches that carries traffic for all VLANs (unless the allowed VLAN list is restricted manually or dynamically). To enable trunk links, configure the ports on either end of the physical link with parallel sets of commands.

4.2.3 Access list

- **ACL** (access control list) is an ordered list of rules used to filter traffic. Each rule states what's permitted or what's denied. When a packet attempts to enter or leave a router, it's tested against each rule in the list — from first to last. If the packet matches a rule, its outcome is determined by the conditions of the statement: If the first rule the packet matches is a permit statement, it's permitted; if it's a deny statement, it's denied.

Chapter 5

Equipment list

5.1 Switch - Cisco WS-C2950C-24 2950 Series 24 Port



Figure 5.1: Switch

- Number of ports: 24 x RJ45
- Speed : 10/100/1000Mbps
- MAC Address Table: 8K
- Authenticate Algorithm: MAC
- Routing/firewall: TCP/IP
- Management: Telnet

- SNMP
- RMON

5.2 Wireless – AC/N Premium Dual Radio Access Point with PoE Cisco WAP571-E-K9



Figure 5.2: Wireless Access Point

- Bandwidth: 2.4GHz and 5GHz
- Speed: 1.9Gbps
- Support 16 SSID, 32 VLAN.
- Support over 200 users connect or 50 users each frequency band.
- Support WDS, Repeater, Bridge.

5.3 Photodiode Light Sensor

- Working voltage 3.3 → 5VDC
- Use Photodiode for high accuracy
- Output fine-tuned digital signal by on-board rheostat or analog very easy to use
- Dimensions: 30 x 16mm

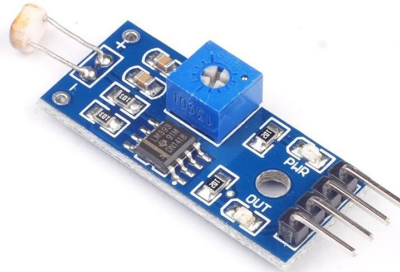


Figure 5.3: Light Sensor

5.4 Temperature Sensor Thermistor NTC

- Size 32*14mm.
- Working voltage 3.3-5V.
- Use Thermistor NTC sensor combined with ic LM393 to compare.
- The application of the circuit to detect whether the temperature has exceeded or reached the limit threshold.

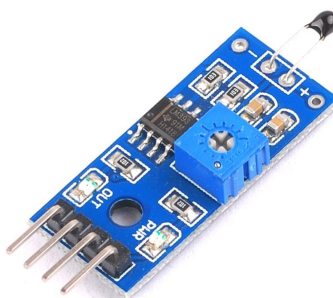


Figure 5.4: Temperature Sensor

5.5 Camera Hikvision DS-2CE56D0T-IRP



Figure 5.5: Camera

- Consumption Max: 2.2W.
- Power Supply 12 VDC $\pm 25\%$.
- Transfer Rates 11 Mbps, 54 Mbps, 72 Mbps.
- Angle AdjustmentPan: 360°.
- Resolution 1920 (H) \times 1080 (V).
- Video Output 1 HD analog output.

Chapter 6

Total expected cost

- Amount Switch: $5 \cdot (6+3) + 2 \cdot (6+3 \cdot 2) + 1 = 70$.
- Amount Access Point (AP): $5 \cdot (6+3) + 2 \cdot 9 + 1 = 64$.
- Amount Light Sensor: 228.
- Amount Temperature Sensor: 228.
- Amount Camera: 28.
- Length Cap: 2000m.

Type	Name	Unit cost	Amount	Cost
Switch	Cisco WS-C2950C-24 2950 Series 24 Port	3,000,000	70	210,000,000
AP	Wireless – PoE Cisco WAP571-E-K9	4,500,000	64	288,000,000
Sensor	Photodiod Light Sensor	10,000	228	2,280,000
Sensor	Temperature Sensor Thermistor NTC	8,000	228	1,824,000
Camera	Camera Hikvision DS-2CE56D0T-IRP	700,000	28	19,600,000
Cap	CAT6 STP Ugreen 108UM11253NW 100M	1,500,000	20	30,000,000
Total Cost				551,704,000

Table 6.1: Total expected cost