The Internet Ecosystem and Evolution

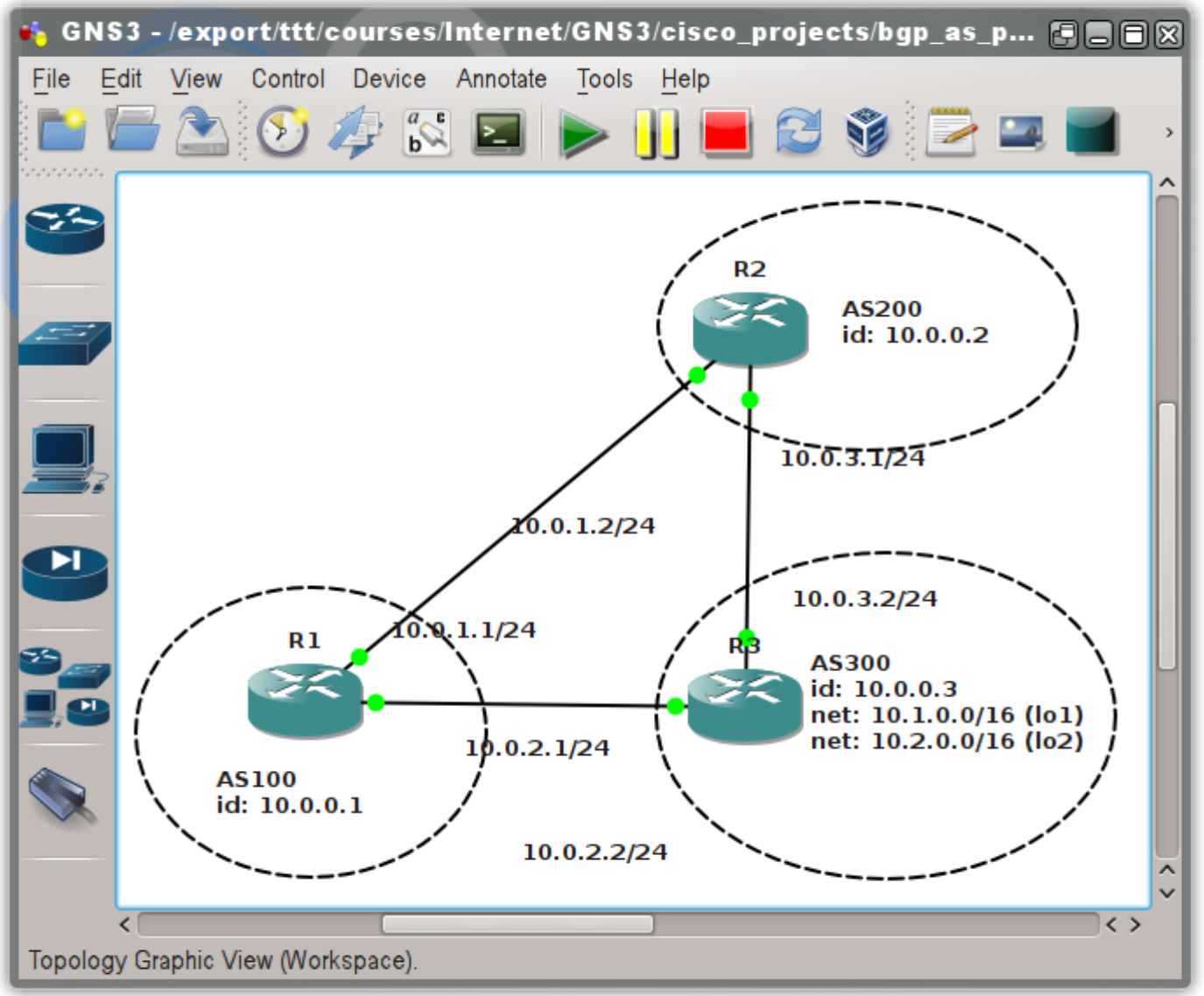
Lab 1

GNS3: Installation and configuration

GNS3: Network simulator

- Real router and host images connected into an emulated network: CISCO, Juniper, Vyatta, Linux, etc.
- Traffic analysis: traffic capture (WireShark)
- Fast and responsive GUI, projects, labs, etc.
- Complex network topologies, arbitrary network layers, guests can be connected to the Internet
- Simple router configuration through CLIs (Command Line Interface)
- For learning and testing

GNS3: Network simulator



GNS3: Installation

- See the guide at: http://www.tmit.bme.hu/internet_english?language=en
- Commercial switch/router images require a lot of resources, but here is a free Cisco image: http://heszi.tmit.bme.hu/klima/hda.qcow2.tar.gz
- We use a hand-crafted Linux/OpenWRT image instead, with only open and free software tools
- Routing protocols are supplied by **Quagga**
- Download the image at: http://heszi.tmit.bme.hu/klima/openwrt_internet_v1_1.zip

Quagga basics

Quagga

- Free and open source routing protocol package for all operating systems (UNIX/Linux/Win/OSX)
- Config modeled after Cisco “industry-standard” CLI
- Syntax/config files are usually portable between Quagga and Cisco with little work
- Routing protocols in separate processes:
  - OSPF protocol: `ospfd` (port: 2604)
  - BGP protocol: `bgpd` (port: 2605)
  - RIP (`ripd`), IS-IS (`isisd`), etc.
  - Zebra: miscellaneous services, interface management, kernel FIB, timers, threads, etc. (port: 2601)

