**Benchmarking in Communication Network for Distribution Power System -Case Study USM Campus**

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1. **Introduction**

Smart grid is a project that involves many disciplines and that brings many economic, political and legislative challenges of the countries that have decided to implement this technology. One of the main implementations of this technology is related to the stabilization of the load in the Grid that can be impacted by the inclusion of electric vehicles with the energy peaks that occur at the time of loading.

In order to make an adequate administration of the electrical distribution system, an efficient communication network must be implemented, with good measuring metrics and which guarantee the transport of large, medium and large scale information.

For this purpose in this project is going to implement a solution based on 3 layers, and taking as reference one of the last articles that have been published about it, we will evaluate with respect to the latency generated in the proposed architecture, and then we will make an implementation of our proposal to compare according to the measure of the latency that type of architecture works best in this type of evaluation.

1. **Work Related**

In the first work we analyze how the generation of input data is automated in programs to simulate electrical distribution systems,this type of programs allows us to analyze voltage, harmonics, abnormal behaviors, and that can be of great help in order to raise and evaluate different distribution architectures in intelligent nodes.(Tadokoro et al., 2018)

Besides that for the approach of these topics you have to do simulations we also find a job in which you evaluate the high performance of the communications architecture in an electricity distribution system oriented to developing countries, this is very interesting and Chile currently by the G20 is considered a country on the road to development, and this article assesses some items such as quality of service (QoS) and the impact of migrogrid on the type of communications architecture that should be chosen.V(Devidas, Ramesh, & Rangan, 2018)

We take as the main point of departure the following article where an EPCON architecture is implemented for the communication of an electrical distribution system, taking this article as a reference it is interesting to analyze the form of evaluation of the impact and performance and whose results can be compared with those obtained in the next proposal.(Ahmed & Kim, 2019)

One of the main factors leading to this type of studies is the introduction of electric vehicles, and the need that these lead to the communes to charge their batteries, in the following work some methods of optimization are proposed. Inclusion of EVs in the grid (V2G).(Hussain, Brandauer, & Lee, 2018)

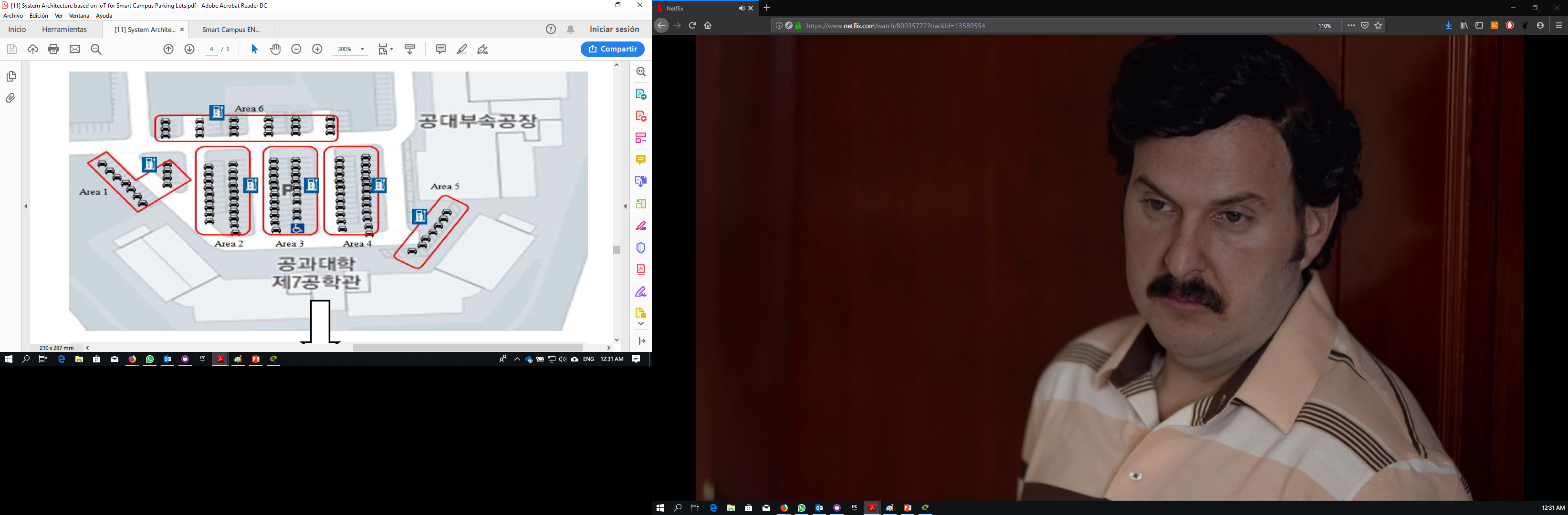
In addition, it is necessary to analyze the configuration of the electrical systems, the novelties that can be implemented to focus on the communication systems and be able to make an evaluation of the results obtained, these systems should be chosen taking as reference the efficiency and stability of the system .(Kim, Cho, & Shin, 2013)

