A Theoretical Architecture for TM Through Software Defined Mobile Network in 5G Environments

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Abstract. The 5th generations of networks have been evolved to satisfy the enormous growth of the user's requirements. To achieve the user's requirements and to assure the QoS, the traffic management (TM) of data transmission must be considered with the different network architectures. Thus, this paper presents using Software Defined Network (SDN) as well as Software Defined Mobile Network (SDMN) for (TM) purposes. Additionally, this article has analyzed the recent contributions of SDN and SDMN regarding TM within 5G environments. Moreover, we have proposed a theoretical architecture for the mobile TM systems through the SDMN controller. This architecture allows us to improve the performance enhancement through loading TM. Thus, benefits and challenging points of the proposed architecture have been presented.

Keywords: TM · Software-defined multiple access · 5G networks

1 Introduction

The massive usage of internet applications and data transportation have required tremendous demand of TM solutions. However, with the spread of various raising systems and tools, there are enormous needs for controlling the data TM. In fact, several technologies have been developed for handling traffic issues. However, some of them were not applicable for different scenarios. Traffic applications assist in managing the best service delivery requirements. Thus, each application should be able to evaluate the needed service and determine the priority behaviors. Therefore, many attempts have discussed the possible solutions to managing the massive traffic caused by large data transmissions through 5G networks. The remainder of this paper is structured as follows. Section 2 gives a brief synopsis of the relevant literature review. Section 3 covers the previous works of SDN, as well as SDMN. Furthermore, the analytical discussion is presented in Sect. 4. Consequently, a theoretical architecture has been presented in Sect. 5 for the TM using SDMN in 5G networks. Finally, the conclusion is presented in Sect. 6.

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2 Literature Review

The term of TM can be applied to any system that permanently works for large numbers of users under different circumstances. Thus, this section briefly covers different ideas that are using TM applications in different scopes. Thus, authors in [1] have proposed fair downlink TM for enabling cell-load based on service differentiation with huge respect to the performance of different Wi-Fi networks. However, another trend has been evolved for the cloud TM. This trend has considered the importance of managing the convergence between multi-networks as in [2]. Though LTE networks have faced the traffic issues, several systems were proposed to assure reliable and efficient practices [4].

3 State of the Art

Due to the enormous applications in the increasing environments, data TM has raised as a new challenge for dealing with required network specifications. However, researchers have proposed several solutions based on their network design needs for enabling the best possible of QoS. Despite many solutions, we have studied that the TM will be better with following network and multiple access schemes.

3.1 Software Defined Network (SDN)

Mostly, SDN was proposed for enabling perfect control of network features [8] as well as for good content delivery. Other attempts are focused on the quality of service as [10, 11]. Intensely, another approach was developed in [12] for Industrial Internet of Things IIoT with excellent use of SDN. Over again, resource allocations are investigated [13]. Although, authors [14] have analyzed the shortages of current solutions, especially in data centers by proposing flexible programmability solutions.

3.2 Software Defined Mobile Network (SDMN)

Truthfully, mobility issues and features have attracted researchers in the network designing. Thus, they have increased network capabilities as in [15, 17]. However, others have used different technologies with SDMN traffic in heterogeneous networks as [16, 21]. Nonetheless, some attempts are focused on security issues [18, 19, 21]. Although, authors [22] have proposed an interference graph as an abstraction of the control. But, authors in [23] have addressed using SDN for controlled LTE network testbed with management applications.

3.3 Non-Orthogonal Multiple Access (NOMA)

Initially, NOMA is appeared to solve the access traffic problems. However, it has achieved higher loading factor. But, some approaches have investigated performance capabilities by using NOMA as in [5]. Specifically, several attempts were focused on

NOMA in LTE networks such as [6]. Recent tendencies have concentrated on energy power allocations by enabling more capacities of QoS for energy saving [7, 23].

3.4 Software Defined Multiple Access (SoDeMa)

In fact, the term of SoDeMA has been proposed for different purposes which are not only to replace NOMA but also improve the programmable capability in TM. However, it provides the main features in which several users, accessing schemas can be accepted for satisfying different services and users of different applications within 5G networks. In fact, SoDeMa has borrowed some features from NOMA but with borrowing Software Defined Radio (SDR) for multiple access schemas [25]. Thus, the use of either NOMA or SoDeMA can be chosen based on the required services capabilities. Figure 1 below illustrates the main design and use of SoDeMA [25].

