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GNS3 SIMULATION OF IS-IS PROTOCOL IN NETWORK COMPOSED OF JUNIPER ROPUTER

PAVEL CRNOMARKOVIĆ
Military Technical Institute, Ratka Resanovića 1, Belgrade, Serbia, pavel@ptt.rs

RADOSLAV SURLA
Faculty of Technical Sciences, University of Kragujevac, Svetog Save 65, Čačak, Serbia, ekorade@gmail.com

Abstract: *This paper presents the use of free software (GNS3) in a computer network simulation, with an emphasis on the IS-IS protocol. Without the use of hardware such as router, switches and other network equipment, as well as the analysis of the obtained results.*

Keywords: *Juniper, free software, GNS3, simulation, IS-IS protocol.*

1. INTRODUCTION

These days, the Internet is wiedly used by multimillions of people all over the world, with a variety of applications, such as e-commerce and multimedia streaming requiring guaranteed speed and sufficient bandwidth. Furthermore, communication networks are growing rapidly to meet the increasing needs for file transfer, video conferencing etc. With this rapid network expanding, engineers are tasked to find solution for efficient data forwarding through the network.

Network is a connection of multiple hosts which exchange information among each other. The Open Systems Interconnection (OSI) model was developed in order to achieve the compatibility between them [1]. This model contains 7 (seven) layers, Physical, Data-Link, Network, Transport, Session, Presentation and Application. Routing protocols are mainly applied in the network layer. These protocols are used to provide the data traffic path from source to destination host.

Among other routing protocol, Intermediate System to Intermediate System (IS-IS) protocol recently took attention because of the large scalability of network, fast convergence and an additional advantage of not needing the IP connectivity to communicate with neighbours, so is more and more popular with service providers [2][3].

In this paper is shown a simulation of computer network using multple routers and a free software. IS-IS protocol is set on routers and also all settings and readings according which it can be concluded that network is fully operational are given.

2. IS-IS PROTOCIL OVERVIEW

IS-IS protocol is developed by Digital Equipment Corporation, in 1980, originally standardized by ANSI, as International Organization for Standardization (ISO) protocol. IS-IS protocol is a routing protocol, primarly designed to efficiently forward data within computer networks or groups of physically connected computers.

IS-IS protocol is an internal gateway protocol, designed primarily for the use within an autonomous system.

IS-IS is a link state protocol, which operates by sending link state information via a router. Each router independently creates a network topology, aggregating the obtained network data.

The IS-IS router runs the Dijkstra shortest-path first calculation to determine the shortest path to each destination in the network. Each router executes the Dijkstra algorithm independently, and each router has an identical database as a result.

Packets are then sent through the network to the destination via the calculated best route.

Unlike other IP routing protocols, IS-IS is directly applicable to data link layer (the second layer of OSI model), and does not require an address in every interface, but only on the router. This makes the configuration simpler.

IS-IS protocol is designed as part of the OSI network protocol, and not as a part of the TCP/IP protocol. It uses a different network address record. Instead of 32-bit addresses, IS-IS protocol uses a 10-bit Network Entity Titles (NET) in next format:

49.0040.0172.0016.0005.00

The first three bytes (49.0040) represent an area identifier. In this case, the area 40 is defined, while 49 represents Address Family Identifier (AFI) are used for private addresses. The next six bytes represent the system identifier of the router on the network. Finally, the last two bytes must be 00 to denote this system.

The IS-IS protocol divides each autonomous system into several smaller segments, so called areas. Each area is a collection of networks and hosts administratively brought together. Routers in one area use the link state algorithm in parallel, and store the results in their database. Routers,

within one area, exchange this information with each other and have an identical link-state database. In addition, routers can forward a list of routes in their area to routers of the other areas.

Routers within one area that use IS-IS protocol, are divided into two types. Level 1 routers route traffic within the same area, while Level 2 routers route traffic between different areas [4].

3. PROJECT

This chapter describes what hardware and software configuration is needed to simulate the routing protocol for computer network, as well as a brief overview of software installation.

3.1. Hardware requirement

A personal computer (PC) will be required for the simulation.

Minimum required configuration:

CPU: Dualcore 1.7GHz

Memory: 4GB Ram 800MHz

Hard drive: 20GB free space or more

Recommended configuration:

CPU: Intel i5 1.7GHz

Memory: 8GB Ram 1600Mhz

Hard drive: 40GB free space or more

or higher.

3.2. Software requirement

The work is based on usage of free software (software for which is not required to purchase a licence), which can be downloaded for free from developer's websites.

Used platform is the operating system Linux- Ubuntu [5], which can also be used under a virtual machine Oracle „VM VirtualBox" [6].

Remaining required software:

Oracle VM VirtualBox – intended for virtualization [6]

QEMU – sofrware intended for emulation [7]

GNS3 (Graphic Network Simulator 3) – software intended for simulation of network devices [8].

