universidade de aveiro
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REDES DE COMUNICAÇÕES 1

GUIDE

GPON Residential Scenario

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Connecting GNS to a real network

Objectives

- Get to know Internet services over fiber (GPON)
- Apply know-how from previous guides.
- Learn how to extend real networks into GNS and vice-versa

Duration

- 1 week

PART I

What is GPON?

GPON, or Gigabit Passive Optical Network, is a technology used to deliver high-speed broadband internet and other telecommunication services over fiber optic cables. It is a type of passive optical network (PON), which means that it uses fiber optic cables and passive components such as splitter boxes to transmit data over a network.

In a GPON system, a central optical line terminal (OLT) is connected to a network of fiber optic cables that run to individual homes or businesses. The OLT sends data downstream to the fiber optic cables using a single wavelength of light, and the data is then split and distributed to multiple endpoints using passive splitters. The endpoints, such as homes or businesses, are equipped with optical network units (ONUs) that receive the downstream data and transmit upstream data back to the OLT using a different wavelength of light.

GPON is known for its high speed and efficiency, as it can transmit data at rates up to 2.5 Gbps downstream and 1.25 Gbps upstream. It is widely used by telecommunications companies to provide high-speed internet, television, and phone services to customers.

The maximum reach of a GPON system depends on a number of factors, including the type of fiber optic cables used, the strength of the signal, and the number of splitter boxes or other passive components in the network. In general, GPON systems can cover distances of up to 40 kilometers without the need for repeaters or other active components, although the actual reach may be shorter depending on the specific network configuration.

A typical split ratio for a GPON system is 1:64, which means that a single PON port on the OLT can serve up to 64 ONUs. However, it is possible to use splitters with higher (1:128) or lower split ratios to increase or decrease the number of ONUs that can be served by a single PON port, depending on the specific network configuration and the desired level of service.

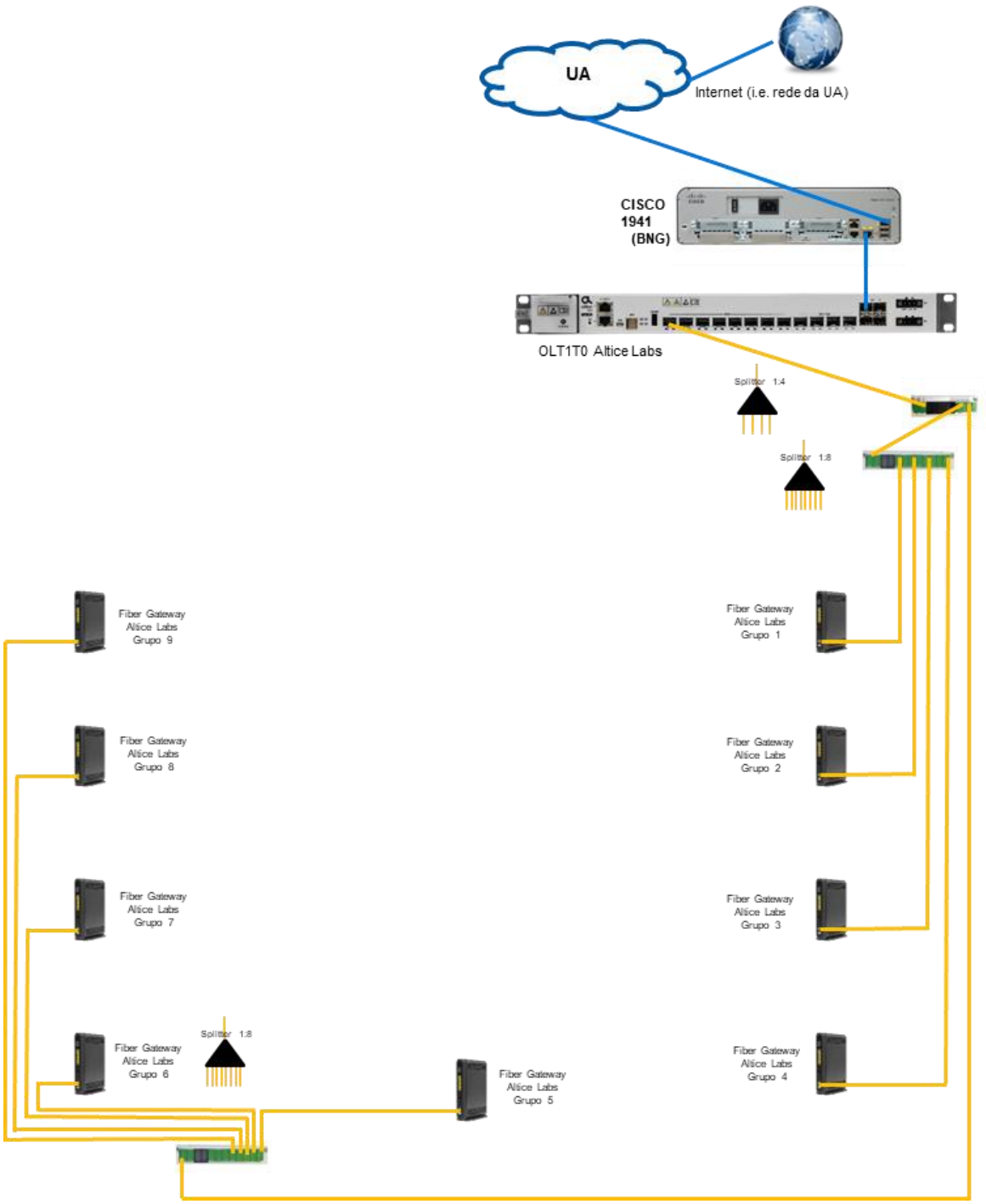
What is a BNG?

