Redes de Computadores (RCOMP) - 2017/2018

Laboratory Class Script - PL10

Developing Project 1 simulation.	Cisco Packet Tracer
Cisco IOS Telephony Services (ITS).	

1. The network simulation

Most configurations are settled and deployed into the Packet Tracer simulation include in Project 1:

- VLANs to be used (distributed by VTP)
- IPv4 network address to be used in each VLAN
- Routers with static routeing tables
- DHCP service available for workstations.

Reviewing the simulation work up to now

- Each cross-connect on the structured cabling project is represented by a single switch on the simulation.

- Cable connections between cross-connects on the structured cabling project are represented by same cable types in the simulation.

- Different pathways redundant cables must be represented, same pathways redundant cables are not to be represented.

- Active devices:

- All access-points in the project must be represented on the simulation, each with an associated workstation.

- All routers in the project must be represented on the simulation (use 2811 models)
- For each horizontal cross-connect:
 - One VoIP phone (use 7960 models).
 - One workstation for each VLAN supposed to be used at that location.

Associating wireless workstations to specific access points and the physical layout

Under the point of view of real physical positions, the layout logical positions of devices mean nothing to Packet Tracer, thus, placing a wireless workstation near an access point doesn't mean the association will be with that access point.

Packet Tracer also handles the physical layout, each device added at logical layout is added to the working closet (Main Wiring Closet) at the physical layout. Other closets (possibly in other buildings) can be created and then devices moved from the working closet to other closets.

To avoid using the physical layout, the workaround for Packet Tracer is using a different SSID for each access point. Of course, this has nothing to do with the real world where all access points within the infrastructure must use the same SSID to allow workstations roaming between cells.

Nevertheless, for the simulation purpose, if different SSIDs are assigned to each access point we can then define on each workstation to which SSID they should connect to, and therefore, to which access point they will associate.

After setting different SSIDs for each access point go to the wireless workstation click the **Desktop** tab, and then **PC Wireless** button. On **Profiles**, select **Default** and edit it, from the list of available SSIDs select de desired one and then connect. The Default profile will now always connect to that SSID.

2. Cisco IOS Telephony Services (ITS)

VoIP configuration is rather vendor specific, moreover, within the same vendor different device models may require different configurations. We will be using the 2811 router and the 7960 phone.

Cisco phones use the Skinny Client Control Protocol (SCCP) to communicate with the Cisco CallManager Express (CME) service, this service is going to be running on the 2811 router. By default, the service is provided at port number 2000.

2.1. Switches configuration

Cisco VoIP devices like the **7960 model** available in Packet Tracer require VoIP packets to be encapsulated in specially formatted ethernet frames.

In a Cisco switch, every port attached to a phone must be configured to use that format, this is achieved by enabling the **voice vlan** on that port. Also **the port should be in access-mode, not trunk-mode**.

Example: The VoIP VLAN is **VLANID=300** and is available at the following switch:



Then, Switch3 Fa0/2 port must in access-mode, have the voice vlan enabled (is disabled by default), and also have the access vlan disabled (is enabled by default), setting this up can be achieved by the following commands:

Switch(config)#interface Fa0/2
Switch(config-if)#
Switch(config-if)#switchport mode access
Switch(config-if)#switchport voice vlan 300
Switch(config-if)#no switchport access vlan

Remember this port configuration is required only on switch ports directly connected to VoIP phones, not all switch ports that use the VoIP VLAN.

2.2.DHCP service configuration

Any device can provide the DHCP service to VoIP phones, but an additional option must be added to provide the client with information about the TFTP (Trivial File Transfer Protocol) server to be used by the phone. The IST server also provides the TFTP service.

A 2811 model router can act as IST server, it will also provide the DHCP service, and hence, it must be directly connected to the VoIP VLAN where phones are connected.

The 150 DHCP option contains an IPv4 address of the TFTP server from where clients are supposed to download configuration data.

Example: If the 2811 router is connected to a VoIP VLAN with IPv4 address 10.40.50.0/24 and is using address 10.40.50.1, it can provides the DHCP service, the ITS service and is also the network default gateway. The configuration might look like:

Router(config)#ip dhcp pool MYVOIP Router(dhcp-config)#default-router 10.40.50.1 Router(dhcp-config)# option 150 ip 10.40.50.1 Router(dhcp-config)# network 10.40.50.0 255.255.255.0

2.3. ITS service configuration

Cisco Telephony Services configuration may differ depending on the model.

By default new VoIP phones are automatically registered by the service, this is controlled by the **auto-reg-ephone** command. Once registered, the phone MAC address is stored and that phone will always be the same. If automatic registration is not used, then the MAC address for each phone must be manually set.

The Cisco Telephony Services configuration requires the declaration of the IST server IPv4 address and port number for phones to register, this is settled by the **ip source-address** command. The service port number is 2000.

Other important settings in Telephony Services configuration are the number of maximum supported phones (max-ephones) and the number of maximum supported directory numbers (max-dn).

More directory numbers (phone numbers) than phones may be required because a single phone can have several lines (referred to as buttons), each line with a different directory number. Of course, directory numbers must be unique and each can be assigned to only one phone line (phone button).

