GNS3 Laboratory Manual: SDN & NFV Fundamentals

Subject: Advanced Networking and Virtualization

Target Audience: 3rd-year Undergraduate Students

Environment: GNS3 (Graphical Network Simulator-3)

Pre-Information: Installation and Environment Setup

Before embarking on the individual labs, every student must establish a stable virtualization environment. GNS3 is not a simple application; it is a complex orchestration of a GUI and a backend virtualization server (GNS3 VM).

1. Architectural Components

- **GNS3 GUI**: The frontend where you design topologies.
- **GNS3 VM**: A Linux-based virtual machine that runs the actual network nodes (VNFs, Docker containers, QEMU/KVM images) to ensure performance and compatibility. [1]

- **Virtualization Layer**: Typically VMware Workstation Player or VirtualBox, which hosts the GNS3 VM.

2. Systematic Installation Workflow

1. **Download GNS3**: Obtain the latest version from the official GNS3 website.
2. **Download GNS3 VM**: Select the version matching your virtualization layer (e.g., VMware).
3. **Import GNS3 VM**: Open your virtualization software and import the .ova file.
4. **Initial Setup Wizard**: Launch the GNS3 GUI and follow the wizard to connect the GUI to the "Local GNS3 VM."
5. **Required Dependencies**: Ensure **Npcap** and **Wireshark** are installed (bundled with the GNS3 installer) for packet analysis and virtual link capturing.

Lab 1: Basic Topology Construction and Packet Analysis

Objective: To familiarize students with the GNS3 workspace, the deployment of virtual nodes, and the use of Wireshark to observe data plane traffic.

1. Scenario Logic

In this introductory lab, you will move away from the **Classical network appliance approach**—which requires physical installations—and instead build a basic virtualized connection between two end-user hosts using a standard Ethernet switch. [333333333]

2. Topology Requirements

- **Nodes**: 2x VPCS (Virtual PC Simulator), 1x GNS3 Built-in Ethernet Switch.
- **Connections**: Use the "Add a Link" tool to connect the VPCs to the switch ports.

3. Procedure

1. **Project Creation**: Create a new project titled Lab1_Basics.
2. **Node Deployment**: Drag the VPCS and Switch nodes from the left sidebar onto the workspace.
3. **Logical Connectivity**:
   - Connect PC1 (Eth0) to Switch1 (Port 1).
   - Connect PC2 (Eth0) to Switch1 (Port 2).
4. **IP Configuration**:
   - Open the console for PC1 and type: ip 192.168.1.1 255.255.255.0.
   - Open the console for PC2 and type: ip 192.168.1.2 255.255.255.0.
5. **Verification**: Execute a ping 192.168.1.2 from PC1.

4. Technical Analysis: The Virtual Tap

Right-click on the link between PC1 and the switch and select **"Start Capture."** Wireshark will open automatically.

- **Observation**: Note the ICMP Echo Request and Reply packets.
- **NFV Perspective**: This mirroring of traffic to Wireshark is a fundamental precursor to the **Virtual Tap** concept used in IDS/IPS deployments. [4444]

Lab 1 Assessment Questions

1. Explain how the GNS3 VM acts as the **NFV Infrastructure (NFVI)** in this setup. [5555]

2. In a physical network, what hardware would replace the "Start Capture" software feature?