



Enterprise Network Design Hospital Network Design

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Hospital:



Floors- 3



Number of
doctors- 10



Administrative
Staff- 10



Number of
patient beds-
30



Nurses- 20



Non-
Administrative
Staff- 20

Overview

- The Hospital Campus Network is a comprehensive network infrastructure specifically designed to cater to the diverse needs of a hospital environment and encompasses various departments and areas within the hospital premises, including emergency rooms, operating theaters, patient wards, and administrative offices.
- The network architecture typically consists of core, distribution, and access layers, ensuring high availability, reliability, and scalability to support the demanding requirements of healthcare operations.
- Key components of the hospital campus network include switches, routers, access points, servers, and security appliances, all meticulously integrated to facilitate seamless communication, data sharing, and resource management across different hospital units.
- Security measures are paramount, with robust protocols and encryption mechanisms in place to safeguard patient data and ensure compliance with regulatory standards.

Objective

- The Hospital Campus Network is multifaceted and aimed at enhancing healthcare delivery within the hospital premises. Key objectives include:
- Seamless communication
- Timely access to information
- Scalability and flexibility
- data security and Compliance
- Disaster Recovery and Continuity
- Patient Experience and Satisfaction

Existing Network Issues

- **Bandwidth Limitations:** Hospital networks often experience congestion due to high data volumes generated by medical devices, electronic health records (EHRs), and imaging systems. Limited bandwidth can result in slow data transfer speeds and network latency, affecting critical patient care activities.
- **Network Security Threats:** Hospitals are prime targets for cyberattacks due to the sensitive nature of patient data and the interconnectedness of medical devices. Security vulnerabilities in network infrastructure, such as outdated software, weak authentication mechanisms, and insufficient encryption, expose hospitals to risks such as data breaches, ransomware attacks, and unauthorized access.
- **Interoperability Challenges:** Healthcare systems rely on interoperable networks to exchange patient information seamlessly across departments and external healthcare providers. However, interoperability issues between disparate systems and legacy technologies can hinder data sharing, care coordination, and clinical decision-making.
- **Strengthened Cybersecurity Measures:** Hospitals must prioritize cybersecurity to safeguard patient data, medical devices, and network infrastructure from cyber threats. This includes implementing robust security protocols, conducting regular risk assessments, and providing comprehensive cybersecurity training to staff.

Benefits of the proposed solution:

- Improved Patient Care
- Enhanced Operational Efficiency
- Advanced Communication and Collaboration
- Increased Patient Safety and Satisfaction
- Scalability and Flexibility

Business Goals

- Improved Patient Experience
- Develop strong security measures
- Ensuring sufficient staff on-site to provide administrative and non-administrative services
- Implement data loss and prevention mechanisms to protect intellectual property
- Discontinue the usage of outdated technologies
- Cost-effectiveness
- Effective Clinical Operation
- Streamlined Administration
- Documentation and Training

Technical Goals

- Network Optimization (Performance)
- Security and Compliance
- Network Scalability
- Redundancy and Reliability
- Data Security
- Affordability
- Availability

Structure of the Hospital

- Floors - 3
- Doctors - 15
- Nurses - 30
- Administrative Staff - 10
- Non-Administrative Staff - 25

Network Topology

Mesh Topology

Servers

HTTP : Hyper Text Transfer Protocol

SMTP: Simple Mail Transfer protocol

AAA: Authentication Authorization Accounting

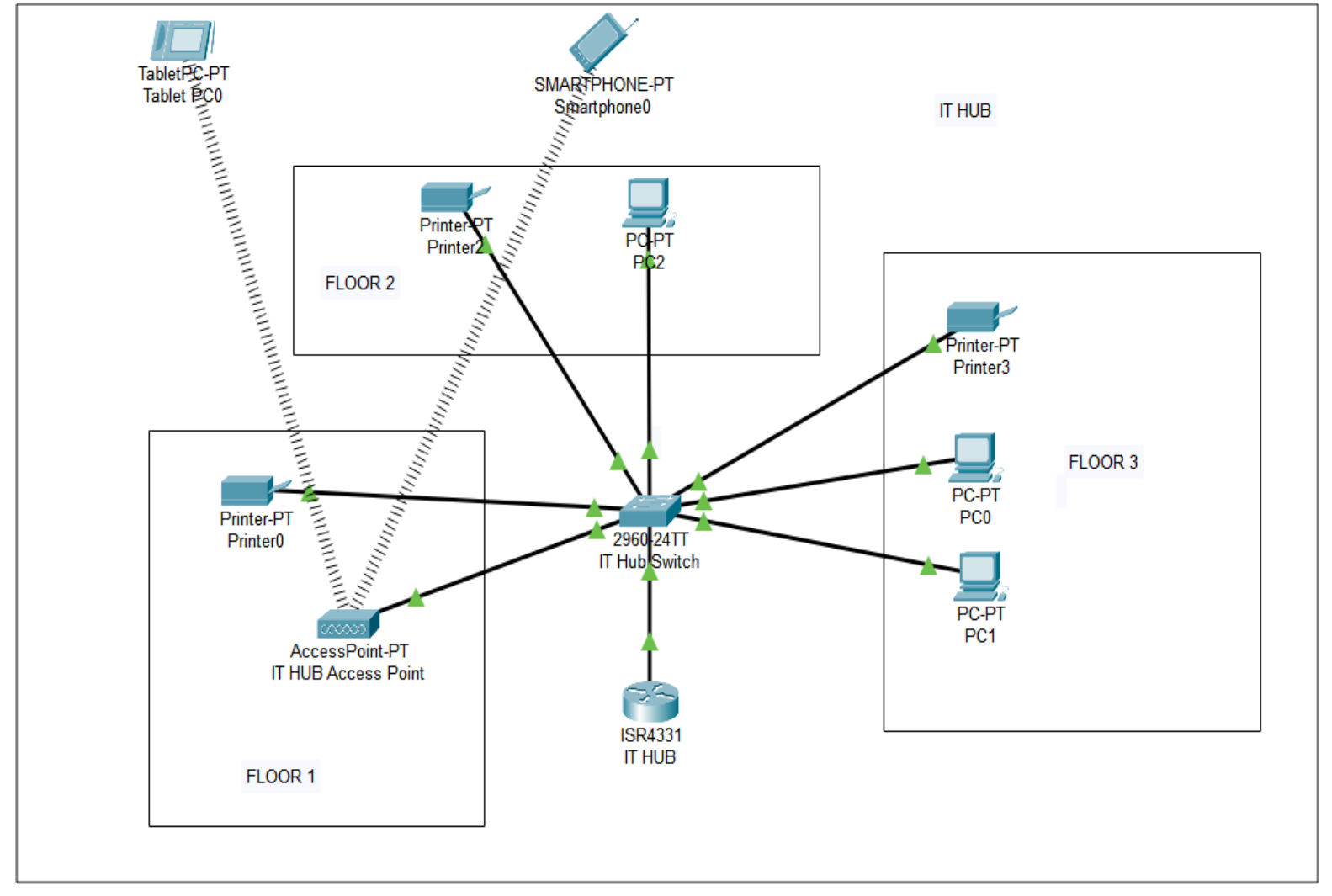
Departments in Hospital:

- General Ward
- ICU
- IT Department
- Administration
- Reception, Lobby, Parking, Cafeteria



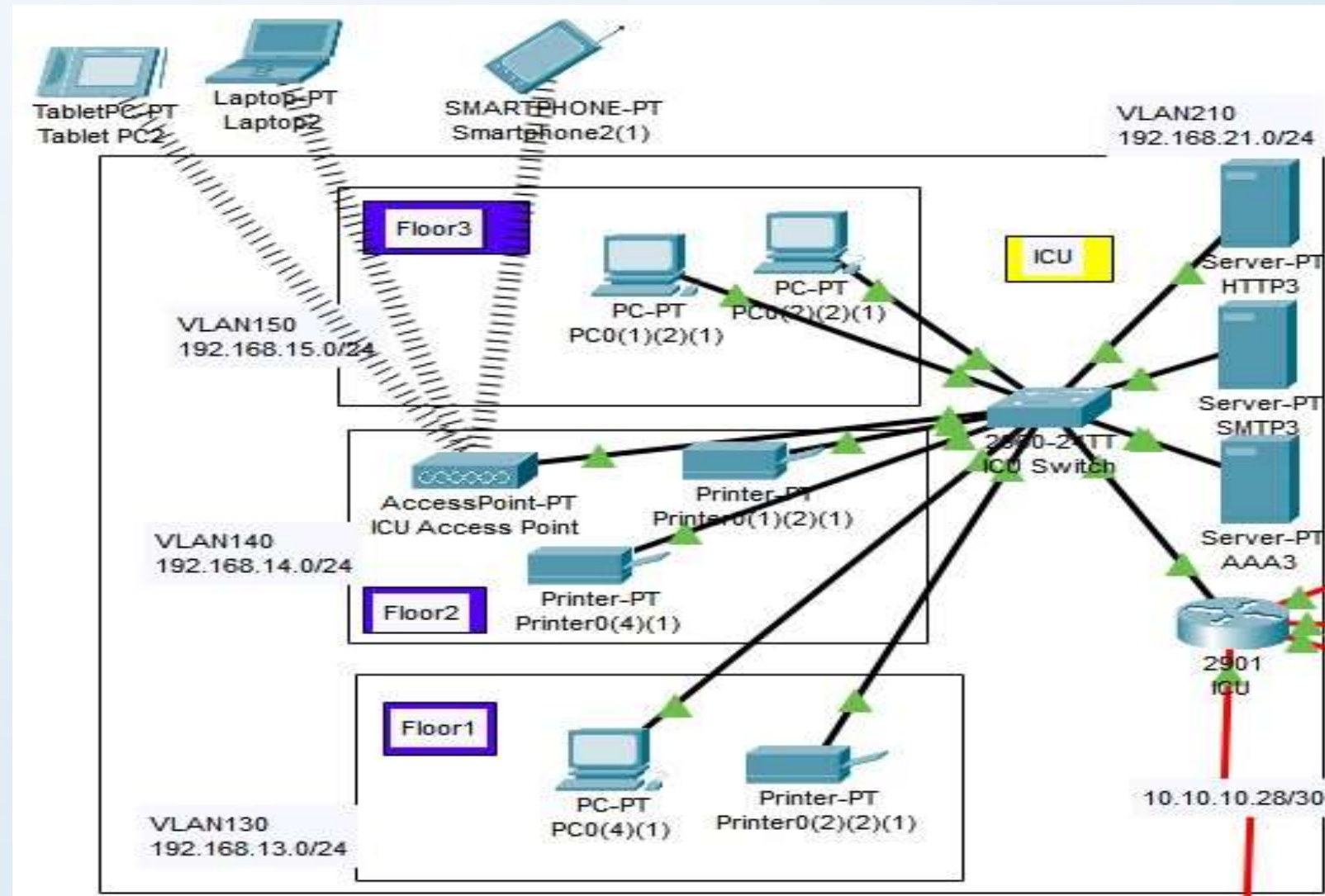
Logical Design

IT Department:



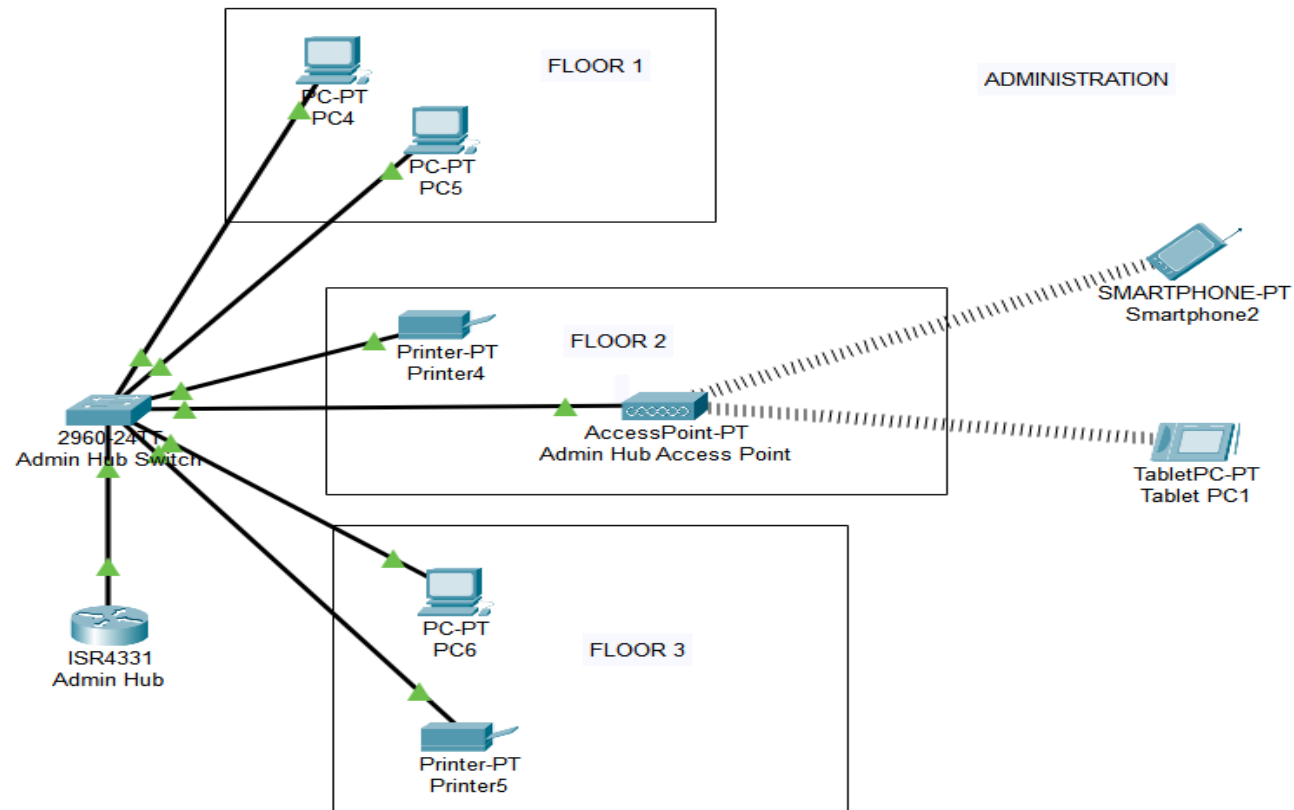
Devices		Numbers
Tablet		1
Smartphones		5
PC	Floor 1	0
	Floor 2	1
	Floor 3	2
Access Point	Floor 1	1
	Floor 2	0
	Floor 3	0
Printer	Floor 1	1
	Floor 2	1
	Floor 3	1
Switches		1
Routers		1
Servers		0

ICU Ward design



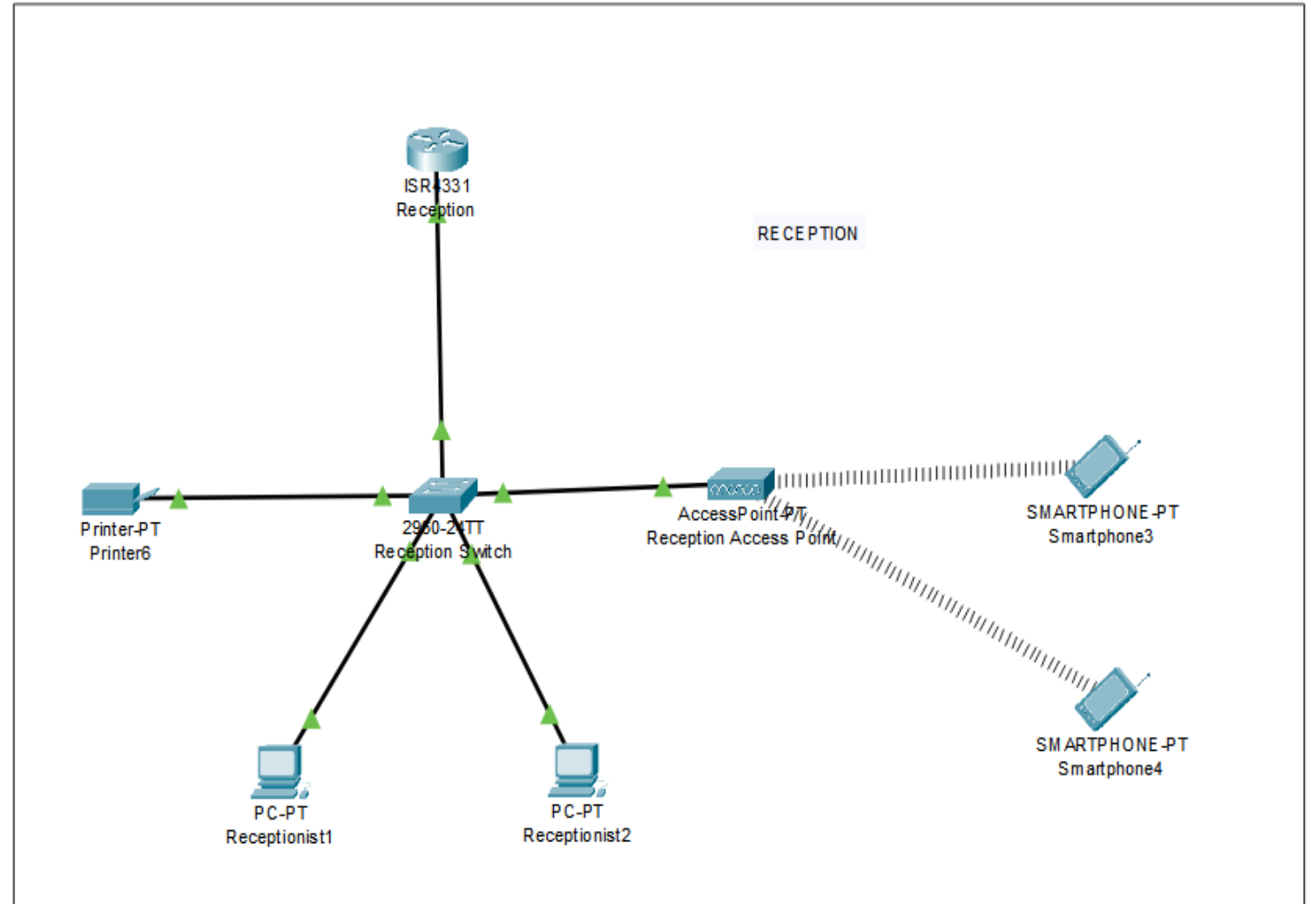
Devices		Numbers
Tablet		1
Laptop		2
Smartphones		2
Printer	Floor 1	2
	Floor 2	2
	Floor 3	0
PC	Floor 1	4
	Floor 2	0
	Floor 3	2
Access Point	Floor 1	0
	Floor 2	1
	Floor 3	0
Switches		1
Routers		1
Server	HTTP3	1
	SMTP3/MIME	1
	AAA3	1