If automatic phone registration is used, then automatic assignment of directory numbers can also be enforced by declaring a range of directory numbers for that purpose (**auto assign** command).

Phones are identified by numbers from one up to **max-ephones**, also directory numbers are identified by numbers from one up to **max-dn**. However, there is no direct relation between a phone and the same number directory number. Directory numbers must be assigned to phones (phone lines).

Once max-dn and max-ephones have been settled, phones and directory numbers can be declared.

A directory number is declared by using the **ephone-dn** command and then the number command to assign a number to be dialled. Example for configuring directory number 11 to be 945073:

Router(config)#ephone-dn 11 Router(config-ephone-dn)number 945073

A phone is declared by using the **ephone** command, then the device model can be specified, the device mac address and a directory number can be assigned to the phone. Example:

Router(config)#ephone 5
Router(config-ephone)type 7960
Router(config-ephone)mac-address 00D0.976D.1BC1
Router(config-ephone)button 1:11

Together with the previous directory number declaration, this means when a 7960 model with MAC address 00:D0:97:6D:1B:C1 is connected to the network it will be registered as phone 5 and the phone number assigned to it (line 1/button 1) is going to be 945073.

There are several approaches for phones configuration and corresponding directory numbers assignment. Totally manual: set up each phone MAC address and directory number. Automatic registration: phones are added automatically and directory numbers assigned later, manually. Automatic registration and automatic directory numbers assignment.

2.3.1. Manual phone configuration and number assignment

If automatic registration is disabled, then each phone MAC address must be manually defined (macaddress command) and the directory numbers must also be manually assigned (button command).

Example:

```
Router(config)#telephony-service
Router(config-telephony)#no auto-reg-ephone
Router(config-telephony)#ip source-address 100.100.100.1 port 2000
Router(config-telephony)#max-ephones 20
Router(config-telephony)#max-dn 20
Router(config)#ephone-dn 11
Router(config)#ephone-dn 12
Router(config)#ephone-dn 12
Router(config)#ephone-dn)number 945074
Router(config)#ephone 5
Router(config)#ephone 5
Router(config-ephone)mac-address 00D0.976D.1BC1
Router(config)#ephone 3
Router(config-ephone)mac-address 00D0.976D.ABC6
Router(config-ephone)button 1:12
```

Phone with MAC address 00:D0:97:6D:1B:C1 will be using number 945073, and phone with MAC address 00:D0:97:6D:AB:C6 is going to have dial number **945074**.

2.3.2. Automatic phone registration and manual directory number assignment

With automatic registration enabled, phones are declared, but not theirs' MAC addresses. The directory number of each phone can only be assigned after registration.

```
Router(config)#telephony-service
Router(config-telephony)#auto-reg-ephone
Router(config-telephony)#ip source-address 100.100.100.1 port 2000
Router(config-telephony)#max-ephones 20
Router(config-telephony)#max-dn 20
Router(config)#ephone-dn 11
Router(config-ephone-dn)number 945073
Router(config)#ephone-dn 12
Router(config)#ephone-dn 12
Router(config-ephone-dn)number 945074
Router(config)#ephone 5
Router(config-ephone)
Router(config)#ephone 3
Router(config)#ephone 3
Router(config-ephone)
```

With this configuration, new phones will be spontaneously assigned to empty **ephone** declarations and the **mac-address** command is automatically added to each declaration. Because these assignments are added to the configuration, they are permanent.

By not including a range of directory numbers for automatic assignment, registered phones will be offline until a directory number is manually assigned. That can only be done after the phone registers.

When new phones are registered, they will show up by using the **show ephone** command in **privileged EXEC mode**. Also, by checking the running configuration (show running-config command) the corresponding **ephone** declaration will have now a MAC address defined.

After a new phone being registered, for instance as ephone 5, then a directory number can be manually assigned to it, say directory number 11:

Router(config)#ephone 5 Router(config-ephone)button 1:11

2.3.3. Automatic phone registration and directory number assignment

With automatic registration enabled, ranges of directory numbers to be automatically assigned to newly registered phones must be declared. In the following example, directory numbers 11 up to 12 will be used:

```
Router(config)#telephony-service
Router(config-telephony)#auto-reg-ephone
Router(config-telephony)#ip source-address 100.100.100.1 port 2000
Router(config-telephony)#max-ephones 20
Router(config-telephony)#max-dn 20
Router(config-telephony)#auto assign 11 to 12
Router(config)#ephone-dn 11
Router(config)#ephone-dn 11
Router(config)#ephone-dn 12
Router(config)#ephone-dn 12
Router(config)#ephone 5
Router(config)#ephone 5
Router(config)#ephone 3
Router(config)#ephone 3
Router(config-ephone)
```

Now, new phones are registered as before, but in addition, to each newly registered phone an unused directory number from the provided range will be assigned. The corresponding button command is also added to the ephone declaration, so this assignment becomes permanent.

Afterwards, the phone number assigned to each phone may be easily changed by changing the **number** command on the corresponding **ephone-dn** declaration.