Congestion Control in 5G Network

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Abstract : In order to cope with explosive growth of data traffic which is associated with a wide plethora of emerging application and services that are expected to be used by both ordinary users and vertical industries, congestion control mechanism is considered to be vital. In this paper, we proposed a congestion control mechanism that could function within the framework of Multi-Access Edge Computing (MEC). The proposed mechanism is aiming to make real time decision for selectively buffering traffic, while taking network condition and Quality of Service (QoS) into consideration. In order to support a MEC-assisted scheme, the MEC server is expected to locally store delay-tolerant data traffics until the delay conditions expire. This enables network to have better control over the radio resource provisioning of higher priority data. To achieve this, we introduced a dedicated function known as Congestion Control Engine (CCE), which can capture Radio Access Network (RAN) condition through Radio Network Information Service (RNIS) function, and use this knowledge to make real time decision for selectively offloading traffic so that it can perform more intelligently. Analytical evaluation results of our proposed mechanism confirms that it can alleviate network congestion more efficiently.

Keywords—MEC, Congestion control, traffic management, QoS, SDN.

I. INTRODUCTION

In The vision of future Fifth Generation (5G) systems is to enable service delivery in ultra-dense networks. Particularly, always-connected devices, such as various types of smart phones, tablets, video-game consoles, Virtual/Augmented Reality (V/AR) devices and wearable electronics impose significant pressure on the backhaul and access networks. Moreover, the emerging Internet of Things (IoT) and massive Machine Type Communication (mMTC) are expected to introduce a huge number of machine connections [1]. In this context, serious performances degradation in terms of QoS and/or Quality of Experience (QoE) is inevitable especially for the services with strict QoS requirements. Nevertheless, in such challenging environments, traffic bottlenecks in the core and backhaul networks can be reduced by locally processing data intensive task at the edge of the network in proximity to end devices.

Mobile Cloud Computing (MCC) was introduced to deal with challenges of diverse and complex mobile service and application in terms of processing and data storage constraints in addition to battery lifetime, memory limitation and computational power of end-devices [2]. MCC augmenting the resource capabilities of mobile devices by acting as an Infrastructure as a Service (IaaS) for data storage and processing. However, the MCC also imposes huge additional load both on radio and backhaul of mobile networks and introduces high latency since data is sent to powerful server that is far away from the users [3].

To address the problem of long latency, the cloud lservices should be moved to a close proximity of the end users, i.e., to the edge of mobile network as considered in newly emerged edge computing paradigm. The edge computing can offer significantly lower latencies and jitter, mainly because the computing and storage resources are in proximity of the mobile users. Moreover, edge computing could exploit the contextual information for provisioning the network congestion states. This could indeed be achieved by combining MEC based application platform with the communication and context services that could be provided by potential 5G technologies [4].

The European Telecommunications Standards Institute (ETSI) standard on MEC [5] may play an important role in this direction. MEC, as a key 5G network enabling technique, allows leveraging the cloud computing power by deploying application services at the edge of the mobile network. This can facilitate content dissemination within the access network. A key component for enabling MEC are servers integrated within the operator’s RAN (e.g., 3GPP, Wi-Fi or small cells). MEC opens the door for authorized third parties, such as Content Providers (CP), to develop their own applications hosted in the MEC servers. These applications can add the flexibility to handle the traffic from/to mobile users. Besides, operators can expose their RAN edge Application Programming Interface (API) to authorized third parties to provide them with radio network information in a real-time manner.

II. LITERATURE SURVEY

Saba Al-Rubaye, et al. [21] proposed new handoff schemes to reduce the interruption time that occurs during re-connection of an arriving mobile user moving from macrocell to small cell or from small cell to macrocell domains. A new call admission control (CAC) function is developed to adjust thresholds during handoff request signaling. To perform the handoff operation, Markov chain technique is used to analyze the call blocking probability characteristic and subsequently to decide handoff approval for various subscriber requests. Numerical results show that the proposed admission control mechanism is able to minimize call blocking probability, without sacrificing resource utilization, and to reduce the number of service interruptions occurring during user re-connections.

Ben-Jye Chang, et al. [22] proposed a cross-layer-based adaptive TCP algorithm to gather the LTE-A network states (e.g., AMC, CQI, relay link state, available bandwidth, etc.), and then feeds the state information back to the TCP sender for accurately executing the network congestion control of TCP. As a result, by using the accurate TCP congestion window (cwnd) under a high interference LTE-A, the number of timeouts and packet losses are significantly decreased. Numerical results demonstrate that the proposed approach outperforms the compared approaches in goodput and fairness, especially in high interference environment.