Administration:



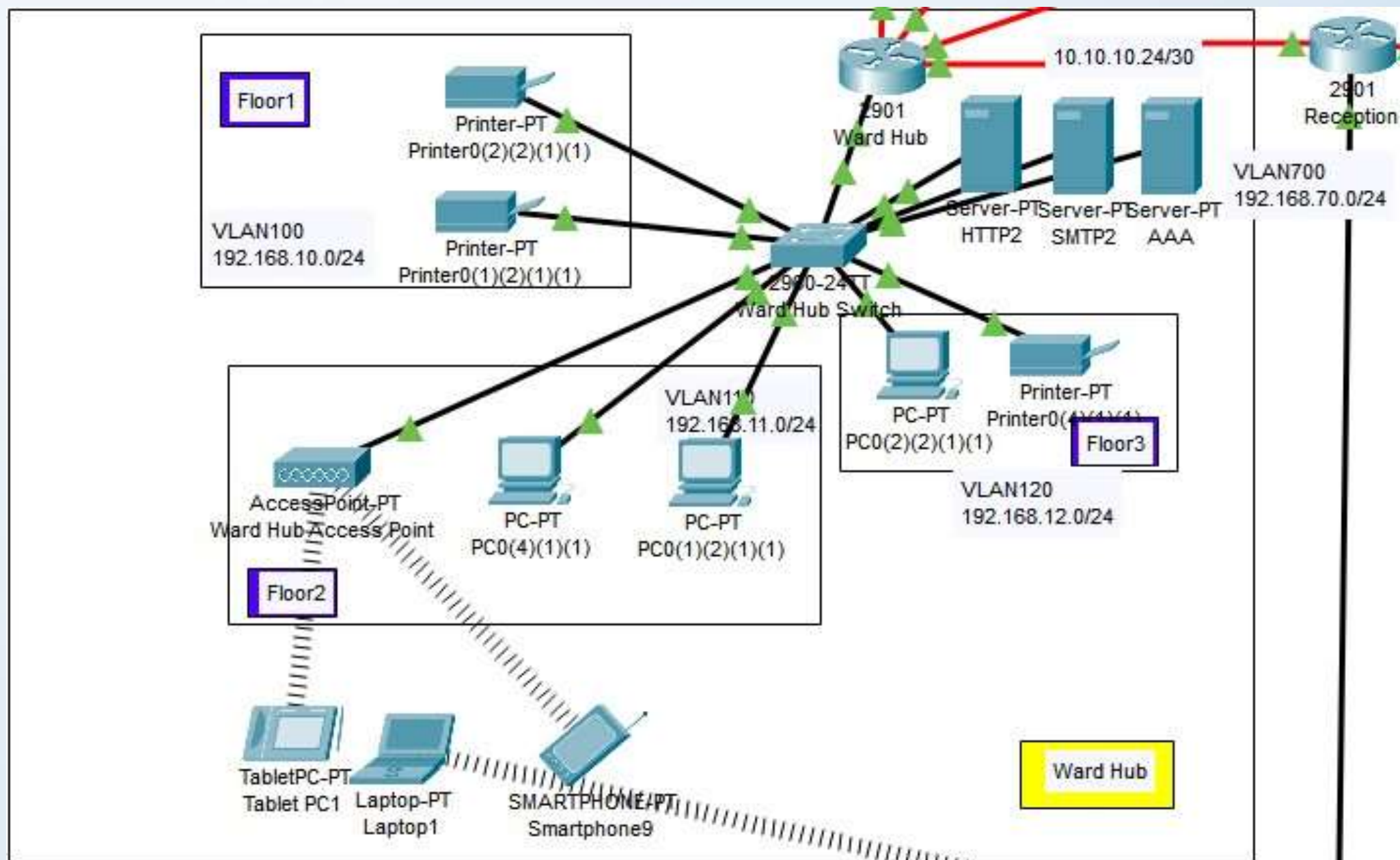
Devices		Numbers
Tablet		1
Smartphones		3
PC	Floor 1	2
	Floor 2	0
	Floor 3	1
Access Point	Floor 1	0
	Floor 2	1
	Floor 3	0
Printer	Floor 1	0
	Floor 2	1
	Floor 3	1
Switches		1
Routers		1
Servers		0

