Software defined networking technology utilization in 5g mobile networks

Sociology, Communication

Technology is evolving by leaps and bounds, mainly wireless technology. Every time we are developing better methods to transmit data in large quantities, at a higher speed, in a much safer way and reducing as much as possible the amount of data in the process, as in turn new devices are being incorporated that in a decade we had not imagined that they could be connected to the network, as are electrical appliances, automobiles, industrial machines, among others. This generates the expectation that a new network and connection system will be capable enough to support all these accelerated changes and more, since this is growing. And here is where the 5G system comes in, a very broad leap with respect to connectivity and mobile technologies whose vision is to connect what we can imagine in great capacities and more, but how can we develop a network architecture capable of supporting all these expectations? In this paper we will discuss how SDN can influence, as well as NFV and Network Slicing in the development of a stable and optimal 5G system.

In the next Paper we will not only talk about a general vision of what 5G technology is, specifically 5G mobile networks and other technologies related to this incredible technological advance, which promises us a future of prosperity, capacity and efficiency as we have not imagined , but also there will be a general vision that is Software Defined Network – SDN, the incredible intelligent architecture that promises to solve a large number of requirements that 5G technology is imposing as it is developed to meet the objectives. But this architecture would not be working alone, to provide an even more significant improvement and that fits even more to the requirements that 5G has, we can incorporate NFV-Network Function

Virtualization, virtualizing all kinds of network protocols and work, saying goodbye to the high dependence on hardware and virtualizing everything to software, plus it could also incorporate the Slicing network allowing to generate different networks in the same virtualized center, expanding the horizons and effectively and transparently organizing the trip of the data between the networks generating collision or disappearance of data, as well as prioritizing it to arrive quickly and through a secure channel to the end user.

In addition to seeing how SDN, NFV, Network Slicing are related and see how they can work as a team to create the best environment for 5G systems. It will be explained how SDN can be directly incorporated in 5G with its advantages and disadvantages. And summarize how some SDOs are working on both SDN / NFV and 5G so that this long-awaited future network comes to our hands and as Operators have planned to offer these services in the near future, not only to clients and end-users but also to other companies dedicated to the development of applications, protocols and controllers to generate new alliances and collaborations, reducing at the same time significant costs to offer more accessible network services.

5G Mobile Network

With the passing of time, mobile networks have evolved exponentially, a few years ago it started with the first generation of mobile connections (1G), quickly reaching the fourth generation and soon after giving a leap to the next generation, commercially known as 5G, which has the potential to

drastically transform what we know as the internet and mobile networks. To start 5G is not just a technology, but several technologies combined working together to provide power, speed, decrease in latency, capacity, connectivity and endless features that may arise in the future, since 5G is still a project in development where we continue to explore the capabilities that it has.

Among these technologies we can highlight some of them that are currently under development as they are milimeter waves consisting of the band of spectrum between 30 GHz and 300 GHz. Wedged between microwave and infrared waves, this spectrum can be used for high-speed wireless communications as seen with the latest 802. 11ad Wi-Fi standard (operating at 60 GHz). [13] And that’s where the devices will be connected.

We also have the MIMO technology (Figure 1) which means Multiple-input Multiple-output and consists in the way in which transmission and reception waves are handled in antennas for wireless devices such as routers; in comparison with the traditional wireless transmission method where the signal is affected by reflections, which causes degradation or corruption of the signal and therefore loss of data with MIMO, this type of situations should be avoided, said technology is taken from the hand with Beamforming, since it can be considered as a derivation of it.

Other technologies are Small Cells and Full Duplex (Figure 1). Where Full Duplex allows simultaneous transmission and reception of data, while Small Cells are operator-controlled low-powered mobile base stations and are used mainly in metropolitan areas or with a high density of population and

buildings to increase the coverage of mobile networks to indoor areas where outdoor signals do not penetrate well, or to add network capacity in areas with very dense phone usage as well, this added with Full Duplex the efficiency of transmission and reception of data is much higher without being affected by the physical obstacles and amount of traffic on the network.

With this small description of some very useful technologies in the innovation and improvement of the future wireless technology that can be found in the extensive 5G system, the future of this network architecture must be highly flexible in comparison to the traditional one also facilitating the incorporation of new ones in the future. At the same time allowing the user-mobility handling in the 5G networks while the terminals decide the number of different accesses to the network in a transparent way. In addition, referring to mobile terminals even more, intelligent components will be in charge of deciding which technology will be the most appropriate to establish a connection based on dynamic changes, guaranteeing optimal end-to-end connectivity, because we are talking about in the near future there will be more than 500 times more mobile devices connected in the next few years and the efficiency, speed, capacity, connectivity, robustness and security are key points for success.

SDN – Software Define Network

As it was already understood 5G in general is very complex and consists of different technologies reflecting a complexity in the networks. Flexibility, efficiency and high-capacity solutions that can handle the complexity of

heterogeneous networks must be sought. Therefore with these features Software Defined Network has been a highly voted candidate to help provide solutions to these problems. With its intelligent architecture for the programming of networks, SDN architecture separate the plane of the controller with the plane of the application in a architecture of traditional networks. SDN provides a simple abstraction that helps not only to describe functions, components and protocols to handle the plans, but also provides safe channels for the administration of not only the controller (located in the control plane based on standards) but also the applications located in the Applications plane to perform a efficient orchestration between the Applications to provide the user with the actually data they need in the shortest possible time.

