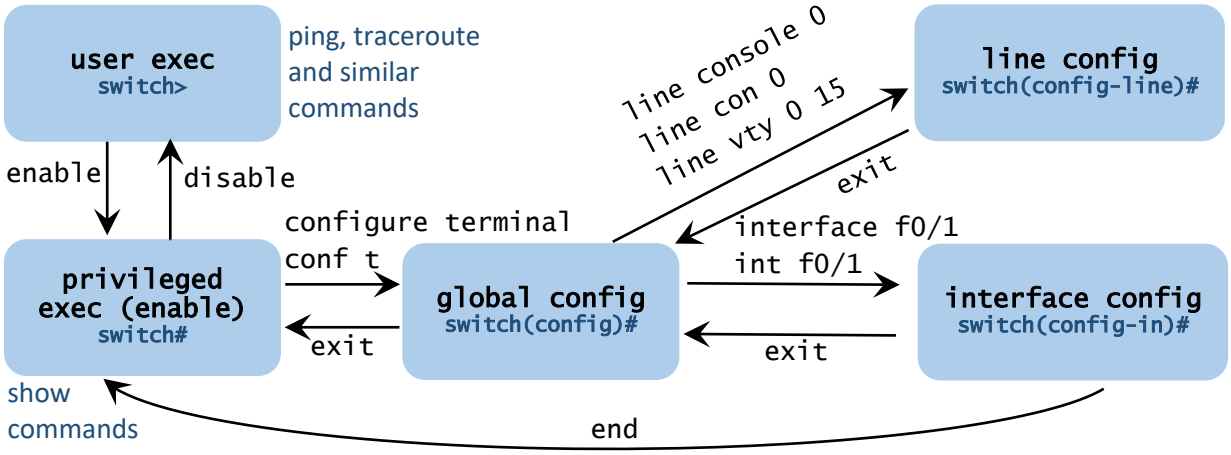
Access Modes for Switches and Routers

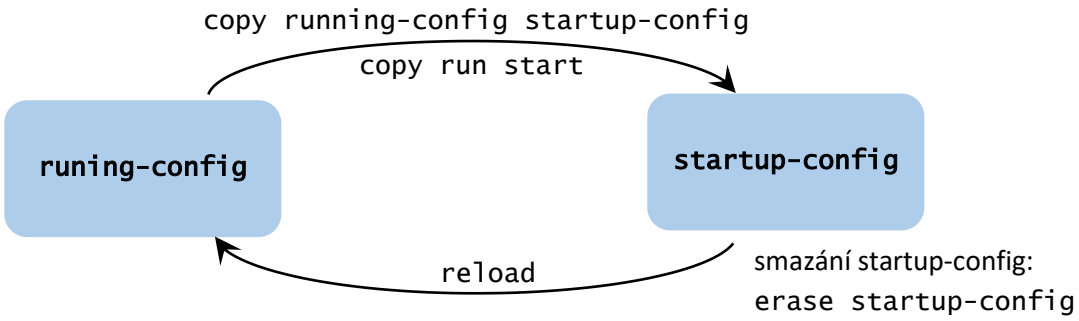
When working with a network device, we navigate between the following modes, each of which has its own purpose:

- user exec mode – least protected, only commands without risk
- privileged exec (enable) mode – show commands, we investigate information about the device
- global configuration mode – configuration commands valid for the whole device (device name, crypto key, default gateway for a switch, starting services,…)
- subconfiguration modes – configuration commands valid for a specific part of the device (configuration of lines, interfaces, routing for a specific protocol,…)



Where what is stored:

- flash: image of the IOS operating system that is used on Cisco devices
- running-config: the configuration that is currently in use; if we make changes using commands (e.g. setting IP address, password etc.), these changes will be reflected here, but it is RAM, so after reboot it is deleted
- startup-config: the configuration is loaded from the chip when booting, it is an NVRAM chip (in real flash), here we can save the running-config so that the changes are not lost on reboot