Reception:



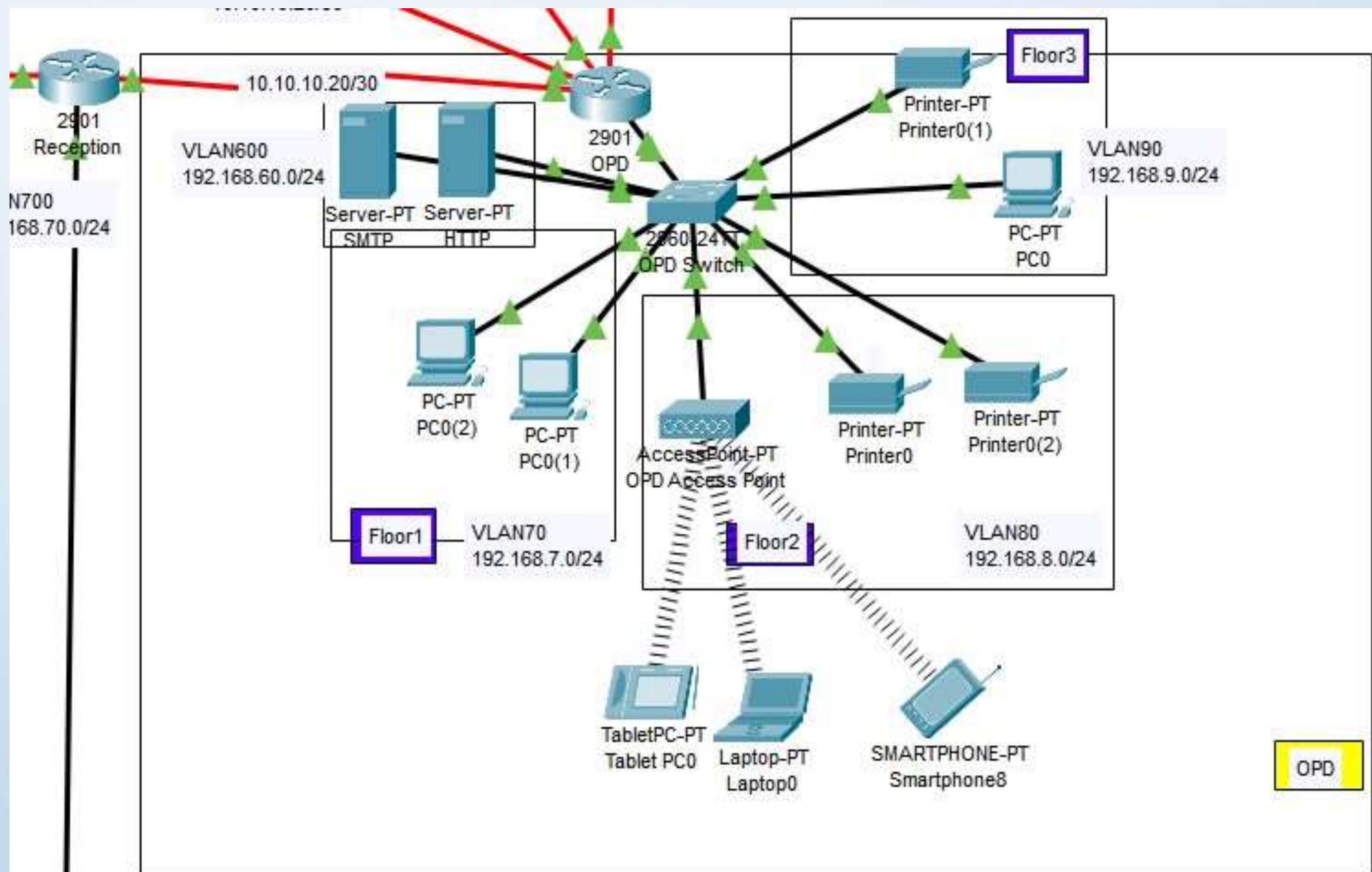
Devices	Numbers
Tablet	0
Laptop	0
Smartphones	2
Printer	1
PC	2
Access Point	1
Switches	1
Routers	1
Server	0