Finally, we will analyze specific case studies, in this case of the Dholera city in India, where they propose the types of distribution systems and their interconnection to communication systems in order to meet the technological requirements of an intelligent city, and where some of the theories related to the communication connection topology that you want to use in this work are confirmed.(Pandya, Velani, & Karvat, 2018)

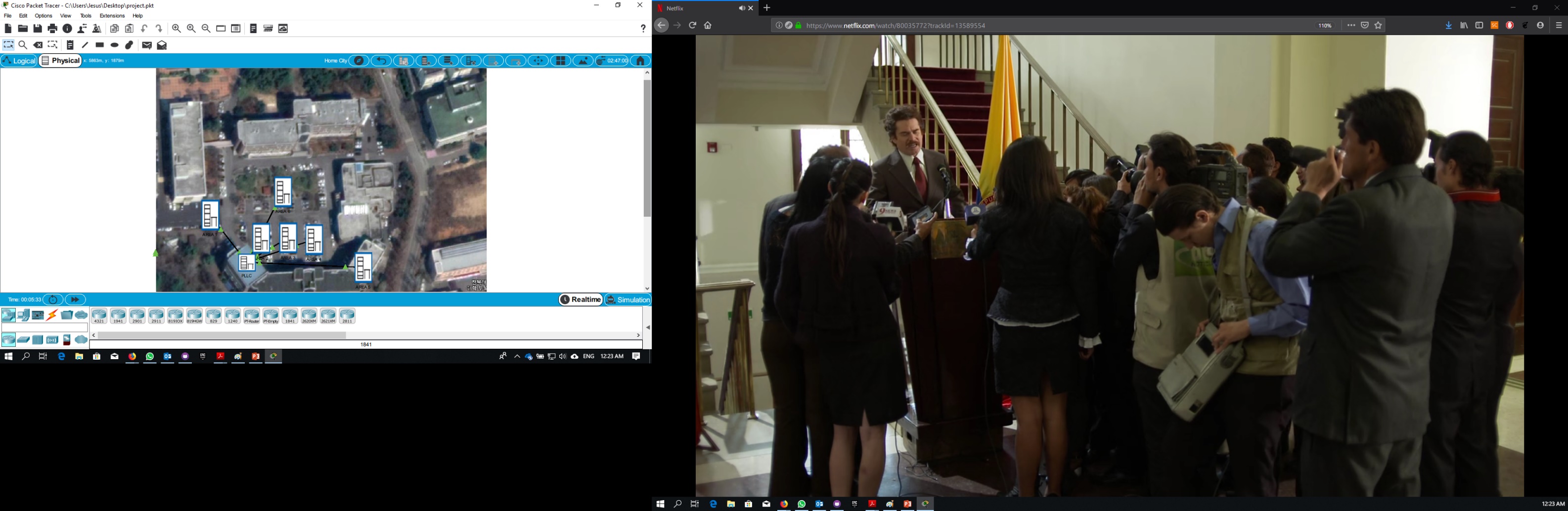
1. **Problem**

In the theory of communication networks there are several topologies that can be implemented in this type of systems, and each can deliver a better result from a subjective evaluation to an indicator, lost, lost packets, bandwidth, transmission capacity, latency , etc.  
In the current literature, a bus-type architecture is evaluated, evaluating the performance with the losses generated in the transmission through fiber optic conductors, with the infrastructure that is proposed, although a fast connection between the elements is allowed, the delay generated by the splitters, as well as forcing the last units to transfer the packages for all the front units, while maintaining the fiber optic technology, we proposed a new star-type architecture with auxiliary concentrators that would significantly reduce the connection latency but with the drawback that if a connection is lost it would be impossible to recover it, unlike a bus connection that allows to detect this type of errors easily.

