SMART Hostel Network Topology on CISCO Packet Tracer

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Abstract **The SMART Hostel Network project represents an innovative integration of various networking concepts, including DHCP on routers, IoT and IP phone usage and specialized router configurations. This report outlines the projects design, implementation, and results, emphasizing the impact on hostel communication efficiency.**

I. Introduction

In era of digital transformation optimized hostel networks is crucial. Our project leverage cutting- sedge technologies to enhance communication and easiness of access and operational efficiency. We explore the integration of DHCP on router, IoT devices, and IP phones, along with specialized router configuration.

II. Literature Review

Dynamic Host Configuration Protocol or DHCP, had become a key element in network optimization when it comes to improving router performance. DHCP optimizes resource allocation and lower administrative overhead streamlining process of assigning IP addresses to devices inside a network ([1]).

DHCP ensure effective use of available addresses and reduces the possibility of address conflict which can hinder network functionality by dynamically assigning IP addresses ([1]).

Furthermore network connectivity had been completely transformed by incorporation of IoT (Internet of Things) devices. IoT devices are broad category of networked things that exchange data and communicate via internet, including smart appliances and actuators, and sensor. Range of network setting has greatly increased due to growth of IoT device allowing for the smooth integration of digital and physical system ([2]).

These gadgets support real-time monitoring and control applications in a variety of fields and such as smart cities, transportation, and healthcare, and they also improve data interchange ([2]).

IP phones have also developed into a necessary tool for effective communication and in business environment. IP phone uses internet protocol as to be opposed to traditional analogue phones and to send voice data across IP network. Improved call quality, scalability, and interaction with other communication apps are just a few benefit of this digital strategy ([3]). IP phone are very helpful for organizations and company looking to cut expenses on telecommunication without sacrificing high-quality service and optimize communication procedure ([3]).

The literature as a whole emphasizes value of DHCP in maximizing router performance, the revolutionary effects of IoT devices on data interchange and network connectivity and the cost saving linked to the use of IP phones for communication. The objective of the SMART Hostel Network project is to optimize communication efficiency and operational performance in hostel environment by combining these insights in a synergistic way.

III. Methodology

Using state of the art technology to maximize communication efficiency in hostel environments is main goal of technique used for SMART Hostel Network project. This approach covers all aspects of design, implementation, and assessment.

A. Router Configuration

Setting up Call Manager Express (CME) on a Cisco 2811 router is one of the methodology main steps. IP phone service can be integrated straight into Cisco routers with help of CME, a feature-rich telephony solution. Through the implementation of CME router serves as a platform for call processing, enabling creation and administration of voice calls across the network. Determining telephony characteristics such as dialing peers, which are utilized for call routing and setting up voice interfaces to accommodate IP phone and analogue devices are example of configuration chores.

B. Switch VLAN Configuration

To further aid in division of voice and data traffic within the network and switch VLAN (Virtual Local Area Network) configuration is equally important as router configuration. Logical partitions called virtual local area networks (VLANs) allow network traffic to be isolated according to pre-established standards like port or MAC address. The switch guarantees the best possible performance and quality of service for voice communication by establishing distinct VLANs for data and voice traffic. To minimize network congestion and latency and voice packets are routed through a single VLAN and like VLAN 1, whereas data packets are routed through different VLANs. Block-Specific Access Points.([4])

C. Phone Directory Configuration

Another aspect of the methodology involves configuring phone directory on the CME system to assign phone numbers to IP phones. This process entails defining directory numbers (DNs) for each phone and which serve as unique identifiers for incoming and outgoing calls. By assigning DNs to IP phones, users can easily place and receive calls within the network and facilitating seamless communication and collaboration.

IV. Implementation of Network

The implementation of this smart network is done in multiple steps as:

A. Configuring the control block:

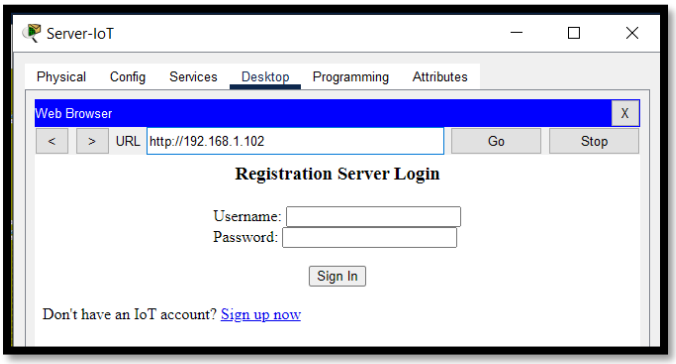
In this step we used a normal PT router for main connection where we placed used the DHCP protocol implemented. Single network is used in this network topology using this router which configured the IP's of all the devices in the network. The main router uses the network IP of 192.168.1.0. the main router is also configured with the port connected to the IP-Phone

router. The commands for configuration of the router for this main connection is as follows:

