Review: Handover Implementation in a 5G SDN-based Mobile Network Architecture

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Abstract. *This meta-paper describes the style to be used in articles and short papers for SBC conferences. For papers in English, you should add just an abstract while for the papers in Portuguese, we also ask for an abstract in Portuguese ("resumo"). In both cases, abstracts should not have more than 10 lines and must be in the first page of the paper.*

Resumo. *Este meta-artigo descreve o estilo a ser usado na confecção de artigos e resumos de artigos para publicação nos anais das conferências organizadas pela SBC. É solicitada a escrita de resumo e abstract apenas para os artigos escritos em português. Artigos em inglês deverão apresentar apenas abstract. Nos dois casos, o autor deve tomar cuidado para que o resumo (e o abstract) não ultrapassem 10 linhas cada, sendo que ambos devem estar na primeira página do artigo.*

Introduction

All full papers and posters (short papers) submitted to some SBC conference, including any supporting documents, should be written in English or in Portuguese. The format paper should be A4 with single column, 3.5 cm for upper margin, 2.5 cm for bottom margin and 3.0 cm for lateral margins, without headers or footers. The main font must be Times, 12 point nominal size, with 6 points of space before each paragraph. Page numbers must be suppressed.

Full papers must respect the page limits defined by the conference. Conferences that publish just abstracts ask for **one**-page texts.

Background SDN and NFV

SDN

The SDN (Software-Defined Networking) is a recently concept of network, nowadays the most part of the networks has a distributed control in the their elements. So, with the growth of the multimedia and the increases of flows of data traffic in the world, it emerged necessity to have more control over the network and more mobility in the chooses, the networks need to be more flexible. With this need the SDN was thought to solve some problems in the actual architecture.

The main of SDN is split the data plane (data flow) of control plane (control flow) and centralized all the control of the network in a unique place named Controller. In the SDN, it has a division between APPs, control plane and data plane, it is possible to seen in (Figure 1). The APPs are applications with functions related to security, network management and others, they are responsible to make security and other needs of the network, in the traditional architecture this responsible is distributed in the elements of network, how SDN has more informations about the network, it became more easy to make decisions about the flow paths, to solve congestions and other problems faced in networks.

The control plane is represented by the Controllers, it is responsible to control the switches OpenFlow in according with algorithms and configurations established in APPs. The communication between Controllers and APPs is done through northbound interface. With the Controllers is possible to set all the connections of the switch through software. The OpenFlow switch quoted is a special switch made for to work with SDN networks.

The data plane is represented by the switches, OpenFlow switches is the principal, The communication between Controllers and switches is done through southbound interface. The OpenFlow switches is more simple than traditional switches and its communication and iteration is made through a API. In the traditional switches we have a proprietor systems for each one, it became more complex to implement a network because the systems is much specifically. With the switches OpenFlow the work of switches is more simple and it can be more flexible, because now all the connections can be defined in the software, moreover, it has more freedom to make changes in its, because of the iteration level is higher than traditional switches.

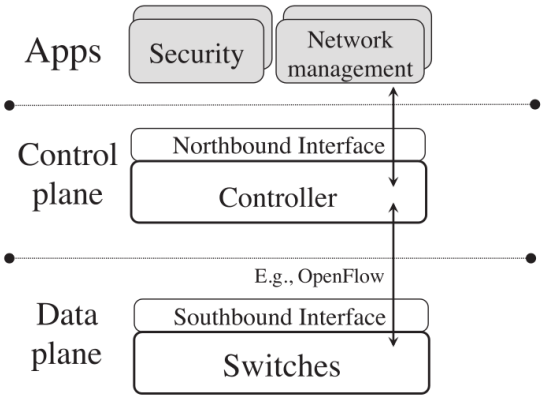

Figura 1. Components of SDN

In the actual architecture, it has the data plane and control plane distributed on the routers, servers, clients ans other elements of the network, with this all the control of network became more complex and hard to manage. The SDN proposed a different way of see the network, it allow to centralize the control of network in a place, with is, it is possible to see all the nodes and connections of the network and to know about everything that occurs, thereby it is possible to do the better actions for to improve the network performance. The picture in (Figure 2) shows a illustrations of the difference between

the networks in a traditional architecture, in a hybrid and using SDN. In a traditional networking, there is the data plane and control plane in all the components of the network, it is distributed. In hybrid networking there is a controller over the traditional networking for to control the switches and elements of the network. In the SDN, there is a clear division between data plane and control plane, the switches has only the data planes and the controller has the control plane.