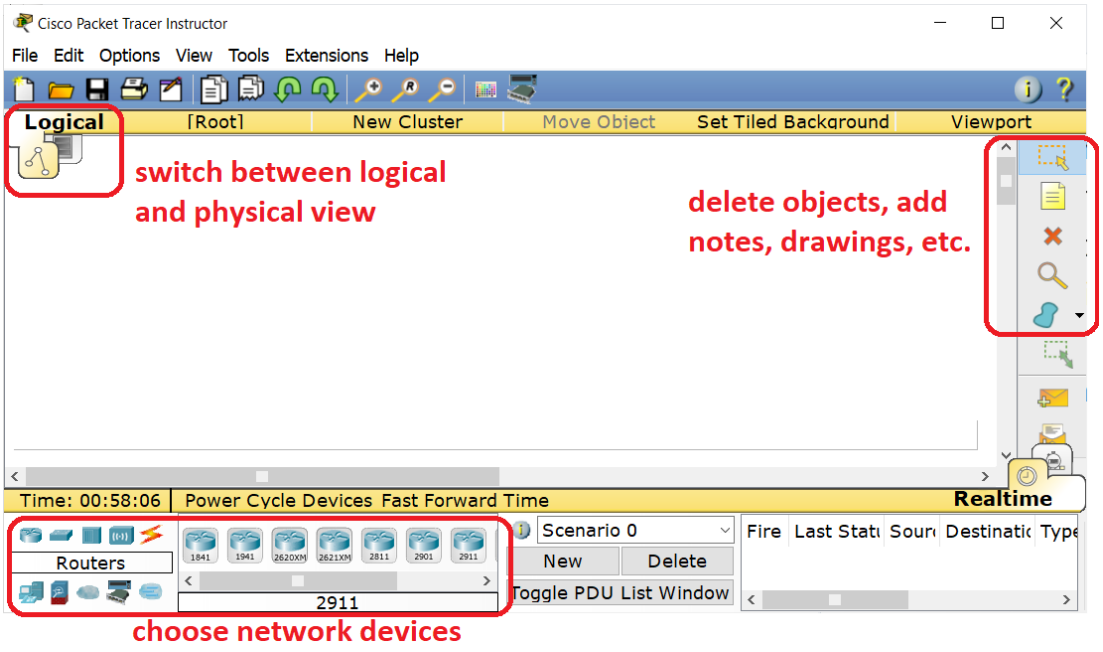


How to terminate a long or stalled command:

- sometimes Ctrl+C
- works even when the previous one doesn't: Ctrl+Shift+6

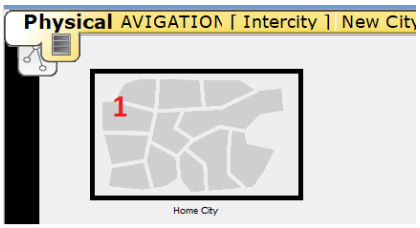
Using Packet Tracer

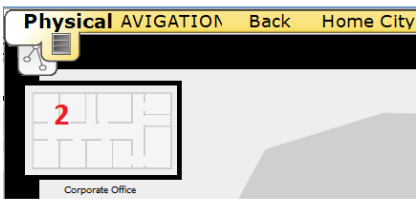
Packet Tracer v. 6.2 is available on https://www.filehorse.com/download-cisco-packet-tracer-32/27899/download/ (newer versions from netacad.com, but cisco credentials are necessary).

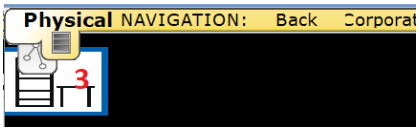


Int the top left corner, there is the switching tool for two views – logical and physical. Switch into the physical mode.

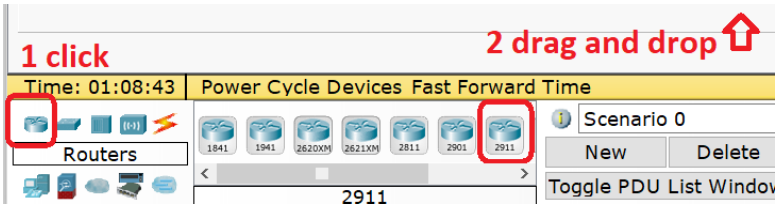
Click on the home city place, then corporate office place, and then the corporate office room, as the following picture shows:



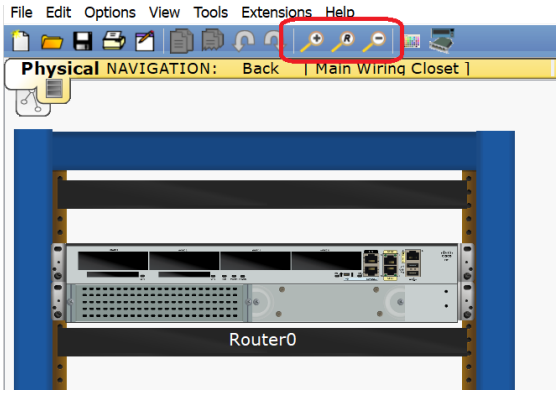




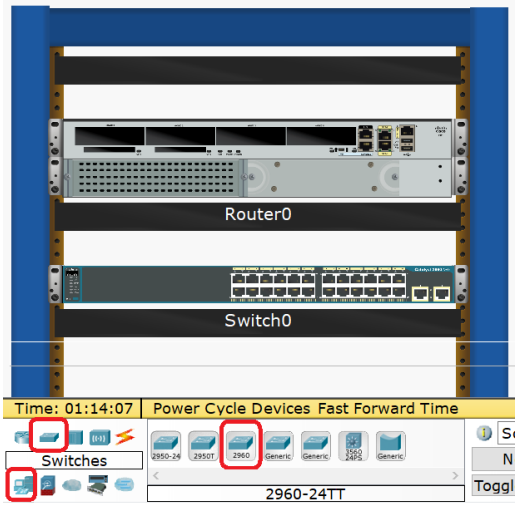
Choose the group of network devices – routers, and drag one of them into the canvas:



The device should be placed into the rack, and we can zoom in and zoom out the view:

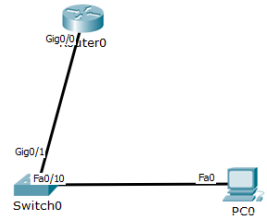


Choose and place one switch and PC, in the similar way.

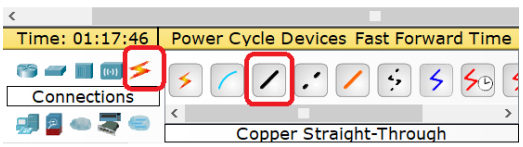


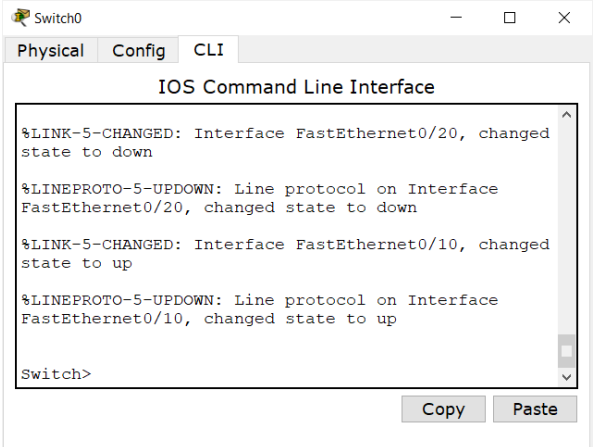
Switch into the logical view (adding devices and other operations are possible in the logical view as well):

In the logical view, there are the same devices, and it is possible to rearrange the devices to make network clear.



Interconnect devices: choose the type of cable – see the picture on the right, click on the switch, choose the interface g0/1, right click on the router to get the context menu, choose g0/0 (or different). Similarly interconnect switch and PC.





Click on the switch (left click) and go to the CLI tab, press ENTER. This is where we write configuration commands.

Example of Basic Switch Configuration

```
Switch>enable                                   ...move to the privileged exec mode (enable mode)
Switch#configure terminal                       ... move to the global configuration mode
Switch(config)#hostname S1                      ... set the hostname of the switch
S1(config)#enable secret some-passwd            ... password to the enable mode
S1(config)#line console 0                       ... move to the subconfiguration mode for the console
S1(config-line)#password some-passwd            ... set the console access password
S1(config-line)#login                           ... force the user to actually enter the password
S1(config-line)#logging synchronous             ... make the syslog on the console not too annoying
S1(config-line)#exit                            ... exit the console configuration
S1(config)#line vty 0 15                        ... enter the configuration of virtual terminals (telnet, SSH)
S1(config-line)#password some-passwd            ... set the vty lines password
S1(config-line)#login                           ... force the user to actually enter the password
S1(config-line)#exit                            ... exit the given subconfiguration mode
S1(config)#service password-encryption          ... the password is stored in running-config
                                                    where it is visible, but now there will be only its hash
                                                    instead of the password = more secure
S1(config)#banner motd #                                    ... set the warning information
unauthorised access is strictly prohibited!!!
#
S1(config)#interface vlan 1                     ...move to the subconfig mode for the interface VLAN 1
S1(config-if)#ip address 10.0.10.2 255.255.255.0           ... set the IP address
S1(config-if)#no shutdown                       ... turning the device on is the opposite of turning it off
S1(config-if)#exit
S1(config)#ip default-gateway 10.0.10.1         ... set the default gateway
S1(config)#int range f0/4,8-12                  ... we can work with multiple interfaces at once (range)
S1(config-in)#shutdown                          ... turn off all unused interfaces
S1(config-in)#end                               ... skip straight to enabled mode
S1#show ip interface brief                      ... display the interface table
S1#show interfaces                              ... view detailed information about the interfaces
S1#show mac address-table                       ... display the MAC address table
S1#copy running-config startup-config           ... save running-config to startup-config
```

Shortening the commands: to the extent that the command is not confused with another (whatever we enter must be unambiguous). For example:

`configure terminal`	shorten to	`conf t`
`show interface brief`	shorten to	`sh int br`
`copy running-config startup-config`	shorten to	`copy run start`

The show commands are entered in enable mode, but if we want to enter such a command in some configuration mode, this is also possible, we just have to put "do" before the command:

```
S1(config-if)#do sh ip int brief
```

