IMPLEMENTATION OF LOCAL COMPUTER NETWORKING LABORATORY DURING ERASMUS+ MOBILITY

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Abstract: *In this article we are describing our Erasmus+ mobility experience also about our studies and the challenges we faced in implementing laboratories during this mobility because of the COVID-19 pandemic. We are describing practical aspects regarding the Local Computer Networking labs we implemented during our stay in Romania. Finally, aspects are presented regarding the issues faced in India by the educational system during this pandemic*

1. INTRODUCTION

"Success is defined by desire to achieve the goals" [1]. As teenagers we all want this and in the very same way, we started our journey to explore the studies and culture of Romania via Erasmus + program: Pranjul Mishra from Lucknow and Neel Paresh Doshi from Gujrat, India. We are students from Marwadi University Rajkot, Gujrat, India [2], from AI- Department. It was month end of January 2021 when we received this opportunity of holding Erasmus + scholarship which included an opportunity to study at UPIT for one semester.

The reason why we applied for the mobility was that it was a good opportunity to explore other countries as well as the educational systems, to investigate the major differences from them, the scholarship grants and also to develop our personal as well as the professional way, to be precise more practical ways also its was a great opportunity which is not easily offered to anyone.

We prepared ourselves for a new experience and learning methods as we were about to study here subjects like Artificial Intelligence, Computer Networking, Operating System, Modeling and Simulation, Microprocessors. Numerical Mathematics and also few more subjects under the guidance professors – despite of the fact it was an online lecture session.Although it was a serious medical situation because of the COVID-19 pandemic the Indian government allows students to go abroad if you meet certain conditions and, especially you are a student, you are a priority. As a result, we got our valid permits after fulfilling the conditions like police verification/medical verification and educational documents. On 25.0.3.2021 we started our journey to gain the Erasmus+ experience in Romania with a 16 hours long flight to reach the destination. We actively participated in weekly activities and other various other events of college and the Erasmus community it is really one of the best time-span of our life for us. In regard to the educational aspects, we implemented many practical laboratory topics of different subjects like Artificial Intelligence, Algorithm and Design, Local computer Networking, Operating Systems, modeling simulation and microprocessors.

2. EDUCATION IN INDIA DURING COVID-19 PANDEMIC

The COVID-19 pandemic started in the month of March 2020 and lockdown was implemented nationwide [3].

For first phase it has an adverse effect on our education system because we were not ready to transfer everything to online and it took few months to get courses resuming normally.

Colleges and schools started their online education and for the first-time mass promotion was used rather than taking exams, although later online evaluation methods were adopted using various platforms.

In our opinion, we faced some major draw backs specially when it comes to practical education like the laboratories and hands on experience.

Later different phases of lockdown were announced and new guidelines were issued [13]. After four phases of lockdown the situation was brought under control for the education of college students, while for school students still have restrictions and are facing the problems of online learning.

From our experience we can say that this need for online education helped develop better habits and techniques for self-learning but it is not so commonly used, especially in the case of small school students.

As per latest guidelines [14] the restrictions are implemented according the number of cases in a specific area and only online education system is to be continued although there are facilities that can be visited (like libraries) by following all protection protocols.

If the situation is not too serious in a particular area, schools/colleges can call students once or twice a week for in person classes, although it is quite impractical in the cases when there is a large number of students in one class. With the exception of the practical sessions everything is now working smoothly: online lecture sessions, fair evaluation and better visual experience via different online platforms.

In comparison to early stages of the pandemic, despite the heavy casualties, the Indian Educational system has control of the educational issues that arise. While mass-exams like board exams and national competitive exams JEE-MAIN and GATE and many other big exams were cancelled because it was not possible to take such a big human risk an exam. [15], [4].

Currently as India produces the antiviral REMDESIVIR [12] as a treatment for COVID-19, colleges for last year students are re-opened for studying and soon this will be applied in schools for 10^{th} and 12^{th} class students. As we move towards a safer situation further restriction will be lifted and this will allow to utilize better facilities for students. The pandemic allowed new education systems to be adopted which mainly focus on practical development rather than only theoretical knowledge either physical or via virtual methods because of the lack of hands-on experience.