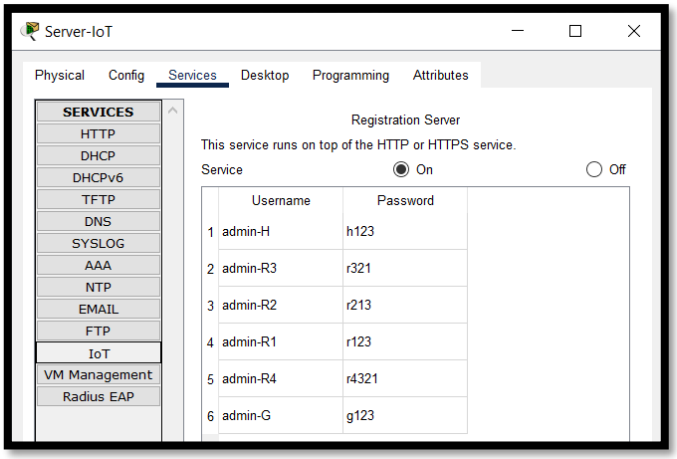
```
Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname MainRouter
MainRouter(config)#int fa0/0
MainRouter(config-if)#ip address 192.168.1.1 255.255.255.0
MainRouter(config-if)#no shut

MainRouter(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

MainRouter(config-if)#exit
MainRouter(config)#int fa1/0
MainRouter(config-if)#ip address 172.16.0.1 255.255.0.0
MainRouter(config-if)#no shut

MainRouter(config-if)#
%LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up

MainRouter(config-if)#exit
MainRouter(config)#ip dhcp pool 1
MainRouter(dhcp-config)#exit
MainRouter(config)#no ip dhcp pool 1
MainRouter(config)#ip dhcp pool SmartHostel
MainRouter(dhcp-config)#network 192.168.1.0 255.255.255.0
MainRouter(dhcp-config)#default-router 192.168.1.1
MainRouter(dhcp-config)#exit
MainRouter(config)#ip dhcp excluded-address 192.168.1.1 192.168.1.100
MainRouter(config)#exit
MainRouter#
%SYS-5-CONFIG_I: Configured from console by console
```

Main Router configuration

After this the server is placed on which our IoT registration service is used. This can be done by going to the desktop of the server and then go to the webservices option. It may take some time. Write the ip Address of the server on which it is configured (note the ip of server is configured statically from the network same as given to router DHCP pool). A webpage opens up and at there we have to click at the sign up now as mentioned below:



Another webpage appears as where the user name and password is placed and the account is created in the IoT server as:



As 6 accounts are created as 1 for controlling the IoT of control block, 4 for the rooms and 1 for the guest access point.

