Practical assignments for CCNA7 COURSE, part 2: Switching Routing Wireless Essentials

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ABSTRACT: This article considers the general requirements of new Cisco CCNA7 course, part two: "Switching, Routing, and Wireless Essentials (SRWE)" and describes the ideas of practical assignments for this part of course based on the Cisco Packet Tracer (PT). The modern automation approaches dictate the usage of the application of the variables and different variants which are specific for each student. The article suggests and covers the options of variable skills assignments and raises questions about the connected potholes and issues.

1. INTRODUCTION

New course of CCNA version 7 was splitted into three parts:

1) "Introduction to Networks (ITN)"
2) "Switching, Routing, and Wireless Essentials (SRWE)"
3) "Enterprise Networking Security Automation (ENSA)"

In my previous article [8] I discussed the proposed numbers of practical assignment for networking skills for the second part (ENSA). This article is devoted to developement of the special PT project assignments for the second part (SRWE). The migration to CCNA v7 last for more than one year but there is still a need for some non-standard and complicated assignments prepared for the big group of the students. So this article considers the new project assignment specifically

developed to cover the main topics of second part (SRWE) of CCNA v7 course materials.

2. PACKET TRACER PROJECT DESCRIPTION

The advantages of Cisco Packet Tracer were perfectly reviewed in [4]. Its strongest site is an ability to apply several variants based on the PT variables [6]. The topology of the proposed PT project is presented in the picture 1 and it consists of Head Quarter (HQ) and Branch (BR) offices connected by router R1 / R2 correspondingly via internet service provider ISP1 and intranet router RCom. RCom connection is used to setup the static routes between two offices while ISP1 connection is used to install PAT on R1 / R2 and then check the internet access from office PCs to ISP server (last bonus assignment). R1 has also been configured by static NAT to provide the access to the internal server of Head Quarter office – HQ Radius server.

The switching topology of both offices consists of one core switch HQ-CS/BR-CS and two switches of access

level HQ-AS1/BR-AS1 and HQ-AS2/BR-AS2 connected by two uplinks configured into Ether Channel ports to provide the required redundancy and load balancing. In addition to the wired type of connection there are two type of Wireless LAN (SSID-HQ and SSID-BR).
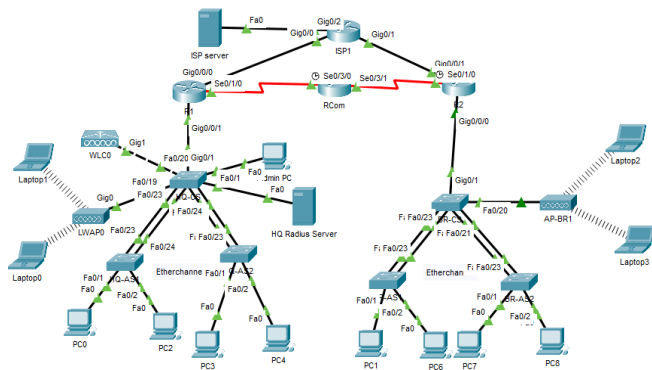

Figure 1: Network topology

The Variable Manager was set to use two numeric variables G (group number) and V (variant number) – see the Figure 2:
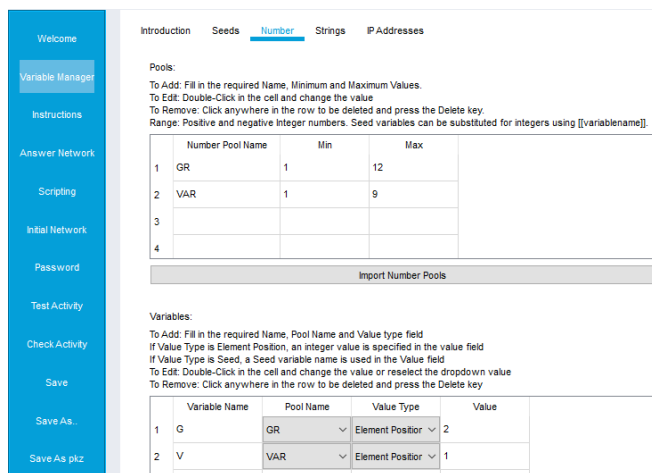

Figure 2: Variable manager

The instruction Table 1 (part 1 and 2) represents the main instruction of the PT project where [[G]] and [[V]] are used to generate various IP addresses.