Quagga

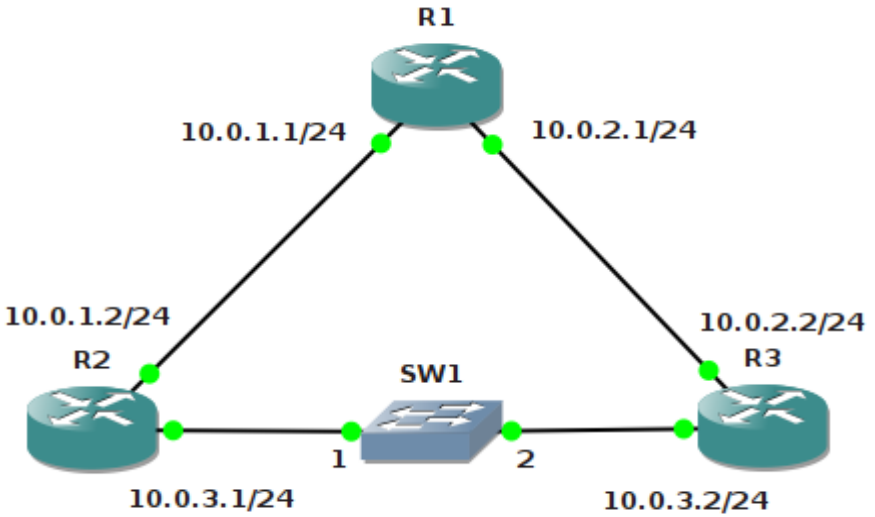
- Quagga automatically starts in the OpenWRT images

```
root@OpenWrt:/# netstat -tanp
Active Internet connections (servers and established)
Proto Local Address Foreign Address State  PID/Program name
tcp   0.0.0.0:2601  0.0.0.0:*       LISTEN 1061/zebra
tcp   0.0.0.0:2604  0.0.0.0:*       LISTEN 1065/ospfd
tcp   0.0.0.0:2605  0.0.0.0:*       LISTEN 1069/bgpd
tcp   :::2601       :::*            LISTEN 1061/zebra
tcp   :::2604       :::*            LISTEN 1065/ospfd
tcp   :::2605       :::*            LISTEN 1069/bgpd
tcp   :::23         :::*            LISTEN 976/telnetd
```

- Default configuration files: `/etc/quagga/{zebra,bgpd}.conf`

Quagga configuration

- Configure the below network:
  - router image: openwrt
  - router name: „Change hostname”
  - links: FastEthernet
  - IP addresses as shown on figure



Quagga configuration

- It is advised to mark IP addresses alongside the interfaces, makes configuration simpler
- Use the Quagga `vtysh` terminal for config:
  - simple Cisco-like CLI
  - saved into the config files for the project
  - config files are automatically loaded next time you open the project, so settings are preserved
- You can also use standard Linux sysadmin commands as well (`ip(8)`, `ifconfig(8)`) or edit the OpenWRT config files manually

Quagga configuration

- `vtysh` uses the Cisco “extended” (`enable`) mode automatically, all commands available
- Enough to specify only the first couple of characters of each command: `enable = en`
- `TAB` completes the command names in a context sensitive manner, `?` gives help

```
OpenWrt# show i<TAB>
interface  ip         ipv6
OpenWrt# show i<?>
  interface  Interface status and configuration
  ip         IP information
  ipv6       IPv6 information
```

Setting IP addresses

- Change the host names to `R1`, `R2`, and `R3` (right button on router icon and see the context menu)
- Fire up a terminal at router `R1`
- Enter configuration mode: `vtysh`
- Enter configuration mode: `configure terminal` (`conf t`)
- Start the configuration of the interface called `eth0`: `interface eth0`

Setting IP addresses

- Set IP address: `ip address <cím/prefix-length>`
- Set interface UP: `no shutdown` (needed on Cisco only, Quagga sets this automatically)
- Exit interface configuration mode: `exit`
- Same for the other interface: `interface eth1`
- Exit from config mode: `exit`
- Dump config to terminal: `write terminal`
- Save actual config: `copy running-config startup-config`

Setting IP addresses: R1

```
root@OpenWrt:/# vtysh
OpenWrt# configure terminal
OpenWrt(config)# interface eth0
OpenWrt(config-if)# ip address 10.0.1.1/24
OpenWrt(config-if)# no shutdown    # optional
OpenWrt(config-if)# exit
OpenWrt(config)# interface eth1
OpenWrt(config-if)# ip address 10.2.0.1/24
OpenWrt(config-if)# no shutdown    # optional
OpenWrt(config-if)# exit
OpenWrt(config)# exit
OpenWrt# copy running-config startup-config
Configuration saved to /etc/quagga/zebra.conf
OpenWrt# exit
Connection closed by foreign host
```

Important notice

- Saving a config file (`copy running-config startup-config`) will in theory preserve your settings between invocations of GNS3
- Problem is, Quagga sometimes fails to write the new config file into the router image (sync)
- One way to make sure your settings are not lost between GNS3 sessions is to exit the virtual machines “gracefully”: exit from `vtysh` and then issue the command `halt` in the shell
- If you're lucky, you can get away without this...

Assignments

- Configure router `R2` and `R3` as marked in the figure!
- Check the link-layer connectivity using the `ping` command in the Linux console shell!
- Save the network and the configuration into a GNS3 project, close GNS3, then reload the project and make sure the configurations are preserved! (note the trick on the previous slide)
- **For professionals:** configure IP routing with OSPF and check remote connectivity by `ping`!