FreeBSD – Unix version of operating system [9]

Junos Olive – operating system of generic Juniper router [10]

Wireshark – software intended for monitoring traffic between network devices [11]

3.3. Software installation

As previously stated, the operating system used for simulation is Linux Ubuntu. After that, the GNS3 software package is installed, and also additional software as QUEMU and VPC.

In order to add Juniper router in the GNS3 software package within the installed QEMU emulator, FreeBDS is installed, and at the end Juniper Olive software.

After all the installation is finished, GNS3 is started and the software is ready for creating certain network topology, simulation - test and performing further settings of routers, virtual PCs, links etc.

Using the GNS3 software, computer network is created. It consists of five routers, one switch and two Virtual Computers (VPC), whose appearance from the GNS3 software is given in Figure 1.

The system is divided into three autonomous areas. The first autonomous area (area20) - consists of routers R1 and R2, connected by a link 10.0.0.0/24. The second autonomous area (area30) - consists of router R3 and R4, connected by a link 10.0.0.0/24. The third autonomous area (area40) - consists of router R5, connected with a link 15.0.0.0/24 with first autonomous area (area20), and with link 14.0.0.0/24 with second autonomous area (area30).

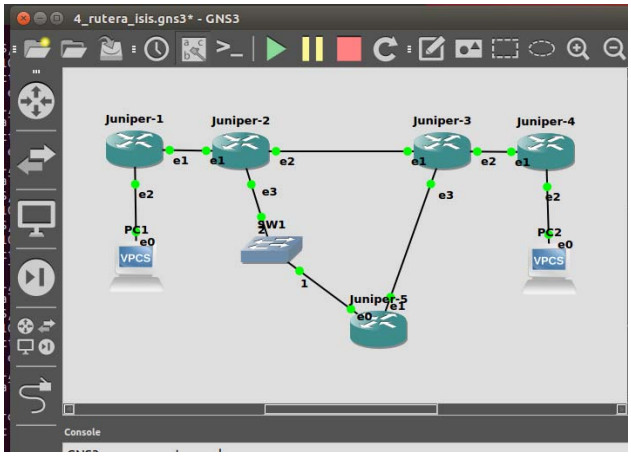

Figure 1. Network topology

The first and second autonomous area (area20) and (area30), respectively, are connected by link 100.0.0.0/24.

The switch located on the link between the routers R2, and R5, enables the use of the Wireshark software in order to monitor and analyse packets.

VPC1 is connected to the router R1, and VPC2 is connected to the router R4. The function of these virtual machines is to finally check if the network is really working. Table 1 shows the port settings of the routers.

Table 1. Port settings on routers: R1, R2, R3, R4, R5

	R1	R2	R3	R4	R5
em0	-	-	-	-	15.0.0.6
em1	10.0.0.5	10.0.0.6	100.0.0.6	11.0.0.6	14.0.0.6
em2	13.0.0.5	100.0.0.5	11.0.0.5	12.0.0.5	-
em3	-	15.0.0.5	14.0.0.5	-	-
lo0	172.16.1.1	172.16.2.1	172.16.3.1	172.16.4.1	172.16.5.1

Table 2 shows the interface settings of the VPCs.

Table 2. Interfaces setting on VPC1 and VPC2

	VPC1	VPC2
ip address	13.0.0.6	12.0.0.6
gateway	13.0.0.5	12.0.0.5

3.4. IS-IS protocol setting

The IS-IS protocol setting is shown through the following three steps:

Interfaces that use the IS-IS protocol are defined as well as the level. These settings are configured in the menu [edit interfaces]

The ISO family protocol is activated in the interface in the menu [edit interfaces]

The NET address is configured (in loopback interface).

In Table 3 are given the NET addresses for the routers R1, R2, R3, R4, and R5.

Table 3. Settings of the - NET address on routers: R1, R2, R3, R4, R5

Router	NET address
R1	49.0020.0172.0016.0001.00
R2	49.0020.0172.0016.0002.00
R3	49.0030.0172.0016.0003.00
R4	49.0030.0172.0016.0004.00
R5	49.0040.0172.0016.0005.00

3.5. Reading the results

Wireshark software package is used for the results analysis.

The results of above performed configuration and settings, is a configured network model with five routers, which work according to the IS-IS protocol, switch and two virtual computers. On one link in the branch with the switch, we activate the recording of the package via the software tool Wireshark. In Figure 2 are shown Hallo ISIS packets first level.