In a broadband network, the BNG is often referred to as a broadband network gateway (BNG). It is typically located in a central office or data center and serves as the entry point for all traffic that is destined for or originates from the customer's network.

The BNG is a critical component of a broadband network, as it enables the service provider to control and monitor the traffic that passes between its network and the customer's network. It also enables the service provider to apply various policies and controls to the traffic, such as rate limiting, Quality of Service (QoS), and security measures.

Laboratory GPON scenario

- One CISCO 1941 acting as BNG
- One Altice Labs OLT1T0 with 8 PON ports (only one will be used), 4x 1GbE + 4x 10GbE uplink ports
- A cascade of splitters (one 1:4, followed by two 1:8)
- 9 ONUs (MEO Fiber Gateways, powered by Altice Labs)

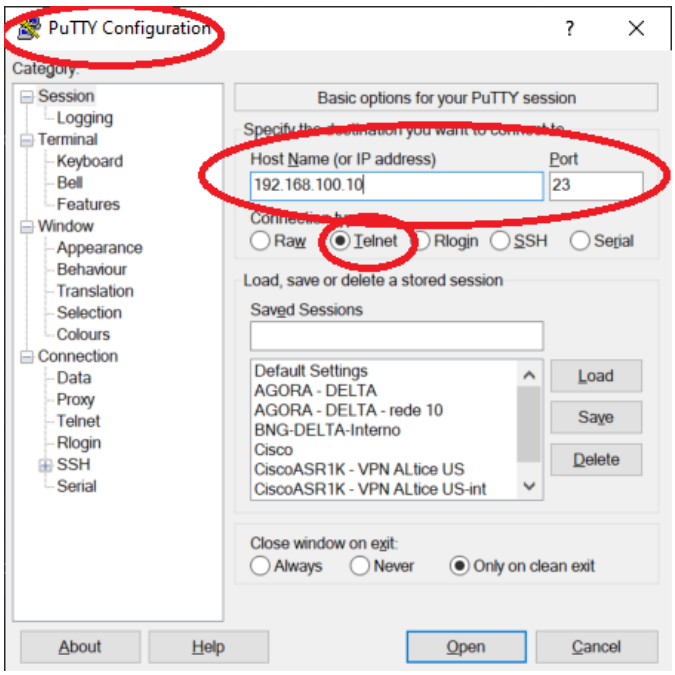


What are you going to do?