3. WORK -EXPERIENCE AND CHALLENGES DURING ERASMUS+ MOBILITY

After we arrived at the University of Pitesti, we received our homework and practical implementation targets for our laboratories. As the courses were fully online, we received study materials, online references for our help and links to attend the lecture sessions.

The first issue we faced was the linguistic problem as the online classes were in native language rather than English so it difficult to understand and the solution was to adapt to a self-learning way and continued with the classes.

Although self-learning is a good way to acquire knowledge, it takes quite a lot of effort from the part of the student, but in this case, it was the only option available. Subjects like artificial intelligence, algorithm design, operating system, modeling-simulation and microprocessors require a guidance to understand the concept because implementing the right code can be done by any individual but what makes the difference is how you understand the concepts. Only if we understand the subjects, they are helpful for us for a long term, as simply copying and pasting it from internet is not the way to perform.

Despite of few issues and disadvantages it really helped us a good habit of reading books and making better abstracts from it, we also got to learn Romanian language a bit, and now we can start a conversation in this language. We also participated in different activities organized by Erasmus+ group from the University of Pitesti for us.

In the laboratories we used different software like Visual Studio Code, Linux, Windows server 2012, Cisco Packet Tracer and MATLAB. Out of them using Windows Server was quite challenging as it was really new for us. The rest all were okay because we have worked with them in our earlier semesters.

Regarding the practical topics we were given to implement, some were quite difficult maybe due to lack of in person guidance. For example, the 8-Puzzle problem was a challenge for us as we used different methods that we never came across and it took enough time to be solved by us. We got to learn many new things in the subject local computer networking and modeling simulation. Solving the parallel programming homework was also quite difficult for us but, in the end, we managed to solve all practical problems and implement the homework as were the requirements of the problem.

We received assistance and study materials from professors in time. We found an interesting difference from Indian educational system; in that it is more on focused on practical aspects than theoretical concepts which is quite useful when trying to get employed.

4. IMPLEMENTATION OF LOCAL COMPUTER NETWORKING LABORATORY (LCN) HOMEWORK

There were many conducted laboratories: Local Computer Networking, Algorithms and Design, Artificial Intelligence *[10]*, Operating System, Modeling and Simulation *[11]* and Parallel programming but in this section, we will be discussing about Local Computer Networking.

Local Computer Networking *[5]* subject deals with basics of networking and it provides an overview of interconnections between multiple devices as a host or a receiver and various protocols related to inter device communication, setting up virtual networks (like VLAN) and also it deals with routing techniques.

As part of the homework, multiple laboratories had to be implemented.

4. 1. Static and dynamic routing lab

In this laboratory we implemented static and dynamic routing. Packet Tracer was used for simulations.

A static routing table is created, maintained, and updated by a network administrator, manually. A static route to every network must be configured on every router for full connectivity. This provides a granular level of control over routing, but quickly becomes impractical on large networks. Static routes have a high priority for routing traffic.

A dynamic routing table is created, maintained, and updated by a routing protocol running on the router. Dynamic routing protocols have a lower priority compared to static routing.

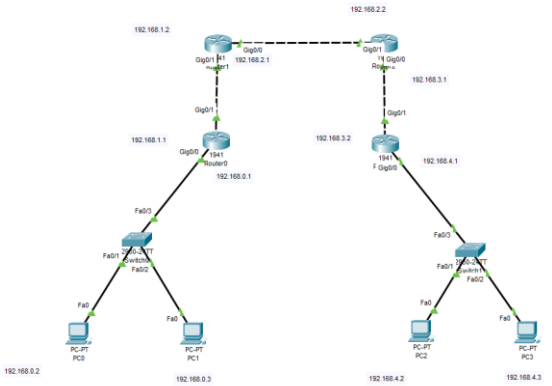

Fig. 1 Network implemented in Laboratory

Fig. 1 has the configuration created in Packet Tracer for static and dynamic routing with four routers, two switches and it is connected with four PCs for transferring data between them. Here PCs are connected to switches which are further connected to router via different networks.

The routers are configured manually (static routes) with the information about the unknown networks and destination locations, so that the data/message can be directed from source to destination. As there are few networks, static routing is effective here. Dynamic routing, although it is also configured, it is not used as static routing is preferred due to its priority. *[6]*

Fig. 2 shows that the message sent by PC0 reaches the destination PC2 and it returns a confirmation (hence sending and receiving process is successful).