Ward Hub

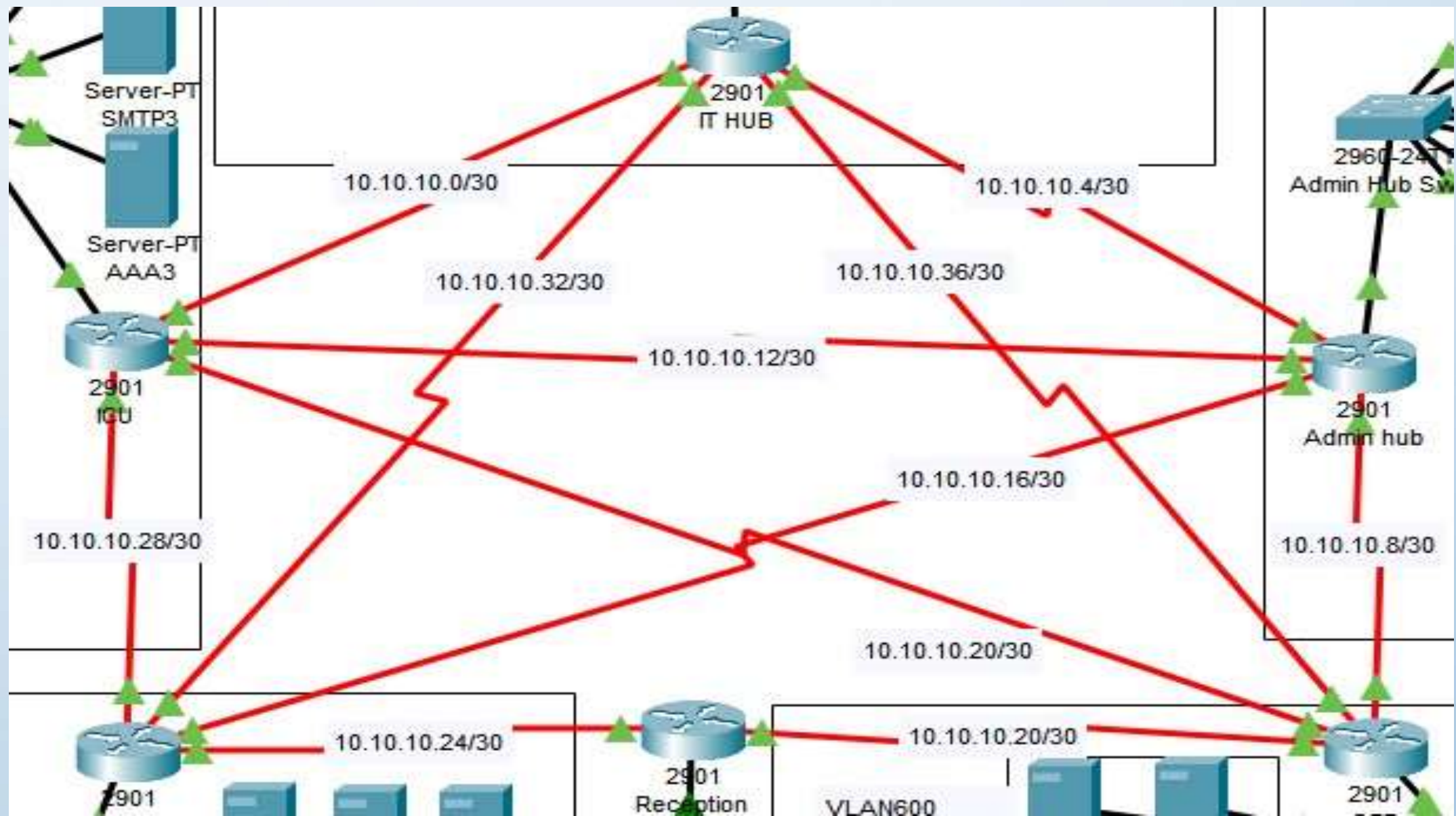


Devices		Numbers
Tablet		1
Laptop		1
Smartphones		9
Printer	Floor 1	2
	Floor 2	0
	Floor 3	1
PC	Floor 1	0
	Floor 2	2
	Floor 3	1
Access Point	Floor 1	0
	Floor 2	1
	Floor 3	0
Switches		1
Routers		1
Server	HTTP	1
	MIME	1
	AAA	1