Other show commands: `sh arp, sh version, sh protocols, sh cdp, sh cdp neighbors`

Example of Basic Router Configuration

Most of the procedures are similar to the switch, except for the number of virtual terminals (usually 0 to 15 for a switch, usually 0 to 4 for a router), and of course the L3 configuration. For routers, we should always add a description of the interface. For switches we can do the same.

```
Router>enable
Router#configure terminal
Router(config)#hostname R1
R1(config)#enable secret some-passwd
R1(config)#line console 0
R1(config-line)#password some-passwd
R1(config-line)#login
R1(config-line)#logging synchronous
R1(config-line)#exit
R1(config)#line vty 0 4
R1(config-line)#password some-passwd
R1(config-line)#login
R1(config-line)#exit
R1(config)#service password-encryption
R1(config)#banner motd #
Enter TEXT message. End with the character '#'.
unauthorised access is strictly prohibited!!!
#
R1(config)#interface g0/0                    ... move to the interface configuration
R1(config-if)#description line to site 10    ... interface description
R1(config-if)#ip address 10.0.10.1 255.255.255.0
R1(config-if)#no shutdown                    ...turn it on
R1(config-if)#interface g0/1                 ...next interface
R1(config-if)#description line to site 20
R1(config-if)#ip address 10.0.20.1 255.255.255.0
R1(config-if)#no shutdown
R1(config-if)#end
R1#ping 8.8.8.8
R1#traceroute 8.8.8.8
```

IPv6 addresses:

```
R1(config-if)#interface g0/1                 ... next interface
R1(config-if)#ipv6 address 2001:db8:acad:1::1/64
R1(config-if)#ipv6 address fe80::1 link-local
R1(config-if)#no shutdown
R1(config-if)#end
R1#sh ipv6 int brief
R1#sh ipv6 int g0/1
```

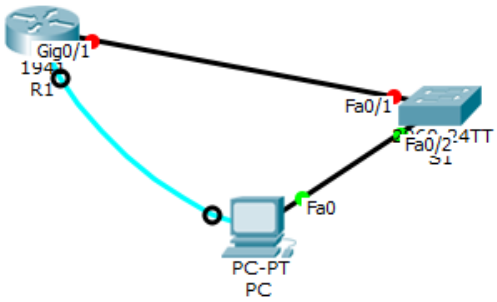
Routing table:

```
R1#sh ip route        (for IPv6: sh ipv6 route)  ...display the routing table
R1(config)#ipv6 unicast-routing                  ...switch on IPv6 routing
R1(config)#ip route 192.168.20.0 255.255.255.0 209.165.200.225
```

... adds a static entry to the routing table (we enter the IP address, mask and address of the neighboring device through which the path leads), instead of the neighbor we can enter our interface

```
R1(config)#ip route 0.0.0.0 0.0.0.0 172.16.64.2  ...default route for IPv4
R1(config)#ipv6 route ::/0 2001:db8:acad:4::2    ...default route for IPv6
```

Telnet and SSH



First, we secure the device via the console and console cable and assign an IP address (switch: to the virtual interface; router: to the real interface), and then the device can be accessed via telnet or ssh.

```
Switch>enable
Switch#configure terminal
Switch(config)#hostname S1
S1(config)#service password-encryption
S1(config)#enable secret some-passwd

S1(config)#ip ssh version 2                ...setting the version 2 of SSH
S1(config)#ip domain-name some.company.com
                                           ... for key generation purposes only, can be nonsense
S1(config)#crypto key generate rsa         ... generate keys, length min. 1024 (asks)
S1(config)#username useradmin secret some-passwd1  ... create users (here two users)
S1(config)#username user-two secret some-passwd2

S1(config)#line vty 0 15
S1(config-line)#transport input ssh    ... disable telnet, only SSH over the network
S1(config-line)#login local            ... authentication via local database
S1(config-line)#exit

S1(config)#line console 0
S1(config-line)#password some-passwd
S1(config-line)#login local
S1(config-line)#exit
S1(config)#banner motd #
unauthorised access is strictly prohibited!!!
#
S1(config)#interface vlan 1
S1(config-if)#ip address 10.0.10.2 255.255.255.0
S1(config-if)#no shutdown
S1(config-if)#exit
S1(config)#ip default-gateway 10.0.10.1
S1(config)#exit

S1#show ssh
S1#show ip ssh
```

Additional security settings:

```
R1(config)#no ip domain-lookup    ... so that the router does not try to interpret a mistyped
                                  command as a domain name

R1(config)#security passwords min-length 10        ...minimum passwords length is 10

R1(config-line)#exec timeout 5    ... if nothing happened on this line for five minutes, the
                                  user is logged out
```

```
R1#copy startup-config tftp://....          ... if we have a TFTP server running on
```
some computer, we can download the startup-config of this device to the backup