Although Packet Tracer from Cisco was used, there are other software tools that can be used for simulation, like GNS3 and EVE-NG. There are few differences within them:

- Packet Tracer is a network simulator and embeds only limited real equipment features.

- GNS3 is a network emulator based on Dynamips and QEMU running real IOS images, virtual machines. GNS3 provides the real environment and supports advanced cisco security protocols and it also creates real packet while all these things are missing in Packet tracer.
- EVE-NG is also an emulator but it is even advanced than GNS3 which support all advanced features and protocols with enhanced experience.

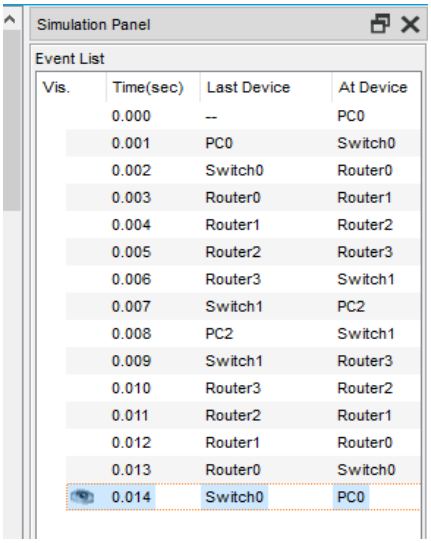

Fig.2 Traffic in simulation mode

4.2. Media streaming laboratory

Using the TCP (Transfer control protocol) *[7]* and UDP (User Datagram Protocol) TCP/IP sockets provide a simple way of connecting computer programs together, and this type of interface is commonly added to existing stand-alone applications.

This laboratory uses the VLC Player Streaming feature to test the behavior of UDP and TCP streaming traffic.

Fig. 3 shows VLC Player configured using TCP *[16]* via HTTP protocol and it basically works by breaking the overall stream file into small file downloads which is further encoded at different bit rates, and when we connect our client to the same port it starts downloading those short chunks of the file and hence leads to the streaming.

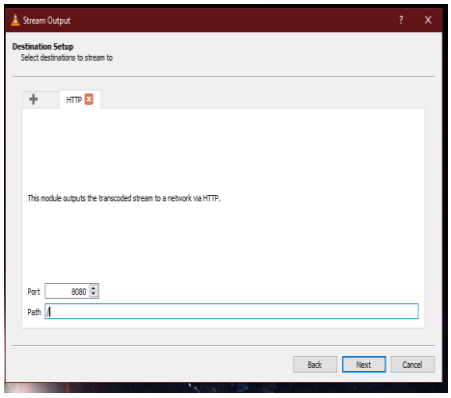

Fig.3 VLC Player Streaming interface

Streaming using HTTP provides the best video quality, but if an interruption occurs, all the lost data needs to be re-sent causing delays in streaming. Buffering is used to prevent interruptions.

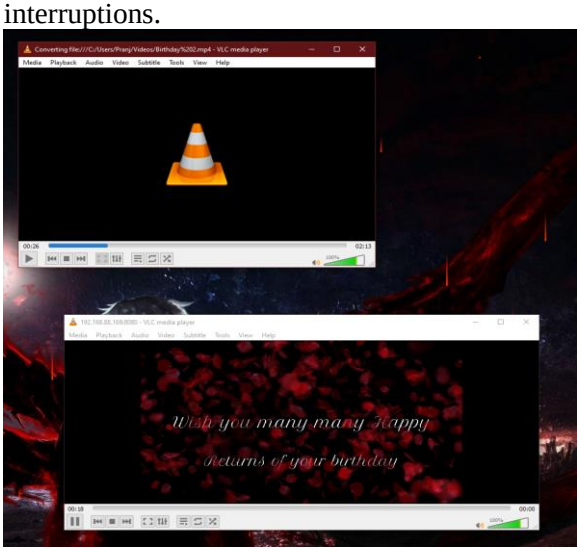

Fig.4 VLC streaming HTTP

UDP *[17]* is useful as a media streaming protocol, but it allows you to build a new protocol layer on top of it with ease. UDP is very simple and has virtually no inbuilt options except for application multiplexing and check summing of the header and payload.