Table 1, part 1 Istruction table: device names, models, port and VLANs

Device	Model	Interface	VLAN
ISP1	2911	G0/0	-
		G0/1	-
		G0/2	-
RCom	2911	S0/3/0	-
		S0/3/1	-

ISP Server		Fa0	-
R1	ISR4321	G0/0/0	-
		S0/1/0	-
		G0/0/1.10	10
		G0/0/1.20	20
		G0/0/1.40	40
		G0/0/1.100	100
R2	ISR4321	G0/0/1	-
		S0/1/0	-
		G0/0/0.30	30
		G0/0/0.50	50
		G0/0/0.40	40
		G0/0/0.200	200
HQ-CS	2960	VLAN40	40
		Fa0/23-24	TR
		Fa0/21-22	TR
		Fa0/1	10
		Fa0/2	40
		Fa0/19	TR
		Fa0/20	TR
		G0/1	TR
HQ-AS1	2960	VLAN40	40
		Fa0/23-24	TR
		Fa0/2	20
		Fa0/1	10
HQ-AS2	2960	VLAN40	40
		Fa0/23-24	TR
		Fa0/2	20
		Fa0/1	10
LWAP0	3702i	Ge0	TR
WLC0	3504	Ge1	TR
PC0/PC3		Fa0	10
PC2/PC4		Fa0	20
Laptop0/Laptop1		Wireless0	100
HQ Radius Server		Fa0	10
Admin PC		Fa0	100
BR-CS	2960	VLAN40	40
		Fa0/23-24	TR
		Fa0/21-22	TR
		Fa0/20	200
		G0/1	TR

BR-AS1	2960	VLAN40	40
		Fa0/23-24	TR
		Fa0/2	50
		Fa0/1	30
BR-AS2	2960	VLAN40	40
		Fa0/23-24	TR
		Fa0/2	50
		Fa0/1	30
AP-BR1	AP-PT	Port 0	200
PC1/PC7		Fa0	30
PC6/PC8		Fa0	50
Laptop2/Laptop3		Wireless0	200

Table 2, part 2 Istruction table: ip addresses, subnet mask, default gateway and comments for variable G=2, V=3

IP address	Subnet	Gateway	Comments
209.12.31.1	/30	-	to R1
209.12.32.1	/30	-	to R2
209.12.33.1	/30	-	to ISP server
10.22.31.1	/30	-	to R1
10.22.32.1	/30	-	to R2
?.?.?.?	/30	209.12.33.1	to ISP1
?.?.?.?	/30	209.12.31.1	to ISP1
?.?.?.?	/30	10.22.31.1	to Rcom
10.2.13.1	/24	-	to HQ-CS
10.2.23.1	/24	-	to HQ-CS
10.2.43.1	/24	-	to HQ-CS
10.2.103.1	/24	-	to HQ-CS
?.?.?.?	/30	209.12.32.1	to ISP1
?.?.?.?	/30	10.22.32.1	to Rcom
10.2.33.1	/24	-	to BR-CS
10.2.53.1	/24	-	to BR-CS
10.2.43.1	/24	-	to BR-CS
10.2.203.1	/24	-	to BR-CS
10.2.43.2	/24	10.2.43.1	Management
EtherChannel		HQ-AS1	to HQ-AS1
EtherChannel		HQ-AS2	to HQ-AS2
-		HQ Radius Server	to HQ Radius Server
-		Admin PC	to Admin PC
-		LWAP0	to LWAP0
-		WLC0	to WLC0