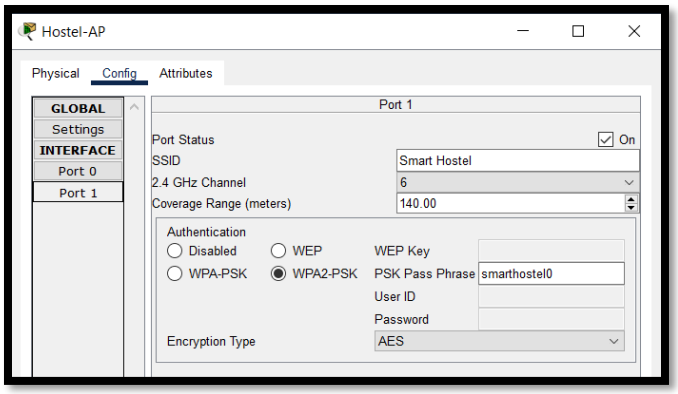
Then the IP-Phone router is placed and configured as to connect with the wire coming from the main router and also configuration of the IP-Phone router with the switch as:

```
IP-Phone-Router(config)#ip dhcp pool phone
IP-Phone-Router(dhcp-config)#network 192.168.2.0 255.255.255.0
IP-Phone-Router(dhcp-config)#default-router 192.168.2.1
IP-Phone-Router(dhcp-config)#option 150 ip 192.168.2.1
IP-Phone-Router(dhcp-config)#exit
IP-Phone-Router(config)#telephony-service
IP-Phone-Router(config-telephony)#max-dn 5
IP-Phone-Router(config-telephony)#max-ephone 3
IP-Phone-Router(config-telephony)#ip source-address 192.168.2.1 port 2000
IP-Phone-Router(config-telephony)#auto assign 1 to 3
IP-Phone-Router(config-telephony)#exit
IP-Phone-Router(config)#ephone-dn 1
IP-Phone-Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 1.1,

IP-Phone-Router(config-ephone-dn)#number 55555
IP-Phone-Router(config-ephone-dn)#ephone-dn 2
IP-Phone-Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 2.1,

IP-Phone-Router(config-ephone-dn)#number 66666
IP-Phone-Router(config-ephone-dn)#ephone-dn 3
IP-Phone-Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 3.1,

IP-Phone-Router(config-ephone-dn)#number 77777
IP-Phone-Router(config-ephone-dn)#ephone-dn 4
IP-Phone-Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 4.1,

IP-Phone-Router(config-ephone-dn)#exit
IP-Phone-Router(config)#telephony-service
IP-Phone-Router(config-telephony)#max-ephone 5
IP-Phone-Router(config-telephony)#exit
IP-Phone-Router(config)#ephone-dn 4
IP-Phone-Router(config-ephone-dn)#number 88888
IP-Phone-Router(config-ephone-dn)#ephone-dn 5
IP-Phone-Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 5.1,

IP-Phone-Router(config-ephone-dn)#number 99999
IP-Phone-Router(config-ephone-dn)#exit
```

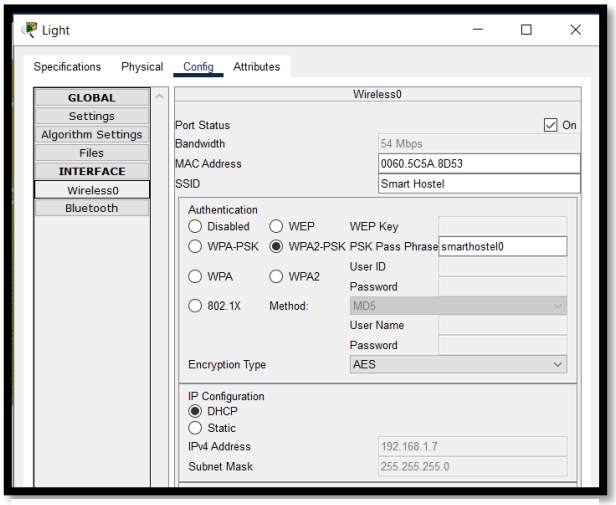
As after configuring the router we have to configure the switch with the VLAN 1. As it is not in the control block highlighted section but it is the part of it. The screenshot of the switch configuration is as:

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int range f0/1-24
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switch voice vlan1
                                          ^
% Invalid input detected at '^' marker.

Switch(config-if-range)#switch voice vlan 1
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

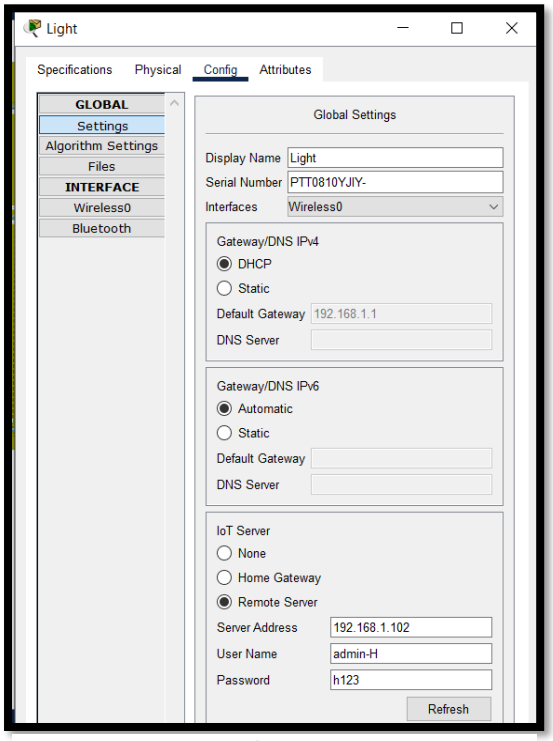
After all this done an access point of control block is configured with the SSID and pass key as:



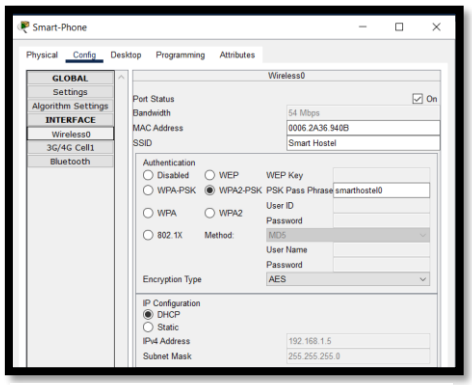
Thus access point is configured the it is connected with a switch which is connected to the main router and the smartphone for monitoring the IoT devices and IoT devices itself are connected wirelessly and then remote server is set up here as:



Wireless connection in IoT



Connecting the remote server

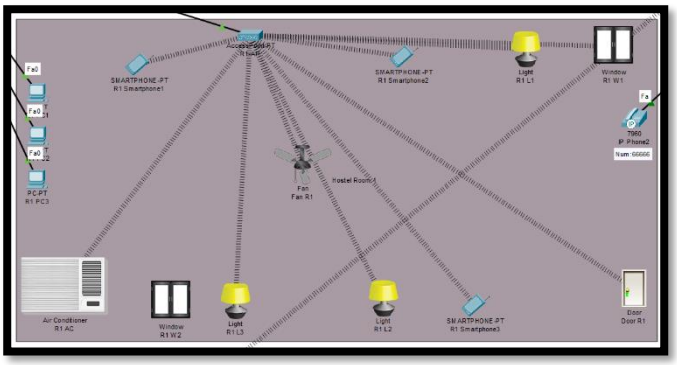


Smart phone wireless connection

In tis way all the IoT devices and smart phones are connected. Then we go to the four rooms of the network but for this firstly we placed 6 switches at the borders in order to connect them to the router through the switch of control Block. The Ip=Phone of the control block have got number 55555 by outing adapter on it and connection it to IP-Phone switch. In each room we can say max 3 students can live so 3 PCs were provided in each room.

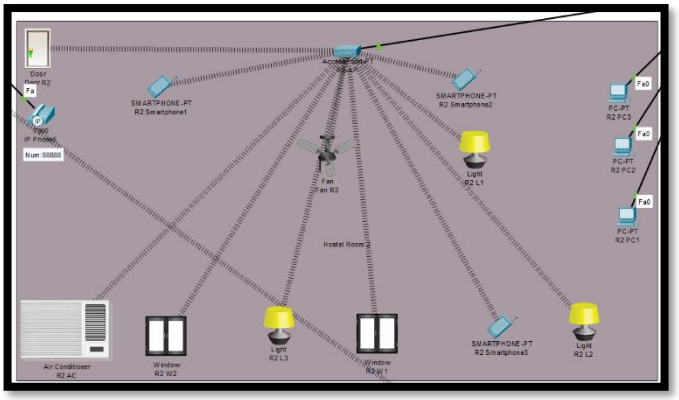
B. Room 1 configuration:

For Room 1 we placed the IP-Phone put an adapter to it and the connect it to the switch. The number got after connecting the switch is 66666. Then the access point is place and connected to the neared switch 3 and after repeating the steps as done in the control room block that access point is give the SSID (Room 1) and pass key(smartroom1) and then using the SSID and password the IOT devices and the smart phone are connected. Here also the PCs are connected to the switch 3. As the IoT devices and smart phone gets connected it takes the IP using DHCP as they are connected to the access point wirelessly which is connected to the switch. The remote server credentials of the IoT server as 192.168.1.102(ip address of server) admin-R1(Username) and r123(password) of Room 1.