0 … 15	16 … 31
Source port	Destination port
Length	Checksum
Data …	

Fig.5 structure of UDP datagram

Fig. 5 presents the structure of UDP datagram.
It uses 16 bit encoding and works layer by layer.

4.3. Spanning tree protocol (STP *[8]*)

Another aspect investigated in LCN is a network protocol which builds a loop free topology for Ethernet networks. Its basic function is to prevent the bridge loops (by closing links that would lead to loops) and the broadcast radiation.

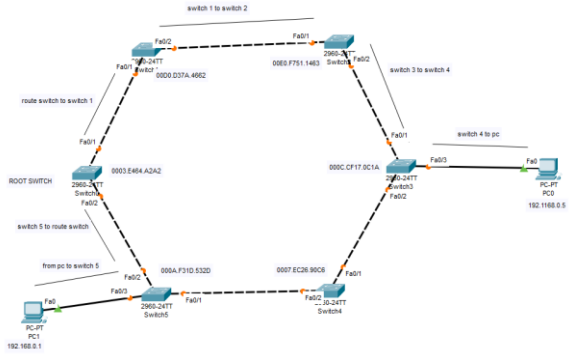

Fig.6 The STP test network

Think of a situation if upstream and downstream of vehicles are on the same lane it will cause a traffic jam in the same way if network processing (sending and receiving) is done in same way it will cause a network jam so STP prevents it and creates a divider as well as decides the shortest to the root bridge.

Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	PC1	ICMP
	0.001	PC1	Switch5	ICMP
	0.002	Switch5	Switch0	ICMP
	0.003	Switch0	Switch1	ICMP
	0.004	Switch1	Switch2	ICMP
	0.005	Switch2	Switch3	ICMP
	0.006	Switch3	PC0	ICMP
	0.007	PC0	Switch3	ICMP
	0.008	Switch3	Switch2	ICMP
	0.009	Switch2	Switch1	ICMP
	0.010	Switch1	Switch0	ICMP
	0.011	Switch0	Switch5	ICMP
	0.012	Switch5	PC1	ICMP
	0.993	--	Switch1	STP

Fig.7 Packet tracer data path simulation

The root bridge is a switch that has the lowest priority field (and in case more switches have the same value, the lowest MAC address). The priority field value can be controlled in software so the traffic path through a switched network can be changed if needed.

Fig. 7 shows how the message is transferred from PC1 to PC2, it transfers to root bridge (switch 0 in this case) first and then it is transferred to respective destination.

4.4. Virtual Local Area Network (VLAN)

VLAN is a subnetwork which can group devices connected on different physical LAN networks. VLANs make it easy for network administrators to partition a single switched network to match the functional and security requirements of their systems without having to run new cables or make major changes in their current network infrastructure. Fig. 8 presents a collection of 4 PC's paired on different physical networks i.e., PC0 and PC1 on one network and PC2 and PC3 on different physical networks.

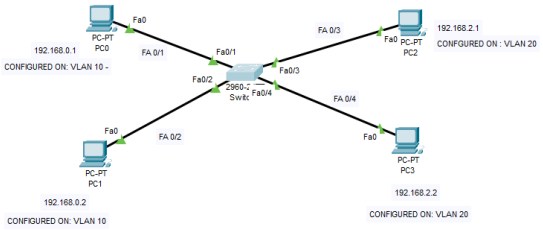

Fig.8 The VLAN test network

Fig.8 presents a collection of 4 PC's paired on different physical networks i.e., PC0 and PC1 on one network and PC2 and PC3 on different physical networks.As a result, paired computers can share a message within themselves but not to the other PCs connected to different physical networks.