The application plane is now connected to the controller plane through a Northbound interface that provides a level of abstraction necessary to allow the programming of several network level services, such as applications in the control panel . As in turn we can see that between the control plane and the data plane (plane where the devices to which the service is provided) are connected through a Southbound interface. In this area we can highlight OpenFlow as an organization dedicated to the development of standards to provide service in this area under the SDN architecture. Under this centralized structure and constantly updated in the control plane, an optimal administration of the network can be developed, as well as its rapid modification under orchestration and offering systems, which in turn allow the storage of resources in virtualized networks or hosted in the cloud ,

simplifying it and helping to invest time to the devices in the understanding and processing of standard protocols and instructions received by the controllers, in addition to reducing hardware costs and investing in software to now offer services of constant income for use, favoring the operators As it can be understood, we are talking about a drastic change from dependence on hardware to one more dependence on software for administration, and that is why Network.

Function Virtualization (NFV) comes into play. Although they do not depend on each other, the work in team brings a remarkable improvement in the management of networks and together with Network Slicing they form an optimal architecture to support future challenges that the technologies related to 5G bring us.

As you can see, SDN is playing an important role in 5G wireless networks, virtualizing networks for better administration, such as automating and optimizing services created on the basis of virtualized and centralized resources to allow greater implementation of other services and applications.

NFV – Network Function Virtualization

As already mentioned in the previous chapter, NFV consists of virtualizing an endless number of sets of network functions to be deploying in software packages, either locally or virtually as well as in clouds. Providing better accessibility and speed when providing services to other associated operators as users. With this definition we can see what a better teamwork with the SDN architecture looks like. While SDN brings the architecture and

all the orchestration in the network. NFV is in charge of virtualizing everything related to its infrastructures, functions and protocols, giving in turn greater security. And for that we can use as an example the virtualized Session Border Controller [3] which consists of protecting the network infrastructure, avoiding costly and complex equipment.

Because that is another point already mentioned with respect to SDN, the costs. As you well know infrastructure and traditional networks cover a lot of costs such as energy consumption, space, equipment, among others. Since these traditional networks and unitary function are based on hardware. Now that we are talking about increasing the amount of services that our new network will provide to a greater number of users and a greater number of applications and uses. Then you would be talking about an increase of hardware considered to be able to process all these requirements, but when performing virtualization, none of this is necessary, reducing in turn the costs of (CAPEX, OPEX). To give an example of how NFV is made, in Figure 3 can be observed. Where you can see in what kind of hardware are the wide variety of virtualized network functions, showing in turn example of uses. Basically NFV builds an end-to-end infrastructure that unites a wide variety of heterogeneous network devices, hosting network functions in a single dedicated hardware store (example: Servers) Allowing scalability, flexibility and resource management in a more optimal way .

But not only that, as indicated by Akram Hakiri and Pascal Berthou in itself report ’Leveraging SDN for the 5G Networks: Trends, Prospects and Challenges’ – the development of SDN as NFV in conjunction to help the

carrier-grade, providing shipping services based on orchestrated functions of dynamic networks, as well as automated deployment mechanisms to improve their efficiency.

Network Slicing

Network Slicing consists of a type of virtual network architecture very similar to SDN and with principles similar to NFV in fixed networks. Basically we are talking about a third piece, which together with SDN NFV can increase the necessary capabilities so that you can develop 5G technologies with great ease.

While SDN and NFV are now being implemented to provide more network flexibility by allowing traditional network architectures to be partitioned into virtual elements; Network Slicing creates multiple custom virtual networks on top of a common shared physical infrastructure and in order to satisfy only what an application, device or service needs.

To have a better vision of how they are made up, reference is made to Figure 4, where you can see how different Networks Slices are dedicated to the transmission of data in a specific area, providing greater efficiency, speed and decrease in latency at the moment. to send information on the network in specific.

Now that we know your relationship with SDN and NFV, we now impliment it to 5G where in only one network, either physical or virtual, it will be divided into several virtual networks, where different radio access networks (RAN) or

services that are run will be accepted. in the same. But not only that, Network Slicing could provide a large number of new services that 5G will support and, in turn, will place different functionality and performance requirements. Since each Network Slice has an independent set of logical network functions that support the requirements of the particular use case based on Software.

The incredible thing about each Network Slice is that its own network architecture will be individually configured with the capabilities required for its particular use and will be managed by the network operator as possibly the client as well, since it will be administered and independently orchestrated as we saw earlier on the basis of the functionality of the SDN architecture, besides that this particular Slide would be isolated and without any contact with the other pieces of networks, found in the same architecture. With these features not only would improve the security levels in this particular network since to receive an attack could only affect a single Slide instead of a whole set of them in the same architecture. But also connectivity, speed and coverage will be assigned to meet the particular demands of the area assigned to the network.

Currently there are various organizations and companies dedicated to this area in particular, developing Network Slicing for 5G, mainly companies dedicated to the construction of mobile devices as well as mobile network operators, conducting numerous research and development, such as Deutsche Telekom in collaboration with Huawei created in 2016 the first 5G end-to-end autonomous network slicing, teaching how Network Slicing are

created automatically and shared in transport networks, as well as RAN. Or as Huawei and BT Group Extend Strategic Partnership to Focus on UK 5G Leadership, teaching the public the first 5G end-to-end lab testing, delivering consistent 2. 8Gbps downlink throughput and sub-5ms latency.

And as these projects there are endless collaborations between large corporations mainly engaged in telecommunications working on research regarding the great utility that has not only Networking Slicing with 5G technologies, but also its relationship with SDN and NFV.