Design and Implementation of Network Architecture for Electronic Engineering Department

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Abstract— Computer networks have become extremely important in our present-day society. University already has a computer network infrastructure to support various activities both administrative and academic. Networking is one of the most essential ways of sharing information and eLearning. In this paper, a network design is implemented to connect the different networks in a department and to get full knowledge of WLANs and the basic processes of designing a campus WLAN. MikroTik router is used to interface the different networks. Cisco wireless router is used for the wireless network access in the network.

Keywords—MikroTik router, TP-Link CPE, PoE switch, Wireless Local Area Network (WLAN)

I. INTRODUCTION

long with the constant development of social economy, ${\rm A}_{
m computer}$ networks have changed people's lifestyle in many aspects. Local area network, which is widely applied, plays a more and more important role in medical treatment, military, education and science. With LANs, work and study efficiency is improved, but it also brings some problems. Wired LAN couldn't change the structure of networks casually according to actual situations. In terms of campuses, most campuses now have their own wired local area network, but teachers and students need a more convenient way to access the network. With Wireless LAN (WLAN), teachers and students can use the same device to get connected to the network at anytime and anywhere. Therefore, in that case, WLAN is the most efficient way to extend the wired local area network. especially on campus. Fig. 1 shows the network architecture of EC Department.



Fig. 1 Network Architecture for EC Department

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II. DESIGN IMPLEMENTATION

In hardware implementation, TP-Link CPE is used as client mode to create the wireless network between EC Department 1 and Department 2. TP-Link PoE switch provides the power and data on the CPE that is connected to the internet port of MikroTik router. This MikroTik router includes five Ethernet ports, one is WAN and other is LAN. Fig. 2 and Fig.3 show how to connect the hardware devices.



Fig. 2 TP-Link CPE and MikroTik Router Connection



Fig. 3 Cisco Wireless Router, MikroTik Router and TP-Link Switch Connection

In software implementation, there are three mains portions such as TP-Link client configuration, MicroTik router configuration and Wireless router configuration.

III. TP-LINK CLIENT CONFIGURATION

In this section, configuration of TP-Link CPE in client mode for wireless network between two departments describes step by step. Firstly, log onto the Client's management page. Open a web-browser (Internet Explorer, Mozilla Firefox etc.) and type the IP address 192.168.1.254 in the address bar, and then press

enter. Then type in the username and password, which are both 'admin' in default and clicks 'ok'.

Windows Sect iexplore The server 1 server report Warning: Vo authenticati	urity 192.168.1.254 is asking for y ts that it is from TP-LINK V our user name and passwore ion on a connection that is admin	our user name and passwov Vireless AP WA5210G. rd will be sent using basic n't secure.	×
A			

Fig. 4 Connecting to TP-Link

Configures the operation mode to AP Client Router and connect to the wireless network. Click on "Wireless" on Wireless Mode Setting, and then select the Client. SSID (Network Name) of the AP will be connected in Client mode in automatically by surveying as shown in Fig. 5.

	K			
Status				
Basic Settings	Wireless Mode Settings			
Quick Setup				
Operation Mode				
Network				
Nireless	Access Point			
Basic Settings	Enable SSID Broadcas	t		
Wireless Mode				
Security Settings				
MAC Filtering	 Client 			
Wireless Statistics	Enable WD	s		
Distance Setting	SSID):	ECServer	
Antenna Alignment		.	90-F6-52-37-04-A6	
Throughput Monitor			0010-02-07-04-70	
Speed Test				
	Repeater			
Advanced Settings	0.100			

Fig. 5 Access Point Surveying

Go to "Wireless" on Wireless Security and configure the wireless security. They must make sure the Security type of the AP. Select WPA-PSK/WPA2-PSK is automatic as the most secure option. Once configure, click Save as shown in Fig. 6.

