University of Minho – Departament of Informatics

Master Courses MERSTel / MIEI, 2019/2020

Internet Technologies and Protocols

Laboratory Work TP4:

*Access Links, Packet Loss & Duplication, Long Delays – **B**est**E**ffort Internet*

Objectives:

- Using the CORE emulator (Common Open Research Emulator) http://www.nrl.navy.mil/itd/ncs/products/core for BE Internet Emulation
- Characterise Links in Access Networks
- Performance Effects of Packet Loss & Duplication
- Long delays effects in BE Internet

Report:

- All working groups shall prepare a report describing the main settings / commands / tasks / developed in the context of this work.
- The definition of the structure and content of the report is a responsibility of each working group.
- The reports will be evaluated taking into account i) the correction / technical quality of the solutions / settings / answers / explanations regarding the diferente tasks / challenges presented and ii) the clarity / organization / quality of the submitted report.
- Reports must be submitted within the deadline established by the teacher.

Access Links, Packet Loss & Duplication, Long Delays

`Figure 1 Access Link to a Core Network` presents a sample network topology showing a core network topology, where all links have a full duplex capacity (BW) of 1 Gbps and 100 µsec delay. There is a ***SERVER*** (IP 10.0.6.10) within the core, with a 100 Mbps (and 50 µsec delay) ethernet connection,

The same `Figure 1 Access Link to a Core Network` presents the attachment for a Residential connection that has an access link whose initial configuration defines BW (BandWidth) to 512 kbps, with 50 msec delay.

At the Residential connection side there is a HOME-ROUTER that has a 100 Mbps port wire connected to a HOME PC.

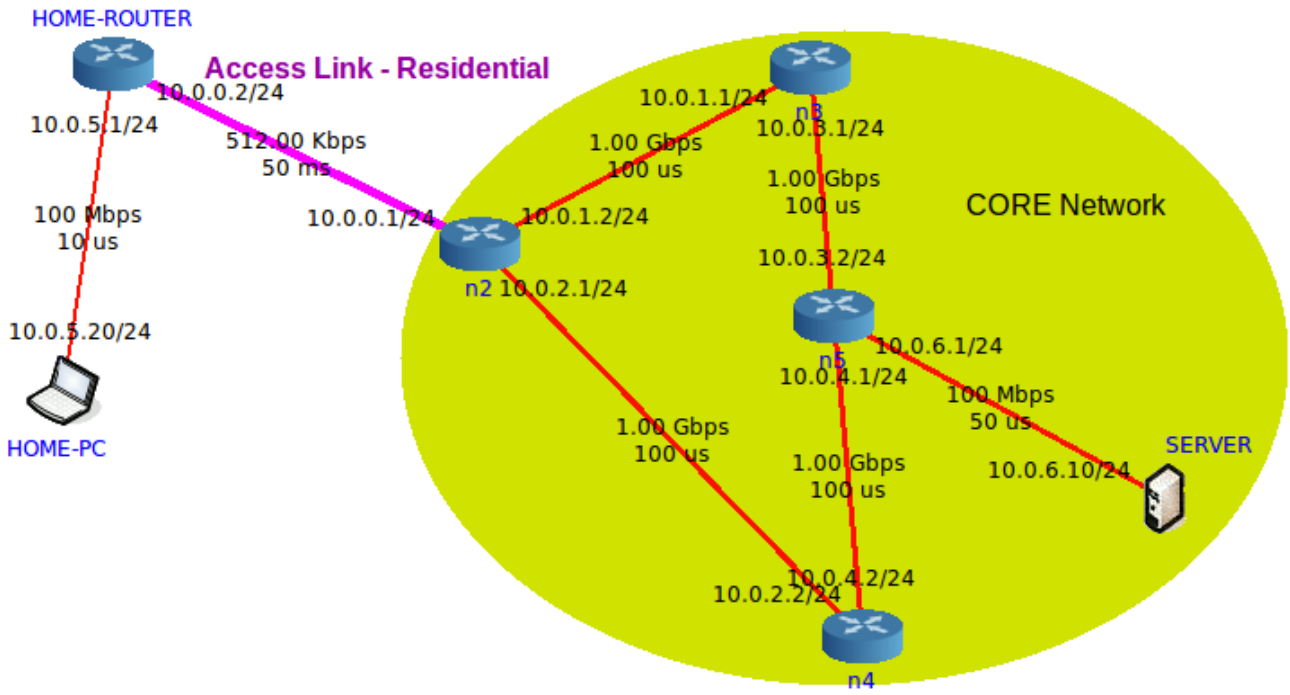

Figure 1 Access Link to a Core Network

1. Establish an executable configuration of such a topology, with a very similar configuration, using the CORE Emulator.

   1.1. Test the global connectivity and present evidence that it is working, using the **ping** and **traceroute** tools. Present and justify the average **delay**, as measured by **ping**, between HOME-PC and SERVER. Justify the values obtained, confronting them with the Access and CORE characteristics.

   - *Note: Use "ping –c <#count> <ip-destination>" to establish the number of packets (eg ping –c 20 10.0.6.10" to send 20 packets); user "ping –s <size> <ip-destination>" to establish the packet size.*

1.2. Now modify the characteristics of the **Access Link – Residential**, so that BW is upgraded to 1 Gbps (1Gbps Download; 256 Mbps Upload) using the option ”Configure” on the link; modifications can be made even during the running phase experiences). Again, get the average **delay**, as measured by **ping**, between HOME-PC and SERVER. [If you are using a CORE version above 4.6 you should even test using asymmetric BWs. Configuring asymmetric links enables you to test typical ADSL residential connections]

1.3. Devise a way to measure the *goodput* obtained from a **file-transfer** application (using any application protocol running over TCP - eg ftp, http) – between HOME-PC and SERVER (**hint:** take into account file size and time taken to transfer the file; suggested size around 100 Mb). Comment on the value obtained, trying to relate this value with the characteristics of the network connection.

2. Get back to the “Configuration” menu of the **Access Link – Residential**. Certainly you can notice that there are several parameters that may be configured with this link; those parameters are:
   - Delay (expressed in microseconds - μsec)
   - Loss (expressed by the random percentage of lost packets)
   - Duplicate (expressed by the random percentage of packets that are duplicated)

   2.1. Modifying a single parameter each time the values Loss % (use values of 2 and 10%) and Duplicate % (use values of 2%, and 5%) and test again using **ping** and **file-transfer**.
   For each combination of values chosen [(2,2), (2,5), (10,2), (10,5)] for for Loss and Dup, determine, comment and justify the results obtained both when using **ping** and **file-transfer**.

   2.2. Modify afterwards the value of **Delay** into a very large value (for instance into 2.000.000 μsec, that is 2 seconds (a value close to Earth-Moon average delay; notice that Earth-Mars average delay is around 10 minutes)). Again, use **ping** and **file-transfer** in order to test the characteristics of the end-to-end “HOME-PC to SERVER” connectivity.
   Present, comment and justify the results obtained.

3. Discuss within the report how Delay, BandWidth, Packet Loss and Packet Duplication may affect the Best Effort characteristics of Internet communications. This discussion should be based on whatever results you have got from this TP work.