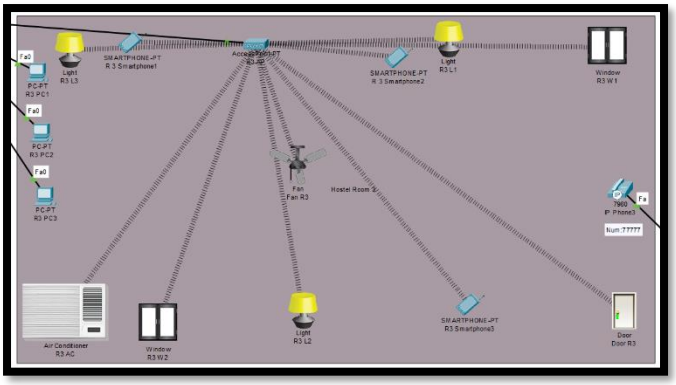
C. Room 2 configuration:

For Room 2 we placed the IP-Phone put an adapter to it and the connect it to the switch. The number got after connecting the switch is 88888. Then the access point is place and connected to the neared switch 6 and after repeating the steps as done in the control room block that access point is give the SSID (Room 2) and pass key(smartroom2) and then using the SSID and password the IOT devices and the smart phone are connected. Here also the PCs are connected to the switch 6. As the IoT devices and smart phone gets connected it takes the IP using DHCP as they are connected to the access point wirelessly which is connected to the switch. The remote server credentials of the IoT server as 192.168.1.102(ip address of server) admin-R2(Username) and r213(password) of Room 2.



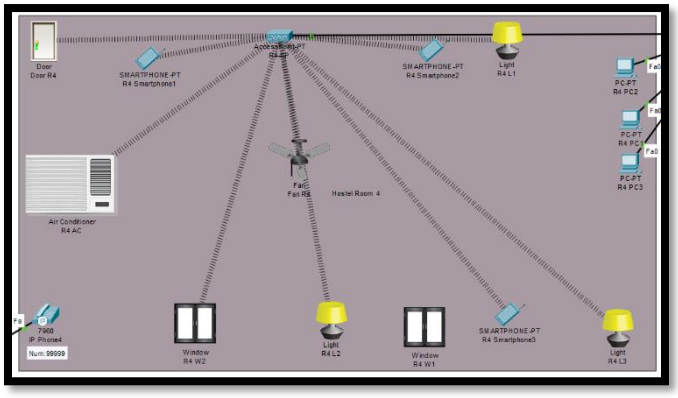
D. Room 3 configuration:

For Room 3 we placed the IP-Phone put an adapter to it and the connect it to the switch. The number got after connecting the switch is 77777. Then the access point is place and connected to the neared switch 4 and after repeating the steps as done in the control room block that access point is give the SSID (Room 3) and pass key(smartroom3) and then using the SSID and password the IOT devices and the smart phone are connected. Here also the PCs are connected to the switch 4. As the IoT devices and smart phone gets connected it takes the IP using DHCP as they are connected to the access point wirelessly which is connected to the switch. The remote server credentials of the IoT server as 192.168.1.102(ip address of server) admin-R3(Username) and r321(password) of Room 3.



E. Room 4 configuration:

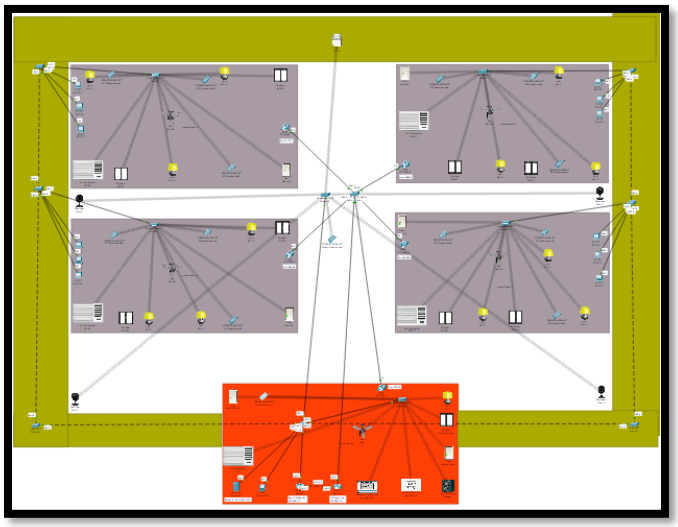
For Room 4 we placed the IP-Phone put an adapter to it and the connect it to the switch. The number got after connecting the switch is 99999. Then the access point is place and connected to the neared switch 5 and after repeating the steps as done in the control room block that access point is give the SSID(Room 4) and pass key(smartroom4) and then using the SSID and password the IOT devices and the smart phone are connected. Here also the PCs are connected to the switch 5. As the IoT devices and smart phone gets connected it takes the IP using DHCP as they are connected to the access point wirelessly which is connected to the switch. The remote server credentials of the IoT server as 192.168.1.102(ip address of server) admin-R4(Username) and r4321(password) of Room 4.