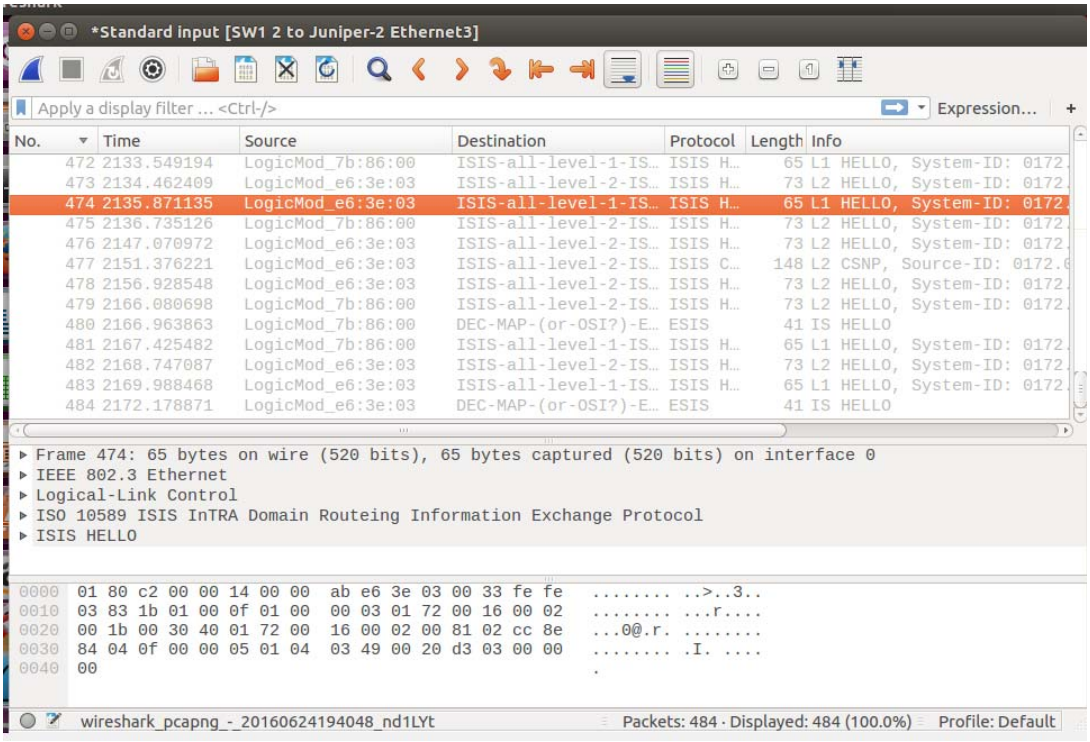

Figure 2. Hallo packets level 1

These are Hallo packets that are exchanged within an area. Their role is to exchange information about routes, inside one, specified area.

In Figure 3 are shown Hallo ISIS packets second level.

These are packets that are exchanged between different areas. Their role is ability to see routes from one area, and beyond this area.

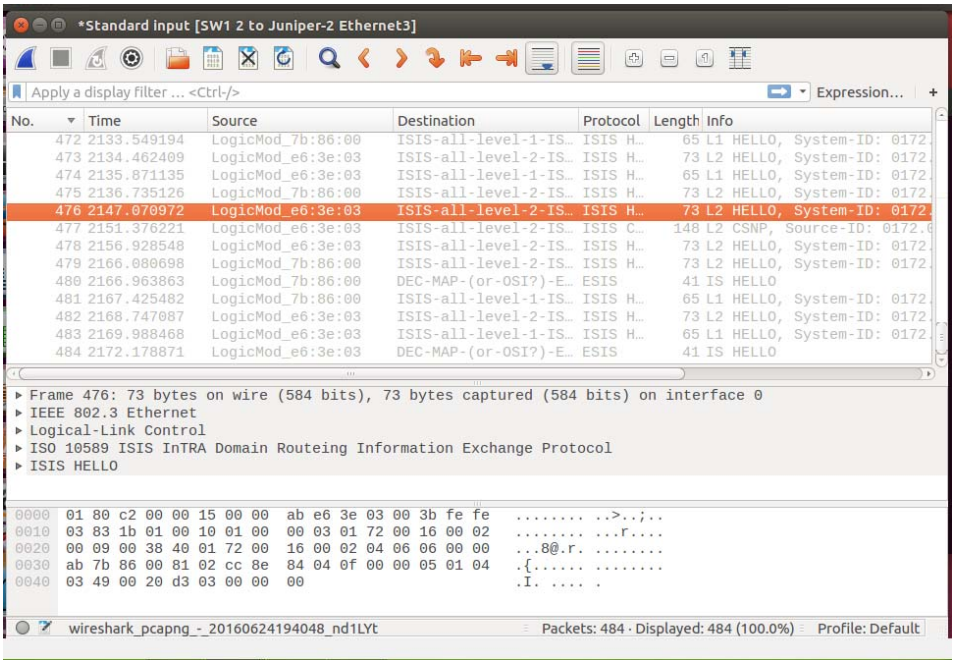

Figure 3. Hallo packets level 2

3.6. Checking network functionality

In this section, the emphasis will be on checking network functionality. Certain commands from the terminal are used for checking on certain router or VPC, which would be otherwise used to work on real routers and computers.

