QoS Techniques in Multimedia Cellular Network

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The literature review chapter analyses the studies relevant to the research topic. It investigates the techniques applied in the 4G LTE, covers the issues related to data and multimedia transmission, characterized QoS and resource allocation.

A 4G network is a self-organizing network that is known for its scalability, cost-effectiveness, distribution, and ability to share cooperative resources. 4G LTE development has increased the data transmission and has enabled the support of different services including video, data, voice, and multimedia. It encourages Service Providers (SPs) to implement numerous real-time applications (Reddy & Varadarajan, 2014). It has been found that there exist different wireless mobile technologies and applications of 4G LTE. Nowadays, cellular wireless networks have been experiencing the growing demand for bandwidth-intensive multimedia applications. Therefore, the quality of service (QoS) provisioning is an essential issue that requires investigation.

Literature analysis has shown that there are several factors that affect QoS in 4G LTE. The first factor is latency; it is referred to as time to delivery and means the time from the event publishing by a publisher and a subscriber to the time when the event notification becomes available. Reddy and Varadarajan (2014) stated that “the overlay network must effectively reduce the overall latency of event notifications” (p. 86). Latency is also defined as delay. The second factor is bandwidth; it represents the available resources across a path during event transfer and indicates the events transferred between the subscriber and a publisher per certain amount of time. Reliability is another factor that affects QoS. It represents the error frequency that occurs on the network. Buffer cache ratio is essential in the transmission of data packets through the node. The fourth factor is packet-loss; it is the inability to be received by the destination. CPU speed is one more factor that is responsible for the control of the traffic factors at different periods of time. Availability capacity is closely associated with the bandwidth and determines the availability of numerous data transmission channels. Memory size is essential for the heavy traffic and time delays (Reddy & Varadarajan, 2014).

The main techniques for QoS provisioning in wireless cellular network include buffer and queue management, call admission control, cross layer design, bandwidth reservation, and the allocation of the distributed dynamic fault tolerant channel. QoS guarantees that: 1. before handoff, a mobile node detects the new network signal; 2. during handoff, a mobile node negotiates QoS through the interface of a new network; 3. after QoS negotiation, a mobile node ensures sending out a mobile IP Registration. Then, a mobile node may break into previous network connections. A better QoS experience is usually achieved through the transferring of the ongoing sessions to the new network.

The provision of QoS for the applications of mobile multimedia needs the support of protocols, architectures and applications to enable the access to the multimedia data. Multimedia transmission should be of low delay, low error rate, high bandwidth, and small delay variance. It was found that most researches related to the QoS at the network layer focus on the QoS routing that determines the delivery flow path in terms of the network resource availability and the QoS flow requirements. It is suggested that a new QoS measurement for data and multimedia transmissions is achieved taking into account the delay sensitive and heterogeneous applications. Such measurements assist in scheduling (Reddy and Varadarajan, 2014; Ansel, Ni, & Turletti, 2006).

Carnerio, Ruela, and Ricardo (2004) carried out a research to overview the issues related to the IP wireless mobile terminals. The scientists presented a simple framework for studying and solving 4G LTE problems through the Cross-Layer design. Their framework was first classified in the coordination planes such as QoS, Security, Mobility and Wireless link. It was stated that security-related problems usually arise from multiple-layer encryption that occurs with the consumption of unnecessary power and processing delay. As a rule, QoS problems negatively influence flows with QoS requirements and result from the link layer ARQ and the control of layer congestion. The research analyzed the mobility problems related to the handover effects on the connections of transport layers and QoS signaling.

Analysis of relevant literature has shown that most wireless problems caused by losses and packet tend to be TCP perceived. It is explained by the fact that congestion indications result in poor performance. The solution to these problems may be achieved through the implementation of an interlayer coordination model that consists of a Cross-layer manager and performs management algorithms. Sanjay, Shakkotai, and Karlson (2003) stated that the advantages of Cross-layer networking are real and will continue to be essential. Coordination of a Cross-layer among different layers may be facilitated through different message interfaces including Inter Signaling Pipe (ISP), Application Programming Interface (API), and Internet Control Message Protocol (ICMP). It is possible to utilize a common control mechanism to assist the discovery of an access network, vertical hand off, and location management (Kawadia & Kumar, 2005). However, the literature analysis has shown that the common signaling problem may be solved thought the use of an overlay structure on existing BS /APS.

According to Hoshyar, Wathan, and Tafazolli (2010), the Orthogonal Frequency Division Multiple Access (OFDMA) is one of the most interesting modern broadband communication techniques. In OFDMA, each sub channel has a different performance; therefore, the transmitter has to have a clear understanding of the channel quality. The scientists emphasized the fact that efficiently can convert a selective channel of a broadband frequency into easily equalized flat fading sub channels. Advanced multiple antenna technologies allow 4G cellular technologies to get the leading data rates over the air interface. Although 4G networks can utilize OFDMA, it is not able to deliver the expected 4G system superior throughput; therefore, antenna techniques are essential as they increase spectral efficiency.

Analysis of relevant literature has shown that multiple antennas enable the achievement of significant improvements related to lower power consumption and lower signal losses, improved coverage, increased data rates, and others (Li, Todd, & Zhao, 2005). The key function of multiple antenna techniques is to send the same signal on multiple channels; the signal should be sent through air. In addition, the technique deals with the sending of the signal energy in one direction.

The standards of modern wireless communication are dynamic enabling the choice of options available within the same standard. Hoshyar, Wathan, and Tafazolli (2010) stated that the techniques of the Multiple Input Multiple Output (MIMO) are the most typical example found in within the LTE technology. This standard allows choosing among 13 different implementation options. In the modern wireless systems, each operator should have an internal R&D department and engineers to investigate the scenario conditions, service characteristics, user's profiles, etc. This enables numerous research groups to suggest new strategies and techniques to improve the current systems of wireless communication.

Kibira and Jamalipour (2007) analyzed the key Next Generation Mobile Network (NGMN) issues that may occur in multi traffic environment. It has been found that there is a shift of the cross-layer paradigm; it happens in hand with the evolution of wireless communication. Another research was carried out by Zhang, Todd, Zhao, and Kezys (2006) who investigated the

Software Defined Radio (SDR) as it is essential for the access to network independent services for 4G networks. According to the authors, it is possible to get a higher data rate through the modification of radio and core network. It will enable renewing the emerging networks for the seamless connectivity.

Researches show that the level of QoS is usually decreased during the process of handover. At the same time, the resource allocation during the handover process can be easily optimized through the combination of two protocols and mobility management. Increased popularity of mobile devices, multimedia applications, and wireless networks makes the QoS provision for multimedia services in the environment of mobile computing a challenging task (Boggia, Camarda, Grieco, & Mascolo, 2007). QoS provisioning has the functions of control place and data plane. It has been found that the QoS support is one of the most essential requirements for the successful employment of 4G mobile networks. Investigation of mobility-related problems helps to identify the difference between QoS provisioning in modern networks and traditional ones. Location change during the data flow lifetime introduces the changed data path. Hence, it requires the identification of a new oath and the installation of new parameters of the resource control through path-couples QoS signaling.

Modern mobile networks seek to employ the best QoS approach. Therefore, there is a need to create a protocol of adaptive QoS application. The Qos approach cannot meet the requirements of the today's mobile networks. It causes the need for the investigation of QoS protocols and mechanisms in terms of the application. Further investigation is necessary in the areas of open research including the development of energy-efficient multimode terminals, the radio and core network dimensioning, consideration of session and personal mobility, inter-working protocol standardization, and others.

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