You are going to configure an interface on the BNG that will enable the Internet Service on your ONU (Fiber Gateway).

1 - First, connect your PC to the LabCom WiFi network

2 – Then, you will do a telnet (e.g. using Putty in Windows or picocom in Linux – see next picture) to the BNG. The BNG IP address is 192.168.100.1Y (lab 33Y) (192.168.100.10 or 192.168.100.11).



Username: labcom
Password: labcom

```
BNG-LabCom> enable
Password: labcom

BNG-LabCom#
```

3 – Then you will configure the BNG interface that serves your ONU (Fiber Gateway).

Check the interface configuration:

Lab 33Y, Group X:

```
BNG-LabCom# show run interface GigabitEthernet0/1.1133YX

interface GigabitEthernet0/1.1133YX
 description Sala33Y GrupoX
 encapsulation dot1Q 11 second-dot1q 3YX
 ip virtual-reassembly in
```

Configure the correct IP address of the interface and configure NAT inside:

Lab 33Y, Group X:

```
BNG-LabCom# configure terminal
BNG-LabCom (config)#
BNG-LabCom (config)# interface GigabitEthernet0/1.1133YX
BNG-LabCom (config-if)#  ip address 172.3Y.X.1 255.255.255.0
BNG-LabCom (config-if)#  ip nat inside
BNG-LabCom (config-if)#  exit
```

Configure a DHCP pool to provide IP Addresses, router information and DNS server to your ONU (Fiber Gateway):

Lab 33Y, Group X:

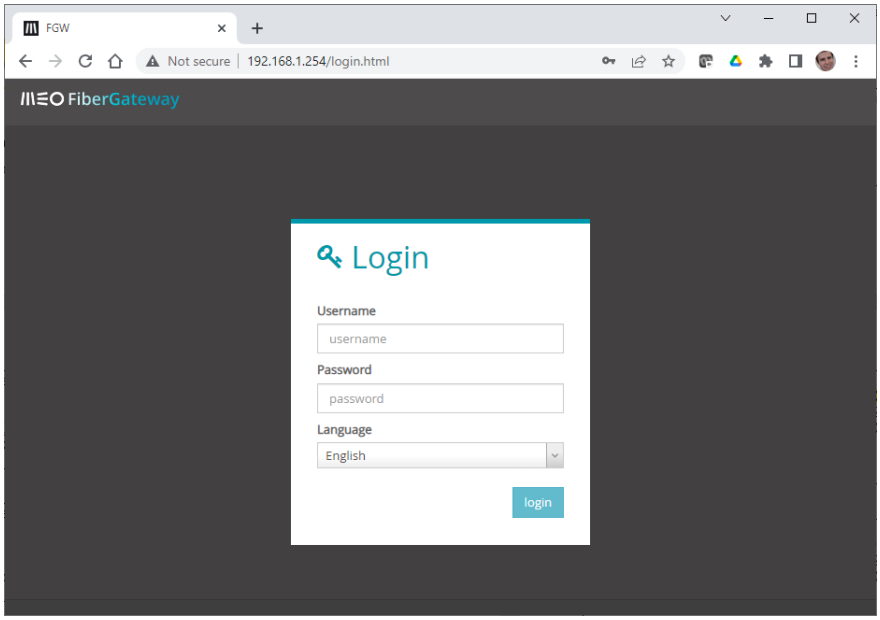
```
BNG-LabCom (config)# ip dhcp pool VLAN3YX
BNG-LabCom (config-dhcp)#  network 172.3Y.X.0 255.255.255.0
BNG-LabCom (config-dhcp)#  default-router 172.3Y.X.1
BNG-LabCom (config-dhcp)#  dns-server 192.168.100.1 172.3Y.X.1
BNG-LabCom (config-dhcp)#  exit
```

4 – Check Internet on your MEO Fiber Gateway

Turn the Fiber Gateway power on.
Wait for about 2 minutes (until the LEDs are stable)
Connect your PC (LAN port or WiFi through the credentials on the label below it)