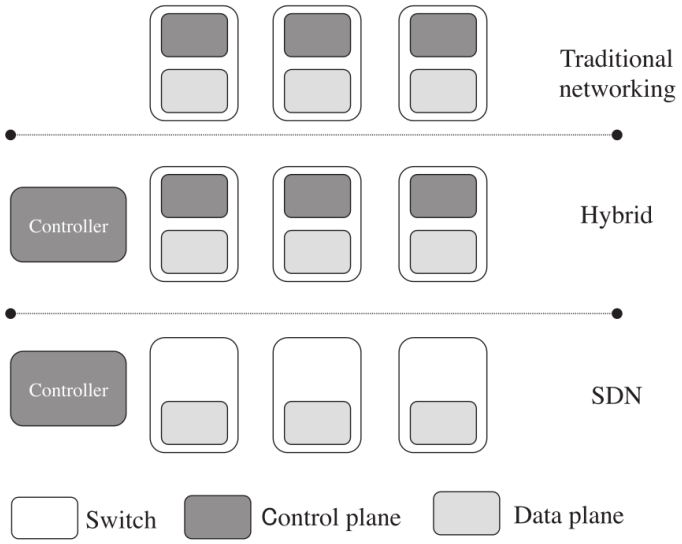

Figura 2. High level illustration of networking paradigms

The OpenFlow is a communication protocol to provide access to switches. Sometimes the OpenFlow concept is confused with SDN, but the concepts are different, the OpenFlow work like a API to make communication between the control plane and data plane. In the picture in (Figure 3), it is a demonstration of the functions of OpenFlow. the OpenFlow controller works in user program to control the switches. In the OpenFlow switch there is a OpenFlow interface for to receive the commands of OpenFlow controller and after the changes are done in the forwarding tables and forwarding path.

NFV

The NV (Network Virtualization) is a newly concept about networks using cloud computing and its resources. With the cloud computing, it became possible to set and use resources distributed in the network in according with the needs of the user. So, the resource is distributed and the control about this is remote and can be more precise and with higher performance than traditional architecture.

With the same idea of NV, emerged the concept o NFV (Network Function Virtualization), this concept is about to emulate into computational resources the elements of the network, like routers, firewalls and EPCs. This is very important to make networks more flexible, scalable and simple to manage.

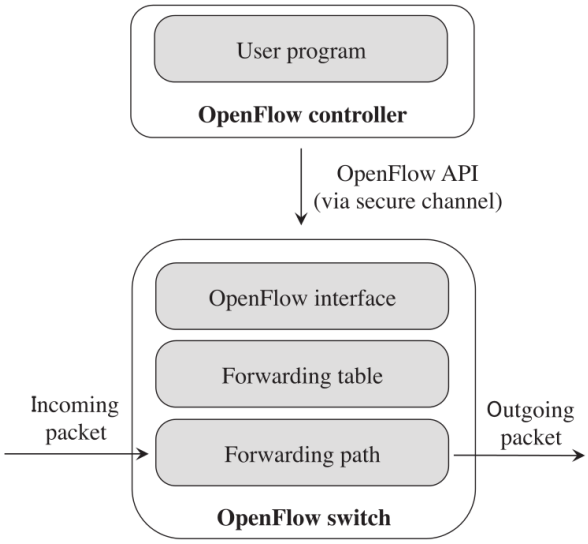

Figura 3. OpenFlow

5G and Mobility

The level of mobility is one of the key issues at the service level. In the 5G system, not all user equipments - UE requires continuous mobility and / or global reach. The level of mobility can be reduced to save network resources and reduce the complexity of the control. Some authors specifies a mobility level control (LoM) requirement in the connected UE state. The 5G system should enable operators to update the level of mobility support provided to a UE, for example, during the establishment of packet data connection.