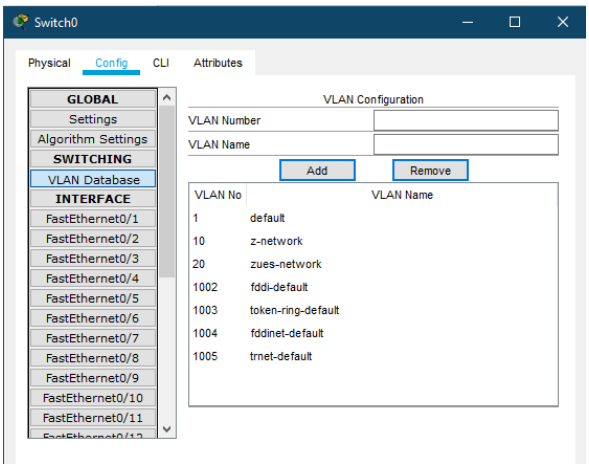

Fig.9 VLAN configuration

This reduces a lot of effort for individual connections and it also won't cause a network

jam for sending / receiving the messages. Fig.9 represents the configuration of two different physical LAN networks that is z-network and zues-network allowing PCs to pair on different networks via single device. Communication between VLANs requires a router.

5. CONCLUSION

Erasmus+ mobility is not only about studies, it gives you experience also information regarding different culture, different lifestyles. You can improve your personal and professional approaches by learning in a mixed environment here. You can adapt different new methods of self-learning. Overall, in short it is really a nice opportunity to enhance ourselves.

Multiple laboratories were completed online at the University of Pitesti. Modeling and Simulation includes using models/ emulators or prototypes and simulate them and learning their functionality. Basics of Artificial Intelligence includes basic understanding of Different Approaches of searching towards a particular problem. Algorithms and Design gives an overview of better programming and also number of ways to solve a program under certain constraints and enhance its performance. Operating systems includes functionality of os like Windows/Linux and how can we work in their environments. Parallel programming includes working on parallel functionality of CPU using threads and increasing its performance.

In the labs presented in this paper we showed that Local Computer Networking studies the interconnection between multiple devices and different methods to communicate within multiple devices via networking under certain protocols/ limitations. The network operation can be simulated in software and virtual laboratories are easy to accomplish.

6. REFERENCES

[1] Success quotes, web, https://www.goodreads.com/quotes/tag/success

[2]. Marwadi University. 360 virtual tour of the college, web, https://www.marwadiuniversity.ac.in

[3] Initial guidelines during lockdown, web, https://www.mha.gov.in/sites/default/files/Guidelines_0.pdf

[4] Indian Express news regarding educational decisions of govt, web, https://indianexpress.com/article/education/gujarat-mass-promotion-ruled-out-for-college-university-students-6344423/

[5] Local Computer Networking, https://web.stanford.edu/class/cs244a/

[6] Routing techniques, web, https://docs.google.com/a/ieee.org/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxsYWJvcmF0b3J1cGl0fGd4OjE3M2YyMGIwNGI5ODQ3NDM

[7] Multimedia streaming, web, https://drive.google.com/file/d/1QsUCmqDMj2WyXgNrpa-ZuM1cSFEzHitC/view?usp=sharing

[8] Spanning tree protocol https://www.cisco.com/c/en/us/support/docs/lan-switching/spanning-tree-protocol/5234-5.html

[9] Windows Server 2012 https://youtu.be/-E1GvdJCoX0

[10] Artificial Intelligence, web, https://cs.calvin.edu/courses/cs/344/kvlinden/resources/AIMA-3rd-edition.pdf

[11] Modeling and Simulation (Matlab), https://www.mathworks.com/

[12] John H. Beigel et al. "Remdesivir for the Treatment of Covid-19 — Final Report", DOI: https://www.nejm.org/doi/full/10.1056/nejmoa2007764

[13] Government of India, Consolidated Guidelines, web, https://www.mha.gov.in/sites/default/files/PR_Consolidated%20Guideline%20of%20MHA_28032020%20%281%29_1_0.PDF

[14] Government of India, Order 40-3/2020, web, https://www.mha.gov.in/sites/default/files/MHAOrder_29042021_0.pdf

[15] Ajay Bhalla, DO40-3/2020DMI(A), web, https://www.mha.gov.in/sites/default/files/MHADOLrDt20052020_0.pdf

[16] DARPA, TRANSMISSION CONTROL PROTOCOL, web, https://datatracker.ietf.org/doc/html/rfc793

[17] DARPA, User Datagram Protocol, web, https://www.ietf.org/rfc/rfc768.txt