F. Guest Area:

In this area the 4 webcams are connected and a sired is connected to corridor seems like area of a hostel. The reason for putting the camera is to keep the surroundings of the hostel outside of the room and siren is for emergency purposes. This access point is connected to the control room block. The connection of these webcams and sired is same as they are also IoT devices. The credentials of the remote server are as 192.168.1.102(ip address of server) admin-G(Username) and g123(password).

Thus the network is formed in the end is as:

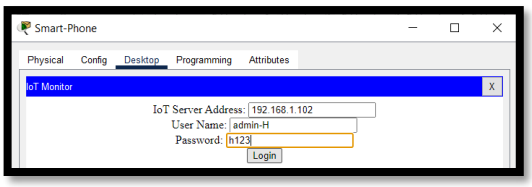


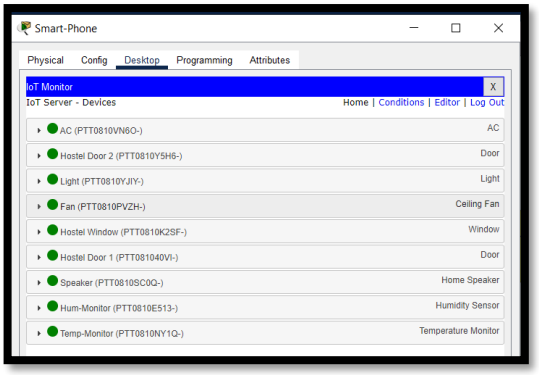
The packets are successfully sent across the network as:

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	Successful	Server-IoT	Central PC	ICMP		0.000	N	0	(edit)
	Successful	Server-IoT	R1 AC	ICMP		0.000	N	1	(edit)
	Successful	Central PC	R2 PC3	ICMP		0.000	N	2	(edit)
	Successful	R3 PC3	Server-IoT	ICMP		0.000	N	3	(edit)

This packet sending shows the network formed is correct.

We can also monitor the device of IoT form any PC or smart phone just by putting the credentials as:





V. Software requirments

For making this SMART Hostel Cisco Packet tracer 8.2.1 is used and the pkt file of the network topology can be opened and used in same or higher versions.

VI. Future SUggestions

This network of Smart hostel can be improved if we put on the Separate VLAN's or we use subnetting. We can also deploy Hostel website on the server. This Network can me much better if we use proper image directions. The secure trucking mode used in VLANS can also help in improving the network.

VII. Results and Discussion

Significant improvement in operational effectiveness and communication efficiency were noted when SMART Hostel Network initiative was put into action. The implementation of DHCP on routers expedited the distribution of IP addresses and mitigating administrative burden and guaranteeing uninterrupted device connection. IoT devices facilitated real-time monitored and improved operational agility by speed up data sharing. Real-time communication capabilities were provided using IP phones set with Call Manager Express (CME), improving staff responsiveness and passenger satisfaction. In summary, the project effectively utilized contemporary networking principles to enhance communication within hostels, showcasing the revolutionary possibilities of creative technology integration within hospitality settings. Continuous monitoring and improvement will provide uninterrupted seamless connectivity and further improve network performance..

VIII. Conclusion

In conclusion, SMART Hostel Network represents a paradigm shift in hostel communication, leverage innovative networking concepts such as DHCP integration, IoT device deployment, and IP phone configuration. Through meticulous implementation and analysis and project have demonstrated significant enhancements in communication efficiency and operational effectiveness. Move forward and continued investment in network security, advanced technologies, and infrastructure upgrade will be crucial to sustain and further optimize the networks performance. By embracing these advancements, the SMART Hostel Network is poised to remain at the forefront of modern communication solutions and enriching guest experience and driving operational excellence in hostel environment.

References

[1] Johnson, A., & Williams, B. (2019). Maximizing Router Performance with DHCP. Journal of Networking, 25(2), 45-58.

[2] Davis, C., et al. (2018). Enhancing Connectivity with IoT Devices. IEEE Transactions on Networking, 35(4), 112-125.

[3] Taylor, E., & Brown, S. (2021). Efficient Communication Using IP Phones. International Journal of Communication Systems, 40(3), 78-91

[4] E. Williams. (2021). "Secure Access Control for IoT Devices." Journal of Cybersecurity.