3.6.1. Router check

In edit mode, from the terminal, on specified router, in the case router 4 (R4), it is typed **show route**, and gotten the printout as shown in the Figure 4.

Figure 4 representation tells us that we have routes created via the protocol IS-IS on the router 4 (R4).

Also in same mode, with command **show isis adjacency**, gotten printout is shown in Figure 5.

In the same picture (Figure 5), can be notice that the router 4 (R4) is directly connected to the router 3 (R3), via interface **em1.0**, and also that the link is active.

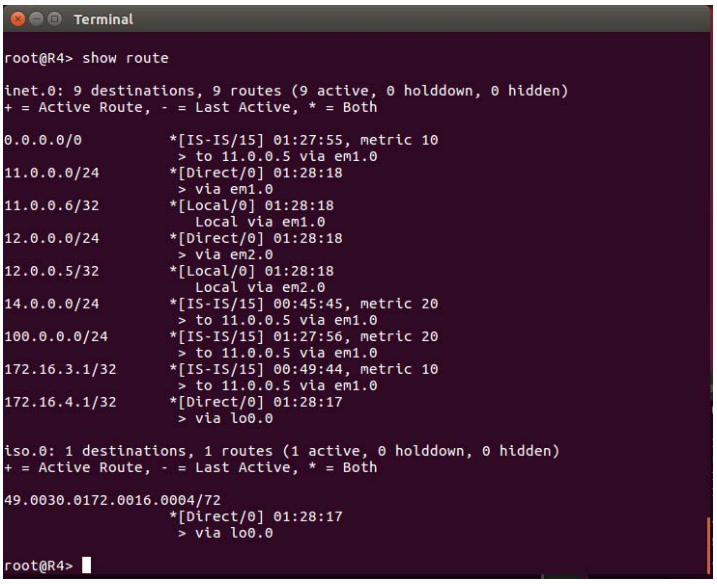

Figure 4. Shows of routes on router 4 (R4)

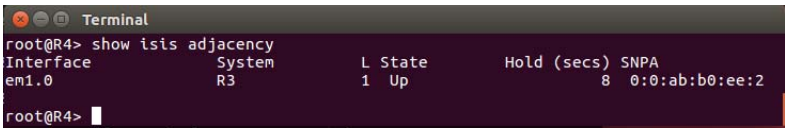

Figure 5. Shows of router 4 (R4) adjacency

By analogy, it is possible to check other routers, which is not given here due to the conciseness of the presentation.

3.6.2. Network check

To check overall functionality of the network, two VPCs are used. They are located on opposite sides of the network, so that communication between them involves the flow of data, through almost all routers (Figure 1).

The check is also performed from the terminal of VPC using the **ping** command, followed by the ip address of the other VPC. The results obtained, when the VPC2 was pinged from VPC1 and conversely, are given in the Figure 6.

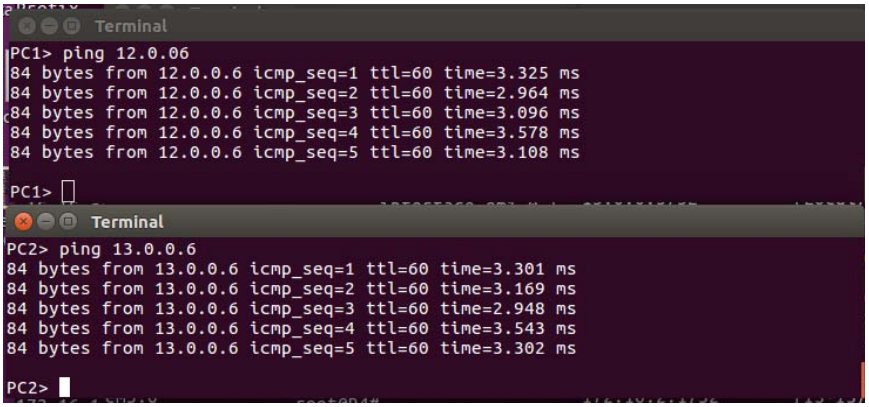

Figure 6. Pinging VPCs

Figure 6 shows that the network is functional that the routing system (routing protocol) is fully operational, since the expected answers to the given command are obtained.

4. CONCLUSION

This paper presents the possibility of performing the network simulation, in this case with IS-IS protocol, traffic flow monitoring using free software, without purchasing expensive hardware or testing on an already existing active network, where routing problem could occur due to certain settings, which could be entered into the routers in the testing process, and which could turn out to be wrong.

Upon successful completion of the test, the router parameters can be implemented on routers in the real network.

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