IP address	Subnet	Gateway	Comments
-		R1	to R1
10.2.43.3	/24	10.2.43.1	Management
EtherChannel		HQ-CS	to HQ-CS
-		PC2	to PC2
-		PC0	to PC0
10.2.43.4	/24	10.2.43.1	Management
EtherChannel		HQ-CS	to HQ-CS
-		PC4	to PC4
-		PC3	to PC3
DHCP WLC0	/24	10.2.43.1	to HQ-CS
10.2.43.240	/24	10.2.43.1	to HQ-CS
DHCP VLAN 10	/24	10.2.13.1	to HQ-CS
DHCP VLAN 20	/24	10.2.23.1	to HQ-CS
DHCP VLAN 100	/24	10.2.103.1	LWAP0
10.2.13.252	/24	10.2.13.1	to HQ-CS
10.2.43.100	/24	10.2.43.1	to HQ-CS
10.2.43.2	/24	10.2.43.1	Management
EtherChannel		BR-AS1	to BR-AS1
EtherChannel		BR-AS2	to BR-AS2
-		AP-BR1	to AP-BR1
-		R2	to R2
10.2.43.3	/24	10.2.43.1	Management
EtherChannel		BR-CS	to BR-CS
-		PC6	to PC6
-		PC1	to PC1
10.2.43.4	/24	10.2.43.1	Management
EtherChannel		BR-CS	to BR-CS
-		PC8	to PC8
-		PC7	to PC7
DHCP VLAN 200	/24	10.2.203.1	to BR-CS
DHCP VLAN 30	/24	10.2.33.1	to BR-CS
DHCP VLAN 50	/24	10.2.53.1	to BR-CS
DHCP VLAN 200	/24	10.2.203.1	to AP-BR1

All corresponding variables are configured in Answer Network (see the Figure 3) to support the collection of required grades:
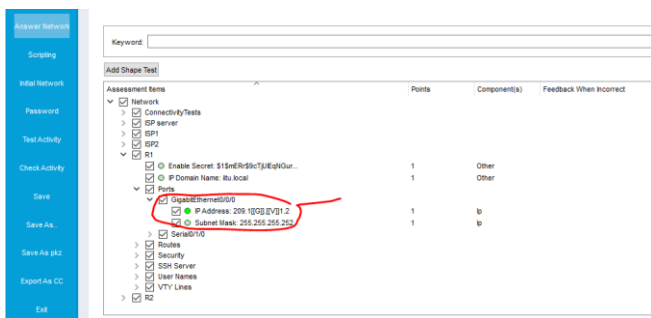
Figure 3: Answer Network

3. ASSIGNMENT CONTENT

3.1. The first part of the project:

This part was developed to check the basic knowledge of IP configuration, securing the router management access and static routing [1], [2].

- Complete the missed information '?.?.?.?' in the instruction table and then configure IP addresses of ISP1, RCom, R1, R2 and ISP Server;

- Make sure that you can ping IP addresses of ISP1, RCom from R1, R2 and ISP Server from R1, R2;

- On the router R1, R2 please also configure the enable secret password 'class', security account 'user ' (privilege level 0) and 'admin' (privilege level 15) with passwords 'cisco'.

- Setup the remote connection via SSH only, the encryption key size is 2048, ip domain is 'iitu.local'.

- Configure the static routes on R1, R2 to ISP Server via ISP1

3.2. The second part of the project:

This part was developed to check the basic knowledge of switch access and trunk ports configuration, securing the switch management access [1], [2].

Restore the configuration done in the previous parts of assignment and then configure the switches of Head Quarter (HQ-CS, HQ-AS1, HQ-AS2) and Branch office (BR-CS, BR-AS1, BR-AS2):

- On all switches please also configure the enable secret password 'class', security account 'user ' (privilege level 0) and 'admin' (privilege level 15) with passwords 'cisco';

- Setup the remote connection via SSH only, the encryption key size is 2048, ip domain is 'iitu.local'.