Bin Han, et al. [23] introduced an innovative set of enablers and algorithmic designs for intelligent slice admission and congestion control in future 5G networks. The proposed architecture is capable for coherence with existing ETSI and 3GPP architectures, making it competitive in 5G pre-standardization. The algorithms are demonstrated as effective by numerical simulations.

Yi Liang, et al. [24] focusesonthe congestion control inside 5G distributed base station. They had build network topology according tothe real network and select 5G data sources with different priority and high frequency burst. Then designed simulation module based onNS-3 simulator. The quantized congestion notification (QCN) protocol isa congestion management mechanism based on feedback. There isnochipto support theQCN protocol at present. Therefore, itis necessary to simulate the performance ofQCN protocol in5G networks.

Richard H. Middleton, et al. [25] discussed the importance of delay characteristics, when the new 5G wireless networks are used to carry application data for feedback control systems. The effects of delay and delay variation on the stability, performance and computational complexity were treated, resulting in a set of basic requirements that support a successful deployment. It was also shown how a new delay skew controller can be used to align these delay characteristics, between the different transmission paths of 5G dual connectivity.

Kaouther Taleb Ali, et al, [26] proposed an algorithm to improve this method based on load balancing mechanism and a dynamic ACB factors, according M2M traffic category with respect to their access delay. Simulation results were done for testing the effectiveness of our proposed mechanism and show that using a base station selection method and tacking into account differentiated M2M services can increase the access success probability and reduce Access delay especially for devices with high priority traffic while satisfying the load balancing between Base stations (BS).

III. OBJECTIVE AND PURPOSE

Objective:

1. Congestion Control
2. Improves Resource Utilization
3. Improve Throughput
4. Reduce Delay Time
5. Remove noise from Communication
6. Reduce PACKET LOSS

Purpose:

The main purpose of this system is to avoid congestion from network and improve the speed of communication.

IV. PROPOSED SYSTEM

In this paper, we propose a congestion control mechanism in MEC context for reducing RAN congestion. The key idea is delaying of DT content from being delivered, until the delay conditions expire. This mechanism driven by the following two context factors: i) the characteristic of data traffic (i.e., delay-tolerant data traffics) and ii) the network conditions (i.e., sudden traffic peaks).

We consider a heterogeneous mobile network orchestrated by the SDN framework which is fully integrated with MEC [22]. This network is composed of Macro-cell Base Station (MBS), Small Cells (SC) and Mobile Node (MN). The MBS provides full coverage to subscribed MNs. The SCs are distributed within the MBS area to provide ample capacity to the few MNs within range. The system overview of this network is illustrated in Fig. 1. In this work, the ETSI MEC [5] is considered as reference framework. It is assumed that there is a tight integration between SC and MEC in a way that a group of SCs are equipped with MEC server. Accordingly, MEC acts as an intermediate server so that DT contents can be temporarily stored and forwarded at later times. This significantly mitigates RAN load and improves resource utilization. Besides, the MEC server actively interacts with SDN through an API interface to facilitate traffic redirection. Additionally, we assume that the core network entities have some capabilities, which would enable them to classify traffics and then, based on the QoS requirements, assign a deadline (i.e., a maximum delay it can wait for) to each DT traffics [6].

Following Figure shows the block diagram of proposed system.