Access the Web Interface at: http://192.168.1.254

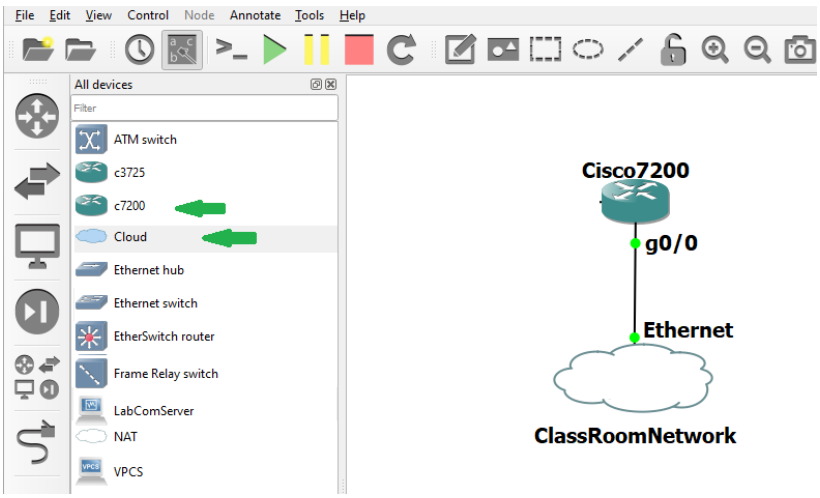
Username: meo
Password: meo



Go to the WAN interface and verify if it acquired an IP from the pool you configured.
Try to access the Internet from your PC, connected to the Fiber Gateway.

PART II

1 - Build the configuration shown below (please note that the Cisco Interface may be different depending on how your router was defined in GNS).



2 - Configure the router:

Cisco7200(config)# interface GigabitEthernet0/0 #replace by the correct interface of your router

ip address 192.168.101.10#G 255.255.255.0
no shutdown

3 - Attach that router interface to a GNS3 Cloud (not the NAT cloud) and select your PC Ethernet adapter to attach the cloud (if your PC does not have an Ethernet interface, please use a USB dongle). The name of your PC Ethernet interface may differ (eg, Ethernet 2).

4 – Use an Ethernet cable to attach your PC ethernet interface to the RJ-45 Ethernet socket on the work desk (the default will the second RJ-45 port)

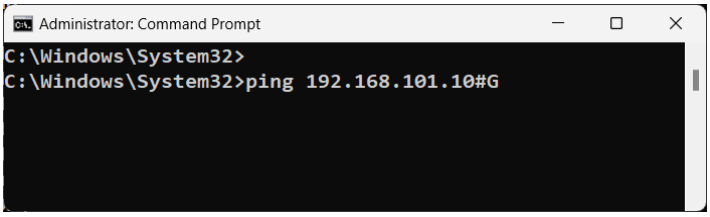
5 - Test the connectivity to the classroom router:

Cisco7200# ping 192.168.101.10

Note: sometimes it is necessary to delete and insert again the connection between the Router and the Cloud to enable connectivity (it is a GNS3 bug).

6 – Add a default gateway entry to your router. Your router default gateway will be the classroom router IP address.

7 – From a PC connected to the MEO gateway (PART I) try to ping your router interface:

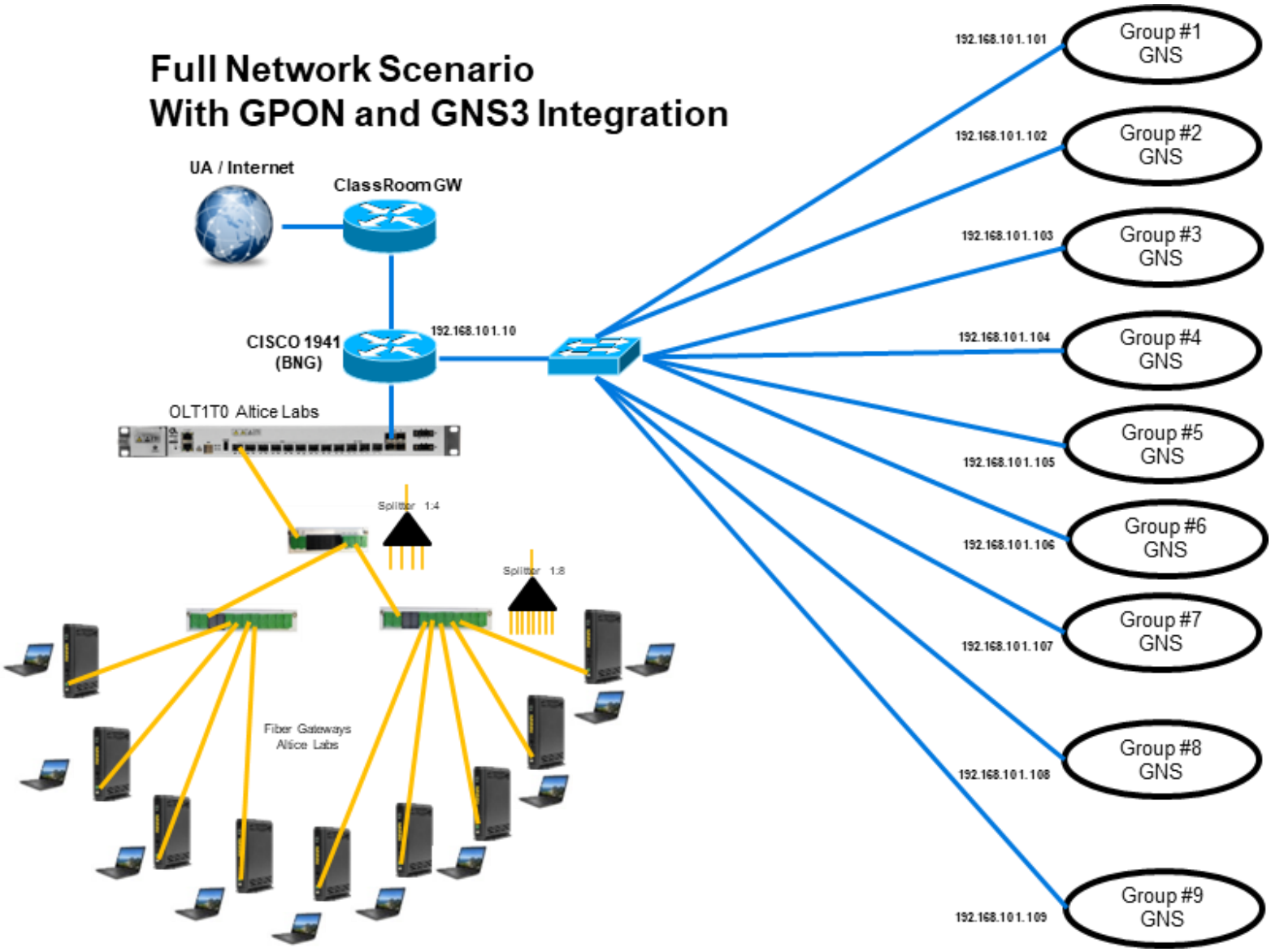


8 – Enable IP domain lookup on your router and define a name-server (DNS server):

Cisco7200(config)# ip domain lookup

Cisco7200(config)# ip name-server 192.168.100.1

9 – Do a ping to www.ua.pt


Full Network Scenario
With GPON and GNS3 Integration
UA / Internet
ClassRoom GW
CISCO 1941
(BNG)
192.168.101.10
OLT1T0 Altice Labs
Splitter 1:4
Splitter 1:8
Fiber Gateways
Altice Labs
192.168.101.101
Group #1
GNS
192.168.101.102
Group #2
GNS
192.168.101.103
Group #3
GNS
192.168.101.104
Group #4
GNS
192.168.101.105
Group #5
GNS
192.168.101.106
Group #6
GNS
192.168.101.107
Group #7
GNS
192.168.101.108
Group #8
GNS
192.168.101.109
Group #9
GNS