- Configure the Ether channels between core switches and switches of access level (HQ-CS and HQ-AS1:

channel-group 1 mode ON / HQ-CS and HQ-AS2: channel-group 2 mode ON) and the same in Branch office (BR-CS and BR-AS1/BR-CS and BR-AS2);

- Configure the required VLAN 10,20,30,50,100,200 where 100 and 200 are Wireless VLANs;

- Make sure that native VLAN 99 on all trunk and list of allowed VLAN includes only required ones

3.3. The third part of the project:

This part was developed to check the basic knowledge of VLAN configuration, DHCP configuration, inter-vlan routing and SVI configuration [1], [2].

Restore the configuration done in the previous parts of assignment and then setup the port security on all switches and DHCP for PCs:

- Configure the port security settings on access port (maximum MAC is 2, dynamic learning of MACs, BPDU protection and portfast are enabled);

- Disable unused ports;

- Configure Router on stick (subinterfaces) in R1 and R2 in order to provide the connectivity among VLANs (description of subinterfaces 'VLAN XX')

- Configure DHCP range on R1 and R2 for VLAN 10,20,30,50,100,200 (pool name VlanXX) and make sure that PC1-PC8 can obtain the required IP addresses

- PCs of VLAN 10,20,30,50 range should take 100 address excluding the beginning address

- PCs of VLAN 100,200 range should take 50 address excluding the beginning address

- Configure formal DNS server 8.8.8.8. in each pool.

3.4. The fourth part of the project:

This part was developed to check the basic knowledge of Wireless and Management VLAN configuration[1], [2]. Restore the configuration done in the previous parts of assignment and then configure the Management VLAN on all routers and switches plus Wireless LAN in Brunch office:

- Configure the required IP addresses and subnet mask of VLAN 40 (Management VLAN) on all switches;

- Configure Wireless AP-BR1 in Brunch office with SSID: 'SSID-BR', Authentication WP2-PSK, channel 6 and password 'Cisco123'

- Make sure that laptop2 and laptop3 obtained the DHCP addresses of VLAN 200.

- Make sure that laptop2 and laptop3 are able to ping the PCs of VLAN 30 and 50.

3.5. The fifth part of the project:

This part was developed to check the basic knowledge of Wireless Enterprise configuration [1], [2].

Restore the configuration done in the previous parts of assignment and then configure the Wireless WLC0 and LWAP0 in Head Office:

- Configure Wireless WLC0 (controller) in HQ office:

- Admin account: 'admin', password: 'Cisco123', management ip address 10.3.42.240/24 gateway 10.3.42.1

- SSID: 'SSID-HQ', WPA2-Enterprise Authentication via HQ Radius Server, port 1812 secret 'Cisco123'

- WLANs profile: 'HQ employees', WPA2-Enterprise Authentication via HQ Radius Server (secret 'Cisco123') and details below:

- Please use the Radius account credentials 'user' and password 'RPass';

- Configure the internal DHCP pool 'WLAN Management' wirh required details;

- Configure Wireless LWAP0 (Access Point) in HQ office connected to CAPWAP of WLC0:

- Obtain the ip address in the required DHCP internal range;

- Make sure that laptop0 and laptop1 obtained the DHCP addresses of VLAN 100.

- Make sure that laptop0 and laptop1 are able to ping the PCs of VLAN 10 and 20.

3.6. The sixth part of the project:

This part was developed to check the basic knowledge of static routes configuration [1], [2].

Restore the configuration done in the previous parts of assignment and then setup all required static routes in order to provide the communication between two offices:

- Configure the required static routes to all VLANs in HQ office

- Configure the required static routes to all VLANs in BR office

- Configure the required default routes on R1 and R2

- Make sure that laptops and PCs of HQ office are able to ping the laptops and PCs of BR office.