Status ^	Key 4. 🕤	Disabled
Basic Settings —	Contraction of a literature of a	
Duick Setup	WPA/WPA2	
Operation Mode	Version:	Automatic 🗸
letwork 👔	Encryption:	Automatic V
Vicolenn.	Radius Server ID:	
Basic Settings	Notice serves in.	
Wireless Mode	Radius Port:	1812 (1-65535, 0 stands for default port 1812)
security settings	Radius Password:	
MAC Filtering	Group Key Undate Deriod:	READA In case of minimum in 30 Company no undated
And Administration and the Administration of the	Croup reef opdate Ferioa.	-06400 Lin second, minimum is 30, o means no opoard)
Wireloss Statistics	Group key optime renou.	abado jur secono, minimum e 30, o minimo no oposite)
Wireless Statistics Distance Setting		20409 Jan second, remember is 50, 6 meters no spose)
Wireless Statistics Distance Setting Antenna Alignment	WPA-PSK/WPA2-PSK	20400 (in second, minimum is 30, 0 missio no opoure)
Wireless Statistics Distance Setting Antenna Alignment Throughput Monitor	WPA-PSK/WPA2-PSK Version:	Automatic
Wireless Statistics Distance Setting Antenna Alignment Throughput Monitor - Speed Test	WPA-PSK/WPA2-PSK Version: Encryption:	Automatic V Automatic V
Wreless Statistics Distance Setting Antenna Alignment Throughput Monitor Speed Test Advanced Settings	WPA-PSK/WPA2-PSK Version: Encryption: PSK Peschase:	Automalic V Automalic V Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y
Wireless Statistics Distance Setting Antenna Alignment Throughput Monitor Speed Test Advanced Settings — DHCP	WPA-PSK/WPA2-PSK Version: Encryption: PSK Passphrase:	Automatic v 122457890
Wreless Statistics Distance Setting Antenna Alignment Throughput Monitor Speed Test Advanced Settings DHCP Wireless Settings	WPA-PSK/WPA2-PSK Version: Encryption: PSK Pasaphrase:	Automatic v Automatic v 1234567890 (The Pasighrane is between 8 and 63 characters long)
Wreless Saturstics Distance Setting Antenna Alignment Throughput Monitor Speed Test Advanced Settings DHCP Wreless Settings SNMP	WPA-PSK/WPA2-PSK Wersion: Encryption: PSK Pasaphrase: Group Key Update Period:	Automatic V Automatic V Automatic V T224567590 V (The Passphraie Is between 8 and 63 characters long) 65400 65400 in second, minimum 18 30, 0 means no update, only be valid in
Wireless Statistics Distance Setting Antenna Algement Throughput Monitor Speed Test Advanced Settings DHCP Wireless Settings SMMP Maintenance —	WPA-PSK/WPA2-PSK Version: Encryption: PSK Passphrase: Group Key Update Period:	Automatic

Fig.6 Wireless Security

Go to DHCP; click DHCP Settings and select enable the DHCP Server Select Save as shown in Fig. 7.

Status 🔷	Wired		
Basic Settings	MAC Address:	C4-E9-84-E3-18-B0	
Juick Setup	IP Address:	192.168.1.254	
peration Mode	Suboot Mask:	366 366 366 0	
letwork	Justier mark.	2002002000	
lireless			
Ivanced Settings	Wireless		
reless Settings	Operating Mode:	Client	
IMP	Singet	33.40	
untenance	Signal:	33 08	
stem Tools	SSID:	ECServer	
	Channel:	11	
	Mode:	54Mbps (802.11g)	
	MAC Address:	C4-E9-84-E3-18-B0	
	Traffic Statistics		
		Received	Sont
	Bytes:	1717095	633813
	Packets;	17670	7395
	System Up Time:	0 day(s) 02 34 14	Bafrash

Fig.7 Client Information

IV. MICROTIK ROUTER CONFIGURATION

This section includes the configuration of MikroTik router with interfacing software "Winbox". As first step, open the Winbox, operating system and click on search button located after Connected To: input box. Connected Ethernet's MAC will appear now. Click on the MAC address. MikroTik router default username is admin and password is blank. So, type admin in the login input box and password field left blank and then click on 'Connect' button as shown in Fig. 8.

Connect To:	192.168.2.1				🖌 Kee	sp Passwo	rd	
Login:	Semin				Ope	Open In New Window		
Password:								
	Add/Set		Connect To F	RoMON Conn	ect			
Managed Neigh	toors							
Managed Neigh	tbors				Find	al		

Fig. 8 Connecting to MikroTik Router

On the left menu, MikroTik graphical user interface (GUI) will appear now. Click on "Quick Set" and then choose "Automatic" in the IP address for WAN and LAN as shown in the Fig. 9.

C* Safe Mode	Session: 192.168.2.1				
Cluick Set	Ethernet Quick Set			-	
I CAPEMAN	- Continuention				0
im Interfaces	Mode C Boster C Bridge				Can
T Wireless	, inclusion of the second seco	ce (conten) e monten		-	0.00
3 Endge	Internet				- 6.9
E PPP	Address Acquisition:	C Static C Automatic (~ PPPoE		
we Switch	IP Address	192.168.1.104	Renew	Release	
TIE Mesh	Network	155 355 355 0 (CM)		AND ALCOLOGICAL PROPERTY OF	
948 BP	(They many -	200200200000			
MPLS 1	Gateway	192.168.1.1			
🜌 Routing	MAC Address:	CC 2D E0 08 E2 D6			
🔵 System 🕴	ALC: MERCERSTON				
Gueues	Local Network		02		
IIII Files	IP Address:	192.168.2.1	-	11 Parts	
E Log	Netmask:	255 255 255 0 (/24)		*	
S. Radius		DHCP Server			
🔀 Tools 👘	DHCP Server Range:	192 168 2 2 192 168 2 100		•	
III New Terminal		NAT.			

Fig. 9 WAN and LAN Configuration

V. CISCO WIRELESS ROUTER CONFIGURATION

Configuration of the Cisco Linksys-E1200 router is described in this section. Go to Internet Setup on the side menu and select "Automatic Configuration-DHCP" for WAN setup that is connected to TP-Link CPE with DHCP service. And then click Enabled (DHCP Server Setting) by assigning the IP address range for Network Setup as shown in Fig. 10.