Thee mobility level can be set in two modes: idle mode and connected mode. The mobility of the sleep mode can be defined for accessibility to the UE in idle mode. Mobility level in connected mode is set to handover level (HO), in this article we focuses on connected mode. To make more plain, handover is a process in telecommunications and mobile communications in which a cellular call or a data session is transferred from one base station to another without disconnecting the session. Cellular services are based on mobility and handover, allowing the user to be moved from one base station range to another or to be switched to the nearest base site for better performance.

In the LTE or 4G mobile system, the network always supports packet lossless mobility. This control overhead is not effective when the number of devices increases tremendously by 5G. In today's network services, most of the application, such as web browsing or chat, does not require seamless mobility. In addition, the application layer has its own mechanism for maintaining the level of application of service continuity. For these services, the network can handle mobility at a lower level than the current 4G system.

The level of mobility control is actively discussed in the 3GPP 5G architecture study. The mobility level (MdA) can be defined in two respects. The LoM of the Area (LoM-A) specifies the area where the UE can have mobility services - RAN, TA, EPC, LTE-5G and non-3GPP. LoM of Continuity (LoM-C) specifies the level of session conti-

nuity - uninterrupted mobility or interrupted mobility. To support the on-demand mobility requirement, the network must have an architecture to update (upgrade or downgrade) the LoM. To support the LoM update of the active session, the UE requests to change the LoM and the operator updates the LoM of the UE, if necessary. Updating the EU LoM-C and LoM-A requires monitoring the status of your application and its location. For example, the smart phone has the Internet messenger that supports the exchange of text messages and voice / video calls. When the user exchanges text messages, the UE does not need to support continuous mobility. But as soon as the UE invokes the voice / video call, continuous mobility is required. Depending on the state of your application, EU must request the LoM update for the network. Similar scenario for updating LoM-A can also be found.

Therefore, 5G network system must support multiple levels of mobility. For the connected mode mobility level, the HO level must be defined in two respects - continuity level and area level - and both aspects must be dynamically controllable - that is, the mobility level can be updated or degraded dynamically. The network architecture must be designed to satisfy the flexibility of control.

Related Works

In the context of future mobile networks , SDN and NFV concepts are present in almost all recent proposals in reason of the improvements on energy consumption,flexibility and cost. The difference of implementation approach, applied areas and the transition from legacy architectures to new paradigms are the main differences between them.

Some authors recomend a smooth and careful transition from the current networks to the future ones, as an example, adopting a 3-step approach trying to reduce the devaluation of the legacy network structure. In other hand, several authors are paying attemption to the mobility support in a SDN-based architecture through removing the GTP-U protocol at UP, keeping the 3GPP unchanged and the use of legacy nodes or focusing in the mobility handling trying to find implementation challenges like session continuity.

Subsections

The subsection titles must be in boldface, 12pt, flush left.

System Architecture

The architecture proposed in the work is a 5g mobile network for the AC(Acess Cloud) whith partial virtualization and SDN-based UP, this scenario is made by implementing the LTE CP as NFVs and running it in a logically centralized data center.

In the work, the virtualized LTE control network design is based in a 1:N mapping architecture, so they are split in 3 components : front-end(FE), service logic(SL) and state database(SD). The FE is implemented with an OF(Open flow) switch and its functions are serve as a communication interface with other network entities and balance the load of SLs. The SL is stateless and its function is implement the of control messages, finally the SDB is responsible for store the user session state(allowing the statless of SL) and that is the reason why the SL number can grow without affect the in-session users.

In the AC there is SDN controller that acts as an interface between LTE CP and UP. As na example, the vS-GW interact with the Controller through NorthBound API and the UP switches are controlled by the switch through the Southbound API.