- Make sure that laptops and PCs of BR office are able to ping the laptops and PCs of HQ office.

3.7. The seventh part of the project:

This part was developed to check the basic knowledge of PAT and static NAT configuration, static routing [1], [2].

Restore the configuration done in the previous parts of assignment and then configure the Network Address Translation on R1 and R2 routers:

- Make sure that all PCs of HQ and BR can open the web-site of ISP Server via PAT (source ACL #1);

- Configure static NAT on R1 to access the HQ TFTP/HTTP server via external IP address 64.1[[G]].5[[V]].1;

- Make sure that you can open the web-site on HQ TFTP/HTTP server from ISP Server. In order to achieve the web-site of internal HQ TFTP/HTTP server from ISP server please provide the proper static route on ISP1

3.8. Additional task (bonus)

- DHCP and ARP snooping

Please review the topology of your project (see the Figure 4) and the table with additional instructions (see the Figure 5)
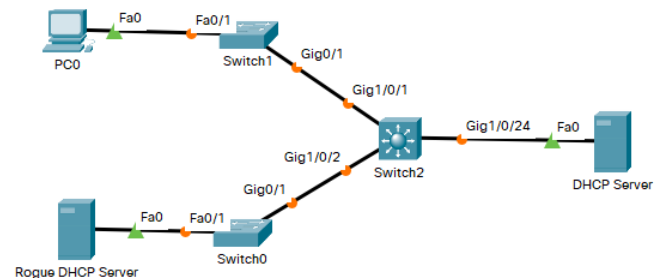

Figure 4: Network topology of additional assignment

Device	Interface	VLAN	IP address and Default GW	Subnet	Range
SW0	G0/1	TR	-	-	-
	Fa0/1	[[V]]	-	-	-
SW1	G0/1	TR	-	-	-
	Fa0/1	[[V]]	-	-	-
SW2	G1/0/1	TR	-	-	
	G1/0/2	TR	-	-	
	G1/0/24	[[V]]	-	-	
DHCP server	Fa0	-	10.[[G]].1[[V]].1	/24	10.[[G]].1[[V]].2-[[G]][[V]]
Rogue DHCP server	Fa0	-	10.[[G]].2[[V]].1	/24	10.[[G]].2[[V]].2-[[G]][[V]]
PC0	Fa0	-			DHCP server

Figure 5. Instruction table of additional assignment (all variables in [[…]] are setup via Variable Manager)

Please configure both DHCP Servers and three switches, then setup DHCP snooping and ARP inspection on all switches.

- Configure the required minimal settings on the ports of switches:

 = access ports: VLAN 3, DTP disabled,

 = trunk ports: native VLAN 99, DTP disabled

- Configure DHCP range on DHCP server and Rogue DHCP server as per requirements in the table above and DNS server 8.8.8.8

- Configure DHCP snooping and ARP inspection to block the Rogue DHCP server

Make sure that your PC0 is obtaining the ip address from DHCP server only

4. CONCLUSION

The considered PT assignment consists of 7 main tasks which encompassed the previously completed tasks and covered the main modules of CCNA course, version 7, part 2 [5]: static routing, VLANs, Inter-VLAN routing, Etherchannel configuration, Switch port security, Wireless LAN of Enterprise and stand-alone types, DHCP and ARP snooping. In addition to that there are the following opportunities and recommendations:

- The variable manager of PT provides an enough flexibility to create the assignments up to 20 groups with 10 variants of configuration settings

- In order to harden the completion of the assignments please hide the "Check results" or "Assessment tree"

- The formal check of PT completion does not mean that the configured network is working properly. More than that the corresponding percentage increase of the last task keys is required to setup the proper score of assessment.

- Activity grader of version 8 of PT does properly work in all considered assignments.

Overall it is a good automation tool for student skills assessment in addition to recommended assignments in [7].

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