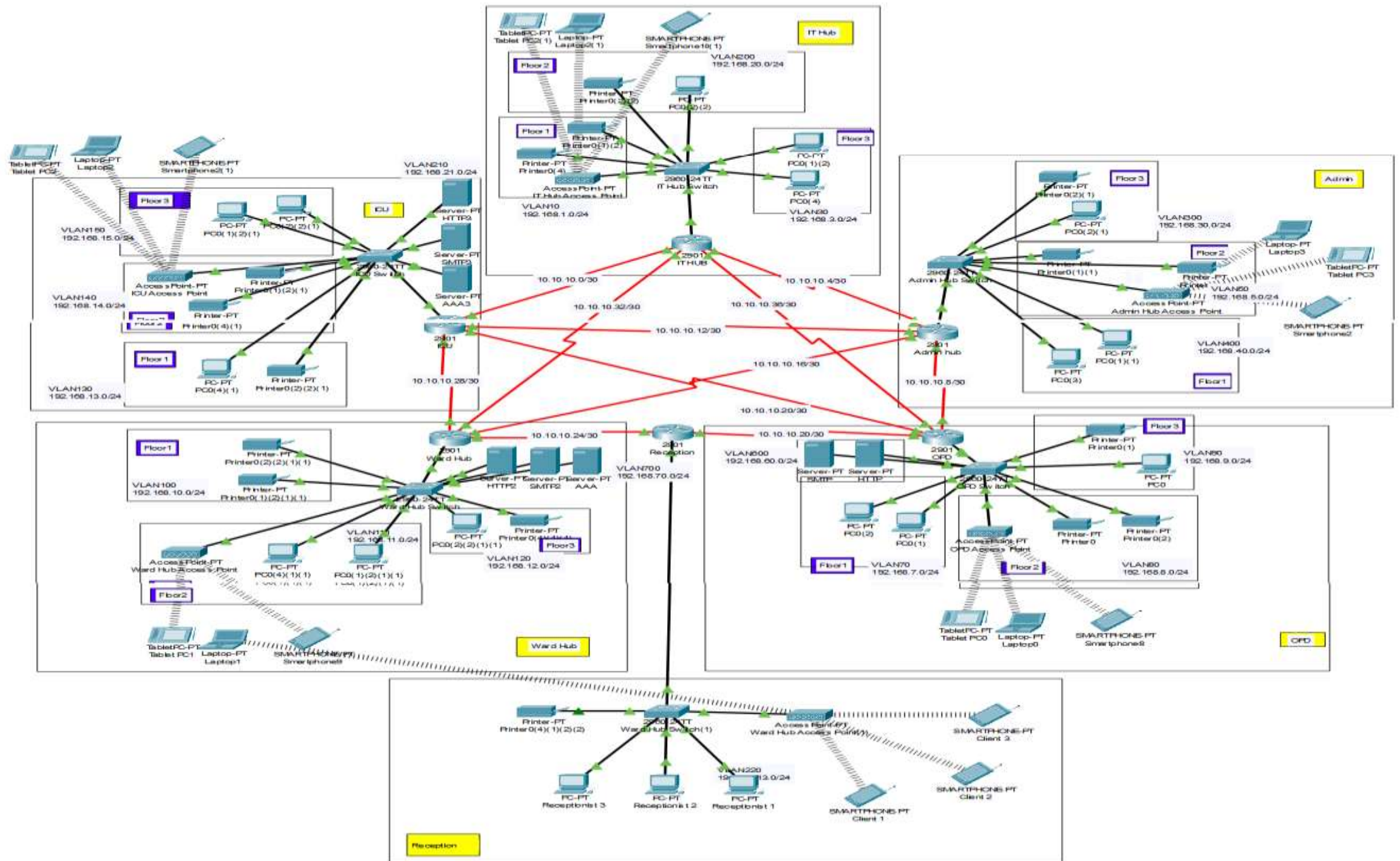
Outpatient Department



Department Interconnection



Complete Network Design



IP Address Assignment

IP Addressing of IT Hub

Floors	VLAN	Address	Mask	Dec Mask	Assignable Range
Floor 1	10	192.168.1.0	/24	255.255.255.192	192.168.1.0 – 192.168.1.63
Floor 2	200	192.168.20.0	/24	255.255.255.192	192.168.20.0 – 192.168.20.65
Floor 3	30	192.168.3.0	/24	255.255.255.192	192.168.3.0 – 192.168.3.63

IP Address Assignment

IP Addressing of Administration

Floors	VLAN	Address	Mask	Dec Mask	Assignable Range
Floor 1	400	192.168.40.0	/24	255.255.255.192	192.168.40.0 – 192.168.40.63
Floor 2	50	192.168.5.0	/24	255.255.255.192	192.168.5.0 – 192.168.5.65
Floor 3	300	192.168.30.0	/24	255.255.255.192	192.168.30.0 – 192.168.30.63

IP Address Assignment

IP Addressing of ICU

Floors	VLAN	Address	Mask	Dec Mask	Assignable Range
Floor 1	130	192.168.13.0	/24	255.255.255.192	192.168.13.0 – 192.168.13.63
Floor 2	140	192.168.14.0	/24	255.255.255.192	192.168.14.0 – 192.168.14.63
Floor 3	150	192.168.15.0	/24	255.255.255.192	192.168.15.0 – 192.168.15.63
At server	210	192.168.21.0	/24	255.255.255.192	192.168.21.0 – 192.168.21.63

IP Address Assignment

IP Addressing of OPD (Out-Patient Department)

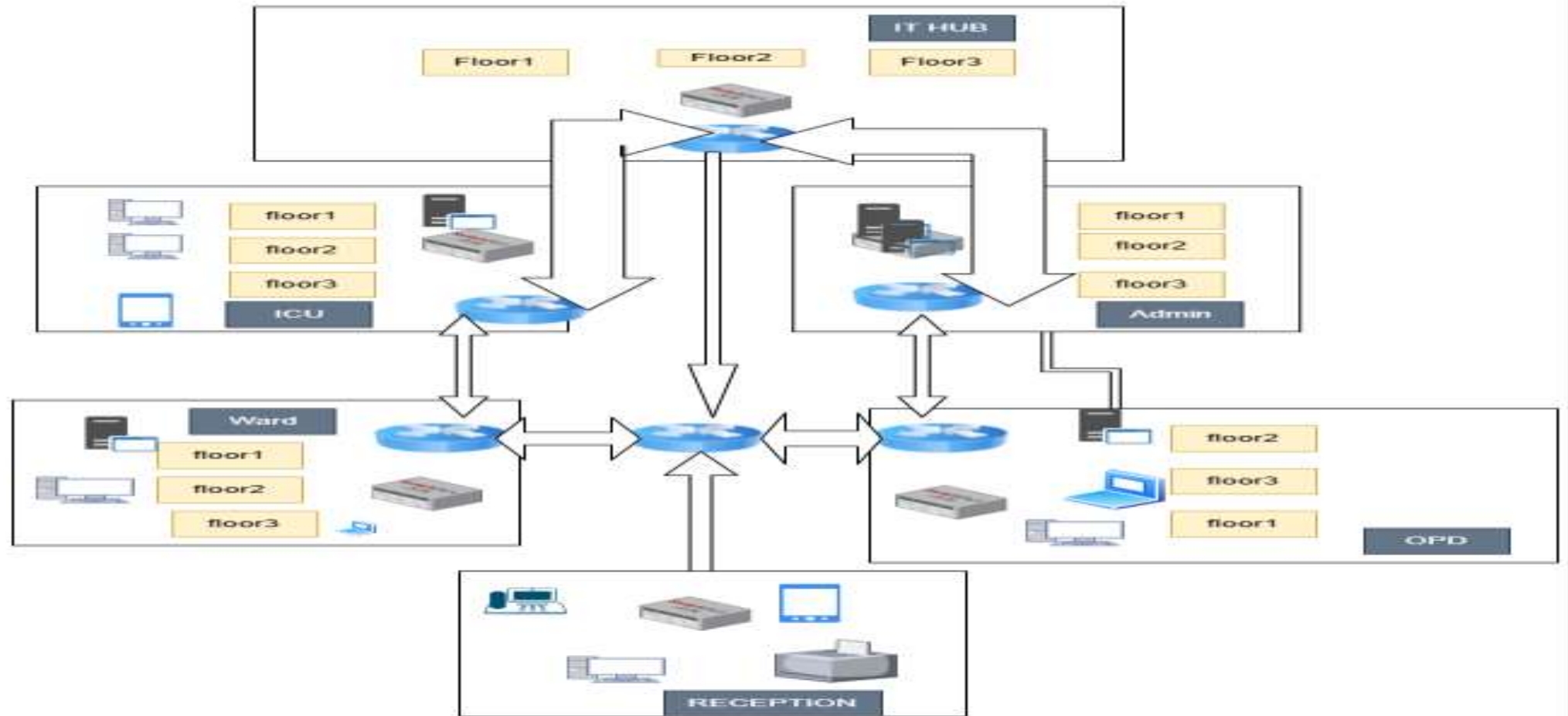
Floors	VLAN	Address	Mask	Dec Mask	Assignable Range
Floor 1	70	192.168.7.0	/24	255.255.255.192	192.168.7.0 – 192.168.7.63
Floor 2	80	192.168.8.0	/24	255.255.255.192	192.168.8.0 – 192.168.8.63
Floor 3	90	192.168.9.0	/24	255.255.255.192	192.168.9.0 – 192.168.9.63
At server	600	192.168.60.0	/24	255.255.255.192	192.168.60.0 – 192.168.60.63