1. **Benchmarking OPNET**

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**Figure 1. Diagram EPCON**

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**Figure 2. Street view EPCON**

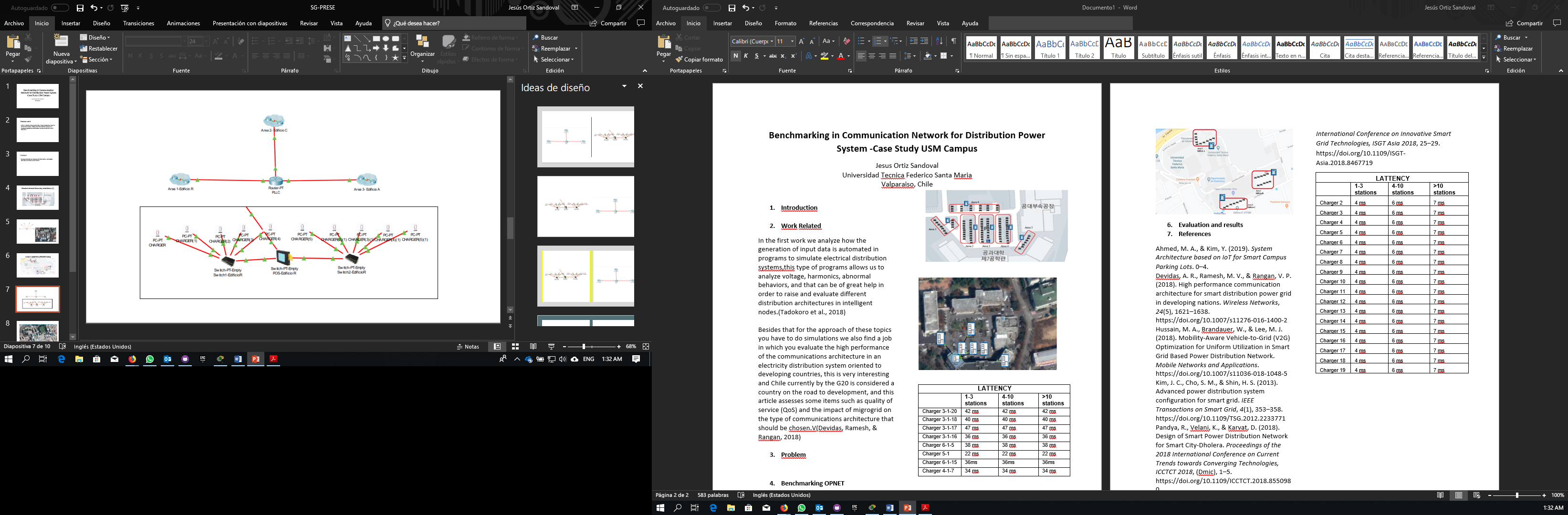
**Table 1. Results OPNET**

|  |  |  |  |
| --- | --- | --- | --- |
| **LATTENCY** | | | |
|  | **1-3 stations** | **4-10 stations** | **>10 stations** |
| Charger 3-1-20 | 42 ms | 42 ms | 42 ms |
| Charger 3-1-18 | 40 ms | 40 ms | 40 ms |
| Charger 3-1-17 | 47 ms | 47 ms | 47 ms |
| Charger 3-1-16 | 36 ms | 36 ms | 36 ms |
| Charger 6-1-5 | 38 ms | 38 ms | 38 ms |
| Charger 5-1 | 22 ms | 22 ms | 22 ms |
| Charger 6-1-15 | 36ms | 36ms | 36ms |
| Charger 4-1-7 | 34 ms | 34 ms | 34 ms |