Fig. 10 DHCP Server Setting

For configuration of wireless network, click "Wireless" from the main menu and select the Wireless Network Name (SSID). Enter a name for COMLAB network's SSID (Wireless Network Name). After it have entered a name, select the "Enabled" radio button for Wireless SSID Broadcast and then select "Save Setting". Fig. 11 shows the configuration of wireless setting in Cisco router.



Fig. 11 Wireless Access Point



Fig. 12 Wireless Security

From the Wireless menu, click "Wireless Security", and then select "WPA2 Personal" in Security Mode. Enter the desired password in the Passphrase as shown in Fig. 12.

VI. TEST AND RESULTS

To display the testing results, graphical and ping command are used. Fig. 13 shows the testing results for wireless network in Computer and Control Lab room using Cisco Wireless Router. This is the ping test results for Laptop PC with Wifi Access named COMLAB.

Wireless LAN adapter Wi-Fi:
Connection-specific DNS Suffix . :
Link-local IPv6 Address : <u>fe80::15f0:2a7</u> b:c7bd:e8af%2
IPv4 Address
Subnet Mask
Default Gateway : 192.168.3.253
Media State Media disconnected Connection-specific DNS Suffix . :
C:\Users\SKY LINK ping 192.168.2.94
Pinging 192.168.2.94 with 32 bytes of data:
Reply from 192.168.2.94: bytes=32 time=5ms TTL=127
Reply from 192.168.2.94: bytes=32 time=3ms TTL=127
Reply from 192.168.2.94: bytes=32 time=3ms TTL=127
Reply from 192.168.2.94: bytes=32 time=3ms TTL=127

Fig. 13 Testing Result for Wireless Network

Fig. 14 shows how to test the network connections of MikroTik Router and wireless access point in department 2 using Ping commands.

Wireless LAN adapter Wi-Fi:	
Connection-specific DNS Suffix . :	
Link-local IPv6 Address : fe80::15f0:2a7b:c7	bd:e8af%2
IPv4 Address	
Subnet Mask	
Default Gateway : 192.168.3.253	
Media State Media disconnected Connection-specific DNS Suffix . :	
C:\Users\SKY LINK>ping 192.168.2.1	
Pinging 192.168.2.1 with 32 bytes of data:	
Reply from 192.168.2.1: bytes=32 time=3ms TTL=63	
Reply from 192.168.2.1: bytes=32 time=3ms TTL=63	
Reply from 192.168.2.1: bytes=32 time=3ms TTL=63	
Reply from 192.168.2.1: bytes=32 time=3ms TTL=63	

Fig. 14 Testing Result for MikroTik and Cisco Router

To test main network connection for this thesis, will have to ping from the Department 2(Computer and Control Lab room) to Department 1(Head of Department room). Thus, Fig. 15 and Fig. 16 show network connection testing results for Laptop PC to TP-Link Access Point in Department 1.

	Connection-specific DNS Suffix . :
	Link-local IPv6 Address : fe80::15f0:2a7b:c7bd:e8af%2
	IPv4 Address
	Subnet Mask
	Default Gateway : 192.168.3.253
	Tunnel adapter isatap.{0ADF0FC7-63A3-4269-B17C-ACEFB52D421D}:
ľ	Media State : Media disconnected Connection-specific DNS Suffix . :
(C:\Users\SKY LINK>ping 192.168.1.1
	Pinging 192.168.1.1 with 32 bytes of data:
F	Reply from 192.168.1.1: bytes=32 time=9ms TTL=62
F	Reply from 192.168.1.1: bytes=32 time=5ms TTL=62
t	Reply from 192.168.1.1: bytes=32 time=4ms TTL=62
	Reply from 192.168.1.1: bytes=32 time=5ms TTL=62

Fig. 15 Testing Results for TP-Link Access Point



Fig.16 Testing Results for E-Library PC in HoD Room

To show the complete testing results, PCs in Computer and Control Lab room available to connect the E-Library PC and Web Server implementing in Head of Department room. Fig. 17 provides the successful results for connecting the E-Library. Computer in Department 2 can search E-Library on web server via browser (<u>http://server</u> IP). Fig. 18 shows E-Library web page on PC in computer room.



Fig.17 E-Library Connecting via Wireless Network



Fig. 18 Connecting to Web Server from Department 2

In this network design, user can also connect to the FTP server implementing in Department 1 via mobile phone using wireless access point named COMLAB in Department 2. Fig. 19 is the testing result for connecting to FTP server via mobile phone. Moreover, the user in Department 2 can also to view the CCTV network installing in Department 1 as shown in Fig. 20.



Fig. 19 Cisco Wireless Router Access Point



Fig. 20 Viewing the CAM1

VII. CONCLUSIONS

WLANs have been used to group clients on the network, and with the aid of a router and switch configurations, data packets routed from one device to another. This paper provides a favor to know the configurations and their features of networking devices that are used in this design such as MikroTik router, TP-Link CPE and Cisco wireless router. This paper can be modified to implement efficiently the desired network using routing protocol in MikroTik router as future work.

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