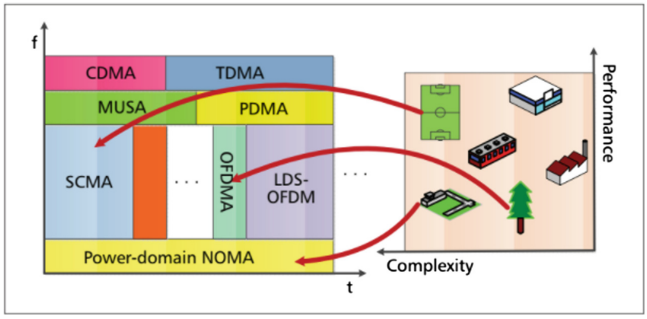

Fig. 1. SoDeMa design as presented in [25]

4 Theoretical Architecture of TM System Through SDMN in 5G

The network design plays an important role in enabling efficient TM system. Recently, several models have been proposed as architecture designs. However, they have not addressed the enormous demand for mobile solutions. Thus, this paper addresses this challenge for enabling the wider spread of mobility choices of TM systems. Thus, the mobility has been considered in this model for enabling more flexibility and usability cases. In fact, this feature is thoroughly fascinated to satisfy the continuous improvements in the mobile-based services.

The traditional SDNs have limited enabling the mobility for TM phases because of static deployments. Thus, this approach improves the mobile features for the heterogeneous networks to enable as much as required services. In fact, this architecture reduces the user's handovers since it balances the traffic loads. Initially, the loading traffic is earlier maintained before accessing the needed service. On the other side, this architecture has enabled the mobility feature for the traffic managers but, it has raised more investigations of the handover optimization mechanisms. As well as, the efficiency of interference management has required potential attentions for handling the

interference issues between large numbers of users. Furthermore, this scheme requires more investigations of the network applications side to assure the fairness and his quality of service. Moreover, energy efficiency requires more attention for future deployments. Over again, the mobility management handovers should be considered before applying this schema. Finally, more security practices are required to enable secure systems with the best possible of TM (Fig. 2).

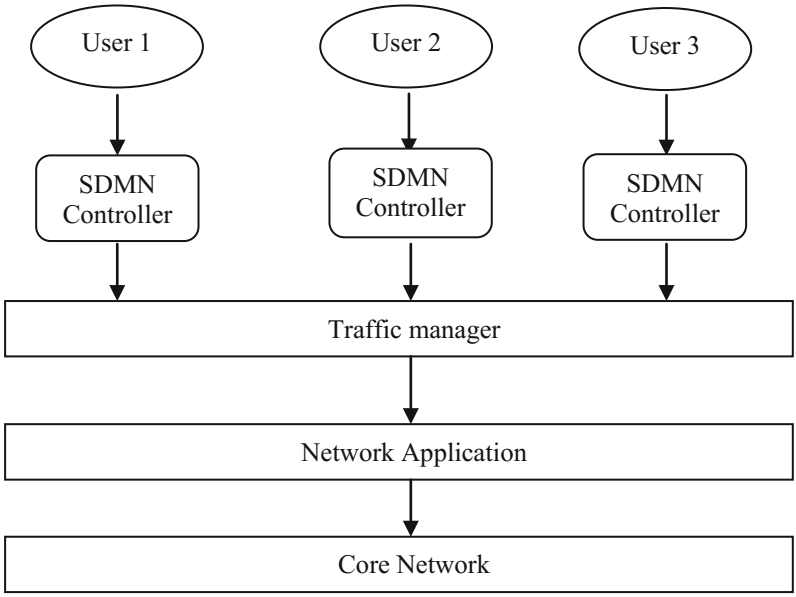

Fig. 2. The proposed architecture for TM through SDMN controllers

5 Analysis

In fact, previous works have covered many aspects of TM on 5G networks. However, different technologies have been used for meeting the requirement of the coming generations. Thus, these solutions have touched issues to solve them regarding increasing networks and number of users. Therefore, a comparison table of previous SDN works has been provided for continuous researcher's interests. Hence, these works have been classified under several considerations. In fact, these contributions have been classified based on the specific matters of their participated works. Thus, it has mainly focused on these contributions with their benefits to SDN and SDMN regarding TM solutions. An example of works that have discussed the energy efficiency can be seen in [9, 19]. However, mobility issues with performance enhancement were discussed in [24, 25] (Table 1).

Table 1. Comparison table of TM works with SDN and SDMN including covered points of these works.

Reference number	Energy efficiency	Performance enhancement	Content delivery and QoS	Mobility supporting	Security issues
[9]	✓	✓	X	X	X
[11]	X	✓	✓	X	X
[19]	✓	✓	X	X	X
[20]	X	✓	✓	X	X
[25]	X	✓	X	✓	X

6 Conclusion

In this paper, we have studied the TM with various network architectures and multiple schemes influenced by 5G networks. Further, we have proposed the theoretical architecture based on SoDeMa for TM. However, this paper has concluded that the TM can be more efficient when enabling flexible mobile controller among different users. Also, they are some restrictions of this architecture such as the interference management as well as the handover optimization mechanisms.

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