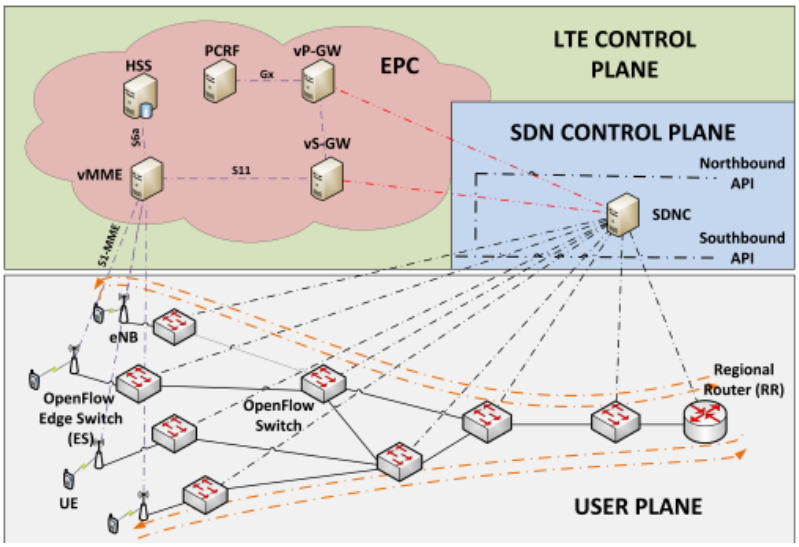

Figura 4. System Architecture

Handover Procedure

Section titles must be in boldface, 13pt, flush left. There should be an extra 12 pt of space before each title. Section numbering is optional. The first paragraph of each section should not be indented, while the first lines of subsequent paragraphs should be indented by 1.27 cm.

SDN-Based Mobility Support

Section titles must be in boldface, 13pt, flush left. There should be an extra 12 pt of space before each title. Section numbering is optional. The first paragraph of each section should not be indented, while the first lines of subsequent paragraphs should be indented by 1.27 cm.

Results and discussions

Section titles must be in boldface, 13pt, flush left. There should be an extra 12 pt of space before each title. Section numbering is optional. The first paragraph of each section should not be indented, while the first lines of subsequent paragraphs should be indented by 1.27 cm.

Conclusions

Section titles must be in boldface, 13pt, flush left. There should be an extra 12 pt of space before each title. Section numbering is optional. The first paragraph of each section should not be indented, while the first lines of subsequent paragraphs should be indented by 1.27 cm.

Figures and Captions

Figure and table captions should be centered if less than one line (Figure 5), otherwise justified and indented by 0.8cm on both margins, as shown in Figure 6. The caption font must be Helvetica, 10 point, boldface, with 6 points of space before and after each caption.

Figura 5. A typical figure

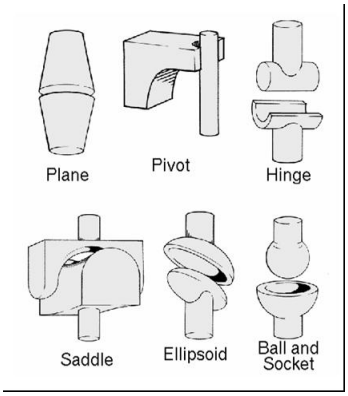

Figura 6. This figure is an example of a figure caption taking more than one line and justified considering margins mentioned in Section 10.

In tables, try to avoid the use of colored or shaded backgrounds, and avoid thick, doubled, or unnecessary framing lines. When reporting empirical data, do not use more decimal digits than warranted by their precision and reproducibility. Table caption must be placed before the table (see Table 1) and the font used must also be Helvetica, 10 point, boldface, with 6 points of space before and after each caption.

Tabela 1. Variables to be considered on the evaluation of interaction techniques

	Value 1	Value 2
Case 1	1.0 ± 0.1	$1.75 \times 10^{-5} \pm 5 \times 10^{-7}$
Case 2	0.003(1)	100.0

Images

All images and illustrations should be in black-and-white, or gray tones, excepting for the papers that will be electronically available (on CD-ROMs, internet, etc.). The image

resolution on paper should be about 600 dpi for black-and-white images, and 150-300 dpi for grayscale images. Do not include images with excessive resolution, as they may take hours to print, without any visible difference in the result.

References

Hamid F, HyunYong L and Akihiro N, 'Software-Defined Networking: A survey', Computer Networks, 2015.

Garzon J, Adamuz-Hinojosa O, Ameigeiras P, 'Handover Implementation in a 5G SDN-based Mobile Network Architecture', PIMRC: Mobile and Wireless Networks, 2016