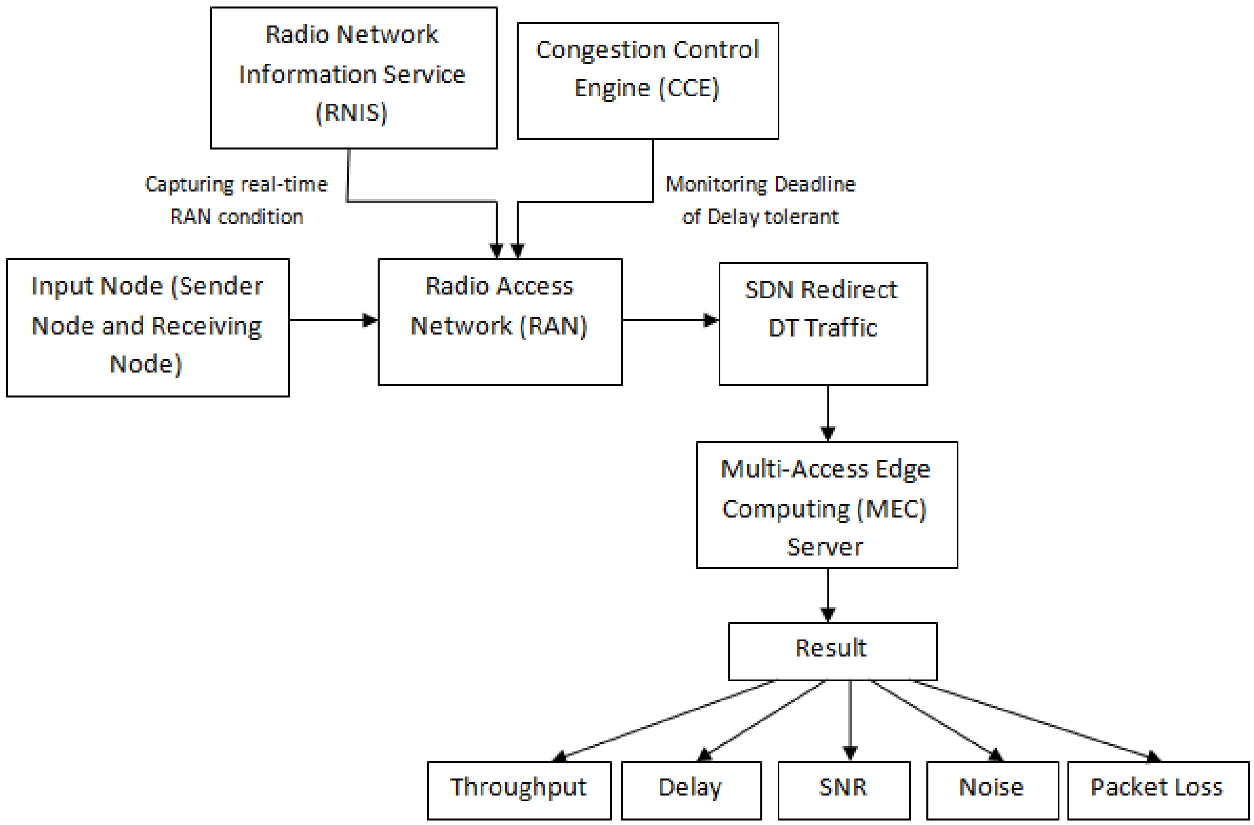

Fig.1: Block diagram of Proposed System

1. Input

Here we are passing input nde to the system i.e. Sender node and Receiving node.

2. Radio Access Network (RAN)

The congestion of Radio Access Network will be monitor. Our system will be used to avoid the congestion control from RAN. The congestion will be monitored through two different modules as bellow.

3. Congestion Control Engine (CCE)

CCE capture Radio Access Network (RAN) condition through Radio Network Information Service (RNIS) function, and use this knowledge to make real time decision for selectively offloading traffic so that it can perform more intelligently, which takes the RAN context information into account and perpetually monitoring the deadline of DT contents.

4. Radio Network Information Service

RNIS is an cloud service which is responsible for capturing real-time RAN condition.

5. Software Define Network (SDN)

For each successive time the network is found to be congested, SDN redirect the Delay Tolerant content to MEC storage where the content will be stored.

6. Multi-Access Edge Computing (MEC)

MEC acts as an intermediate server so that DT contents can be temporarily stored and forwarded at later times. This significantly mitigates RAN load and improves resource utilization. Besides, the MEC server actively interacts with SDN through an API interface to facilitate traffic redirection.

7. Congestion Control Mechanism

The goal of the proposed congestion control mechanism is to alleviate network congestion while makes better use of available network resources. A distinctive characteristic of our approach is that the MEC is playing an active role in this mechanism. The key idea is to intentionally delay DT content from being delivered and buffer it through an intermediate cloud server, with the goal of reducing RAN congestion, particularly during traffic peak hours.

We take advantage of RNIS cloud service introduced by ETSI, which is responsible for capturing real-time RAN condition. In addition, a dedicated function known as Congestion Control Engine (CCE) is proposed, which takes the RAN context information into account and perpetually monitoring the deadline of DT contents.
With the proposed mechanism, a DT content is delivered depending on the network condition and their associated deadline. To illustrate, consider a situation that the network is overloaded, an operator can deliver DT content to an interested MN by temporarily storing content in MEC. In this context, the content will be transmitted to intended MEC over the backhaul and buffer it there until the congestion ratio is reduced under acceptable threshold or before the deadline expires.

Following are the steps for proposed work:
1) Packet inspection: the network traffics are classified and then, each DT content assigned with a deadline based on their delay constraint.
2) Congestion detection: in order to identify RAN congestion, CCE constantly monitors RAN condition and in the case of congestion, it provides feedback to SDN.
3) Redirection & buffering: for each successive time the network is found to be congested, SDN redirect the DT content to MEC storage where the content will be stored.
4) Content delivery: to capture the fact that buffered content may have a different deadline, CCE is monitoring the deadline of the content perpetually. If the deadline of a DT content is approaching, then the contents will abandon the storage and transmit to encountered requesters, immediately. Otherwise, the content is kept until the RAN congestion is reduced to an acceptable level. The output of system will get in terms of improved throughput, reduce noise, decreased delay time, avoid packet loss and signal-to –noise ratio.

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