IP Address Assignment

IP Addressing of Ward Hub

Floors	VLAN	Address	Mask	Dec Mask	Assignable Range
Floor 1	100	192.168.10.0	/24	255.255.255.192	192.168.10.0 – 192.168.10.63
Floor 2	110	192.168.11.0	/24	255.255.255.192	192.168.11.0 – 192.168.11.65
Floor 3	120	192.168.12.0	/24	255.255.255.192	192.168.12.0 – 192.168.12.63
At server	700	192.168.70.0	/24	255.255.255.192	192.168.70.0 – 192.168.70.63

Physical Design



Hardware Components Used

Devices	Type	Specifications	Numbers	Location
Generic PCs	Hosts	CPU: Intel Core I5 RAM: 8GB 2666mHz DDR4 RAM: 128GB NVME SSD	15	All wards
CISCO 4000 series Router	Integrated services router	10 GE SFP+, PoE GE/SFP, GE/SFP 10 Gbps+ performance 7Gbps encrypted throughput	6	All wards Interconnection
CISCO Catalyst 2960-L smart managed switches	Switches	16 PoE+ ports with line rate forwarding	6	All Wards
Cables,	Co-axial, Multimode fiber, CAT 6A	Support for 10Gb and 40Gb Ethernet communication	As per required	
Cisco C9120AXI-B catalyst	Access point	4×4 Flexible Dual Radio with 5GHz and 2.4GHz or two 5GHz configuration, up to 5.38 Gbps data rate, uplink/downlink OFDMA	6	One in each building
Cisco UCS X210c M6	Server	3rd Gen Intel Xeon Scalable Processors		

Testing / Optimization / Documentation:

Before fully operationalizing the new network infrastructure, thorough testing and quality assurance measures will be undertaken to identify and rectify potential issues.

- **Testing Scenario**

- **Quality Assurance Protocols**

Testing / Optimization / Documentation:

Budget and Quantities

Component	Description	Price per Unit (USD)	Quantity	Total Cost (USD)
Switches	Cisco Catalyst 3650 Switches	1500	6	9000
Routers	Juniper MX Series Routers	5000	6	30,000
Access Points	Aruba 500 Series APs	300	6	1800
Server Hardware	Dell PowerEdge R740 Servers	8000	8	64,000
Software Licenses	Microsoft Server 2019 licenses	1200	30	36,000
Network Cabling	CAT6 Ethernet Cables (per ft)	0.5	5000	2,500
Staff Training	Certification Training Programs	2000	5	10,000
Maintenance Support	Annual Support Contracts	Varies	-	25,000
Telecommunication	Internet Service Provider	2000/month	12 months	24,000
Compliance Measures	HIPAA Compliance Audit	5000	1	5,000
Staff	Administration and non-administration	(Salary per month) Varies Between employees	35	220000(Approx)
Total				427,300(Initial Budget Approx)

Testing / Optimization / Documentation:

IEEE Standards

➤ Admin Hub Access Point

SSID – Floor5

Pass Phrase – Floor@12

➤ OPD Access Point

SSID – Floor1

Pass Phrase – Floor@123

➤ Reception Access Point

SSID – Reception

Pass Phrase – Reception@123



Testing / Optimization / Documentation:

IEEE Standards

- Ward Hub Access Point

SSID – Floor2

Pass Phrase – Floor@123

- ICU Access Point

SSID – Floor3

Pass Phrase – Floor@123

- IT Hub Access Point

SSID – Floor4

Pass Phrase – Floor@123

Features:

- DHCP (Dynamic Host Configuration Protocol):

In the healthcare network, DHCP ensures efficient IP address management, allowing medical devices, computers, and other network-connected equipment to obtain IP addresses dynamically without manual configuration, simplifying network administration.

- DNS (Domain Name System):

DNS resolves domain names to IP addresses, enabling users to access various network resources, such as medical databases, patient records, and internal web applications, using easy-to-remember domain names.

- Subnetting:

In the healthcare network, subnetting allows administrators to logically separate different departments, services, or types of traffic (such as patient data, administrative data, and guest access) into distinct segments, enhancing security and network performance.

- HTTPS (Hypertext Transfer Protocol Secure):

HTTPS ensures secure communication when accessing sensitive information, such as patient records, medical images, and laboratory results, over the web, protecting patient privacy and confidentiality.

- SMTP (Simple Mail Transfer Protocol):

SMTP facilitates the exchange of email messages between healthcare professionals, administrators, and patients, enabling efficient communication for appointment scheduling, medical consultations, and sharing of medical reports and information.

- FTP (File Transfer Protocol):

FTP transfers medical images, diagnostic reports, and other large files between healthcare providers, hospitals, and medical facilities, enabling collaboration and information sharing.

- Quality of Service (QoS):

QoS policies prioritize network traffic based on its importance, ensuring that essential services such as voice, video conferencing, and medical data transmission receive sufficient bandwidth and low latency, even during network congestion.

Conclusion

- Secure Infrastructure
- Enhanced Efficiency
- Patient Centered Design
- Impact on Health Care Approach

Thank you

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