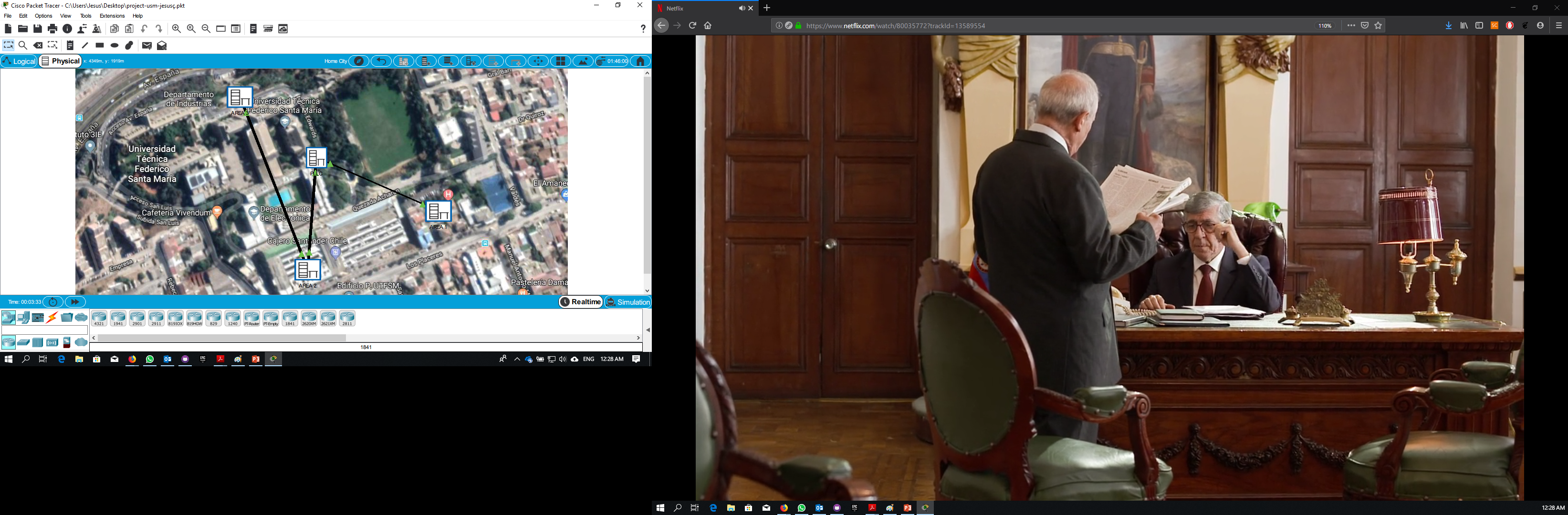
1. **Proposed architecture for the USM Campus**

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**Figure 3. Diagram USM Campus Network**



**Figure 4. CISCO Packet tracer network**

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**Figure 5. Street View Network USM Campus**

1. **Evaluation and results**

**Table 2. Results USM Campus**

|  |  |  |  |
| --- | --- | --- | --- |
| **LATTENCY** | | | |
|  | **1-3 stations** | **4-10 stations** | **>10 stations** |
| Charger 2 | 4 ms | 6 ms | 7 ms |
| Charger 3 | 4 ms | 6 ms | 7 ms |
| Charger 4 | 4 ms | 6 ms | 7 ms |
| Charger 5 | 4 ms | 6 ms | 7 ms |
| Charger 6 | 4 ms | 6 ms | 7 ms |
| Charger 7 | 4 ms | 6 ms | 7 ms |
| Charger 8 | 4 ms | 6 ms | 7 ms |
| Charger 9 | 4 ms | 6 ms | 7 ms |
| Charger 10 | 4 ms | 6 ms | 7 ms |
| Charger 11 | 4 ms | 6 ms | 7 ms |
| Charger 12 | 4 ms | 6 ms | 7 ms |
| Charger 13 | 4 ms | 6 ms | 7 ms |
| Charger 14 | 4 ms | 6 ms | 7 ms |
| Charger 15 | 4 ms | 6 ms | 7 ms |
| Charger 16 | 4 ms | 6 ms | 7 ms |
| Charger 17 | 4 ms | 6 ms | 7 ms |
| Charger 18 | 4 ms | 6 ms | 7 ms |
| Charger 19 | 4 ms | 6 ms | 7 ms |

1. **References**

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