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Analysis of QoS for WiMax

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Abstract: In last few years there has been significant growth in the area of the wireless communication. The Wireless network is a fast growing area. IEEE 802.16/WiMAX is a new network which is designed with quality of service in mind. The Quality of Service (QoS) has become an important parameter for various types of applications that utilize the network resources. These applications include multimedia services, video streaming, voice over IP, video conferencing etc. This paper focuses on an analysis of quality of service implemented by the WiMAX networks. WiMAX is a technology for providing wireless last-mile connectivity. Physical and MAC layer of this technology refers to the IEEE 802.16 e standard that satisfied Quality of Service (QoS) requirements of different applications. WiMAX not only defined the features of the cabled access networks but provides high data rate applications with a variety of Quality of Service (QoS) requirements.

Keywords: "QoS Architecture", "QoS Service Classes", "UGS", "rtps", "nrtps", "ertps", "BE", "QoS Parameters", "Delay", "Jitter", "PDR", "PLR".

I. Introduction:

WiMAX is one of the most important broadband wireless technology. It uses highly efficient for multipurpose services and supports multi frequencies and protocols. WiMAX offers high data rate speed in multimedia (data, audio, video, and Pictures) and WiMAX supports various multimedia applications like VoIP, voice conference and online gaming. QoS is a service that is used to measure the overall performance of the network. Performance of network is measured to check the speed, accuracy, and reliability. Additional bandwidth is not created in the network. In WiMAX network, we have calculated QoS parameters like delay, Jitter, Packet delivery Ratio (PLR), Packet Loss Ratio (PLR) and throughput. Our paper analyzing essential QoS parameters for WiMax Network. WiMAX network examines the capability to deliver adequate QoS to voice and data applications. Effective voice over IP (VoIP) communications requires QoS features that can quickly identify voice traffic and classify and assign implementation priority to assure high-quality audio and service level adherence. Basically, In quality of service if we talk about In the field of networking it could be termed as the probability of a packet successfully passing between two points in the network. The primary goal of a good QoS is to provide priority including better throughput, controlled jitter and latency (required by some real-time and interactive traffic), and improved loss characteristics.

II. QoS Architecture for IEEE 802.16 MAC Protocol:

The WiMax network is a combination of a subscriber station (SS) and a base station (BS). Here the packets are transferred from source to destination node after following various types of scheduling, modulation technique, and routing technique. IEEE 802.16 can support multiple applications (data, voice, and video) with different QoS requirements. The Figure shows the existing QoS architecture of IEEE 802.16. IEEE 802.16 MAC protocol is connection oriented. Uplink Bandwidth Allocation schedule resides in the BS to control all the uplink packet transmissions. The application first establishes the connection with the BS and also the associated service flow (UGS, rtPS, nrtPS or BE). BS will assign the connection with a unique connection ID that is (CID). Each connection requests for desired bandwidth to the BS. ErtPS (Extended Real-time polling Service) is defined only in IEEE 802.16e-2005 and not in IEEE 802.16-2004, then we are not considering it as separate service flow from rtPS.

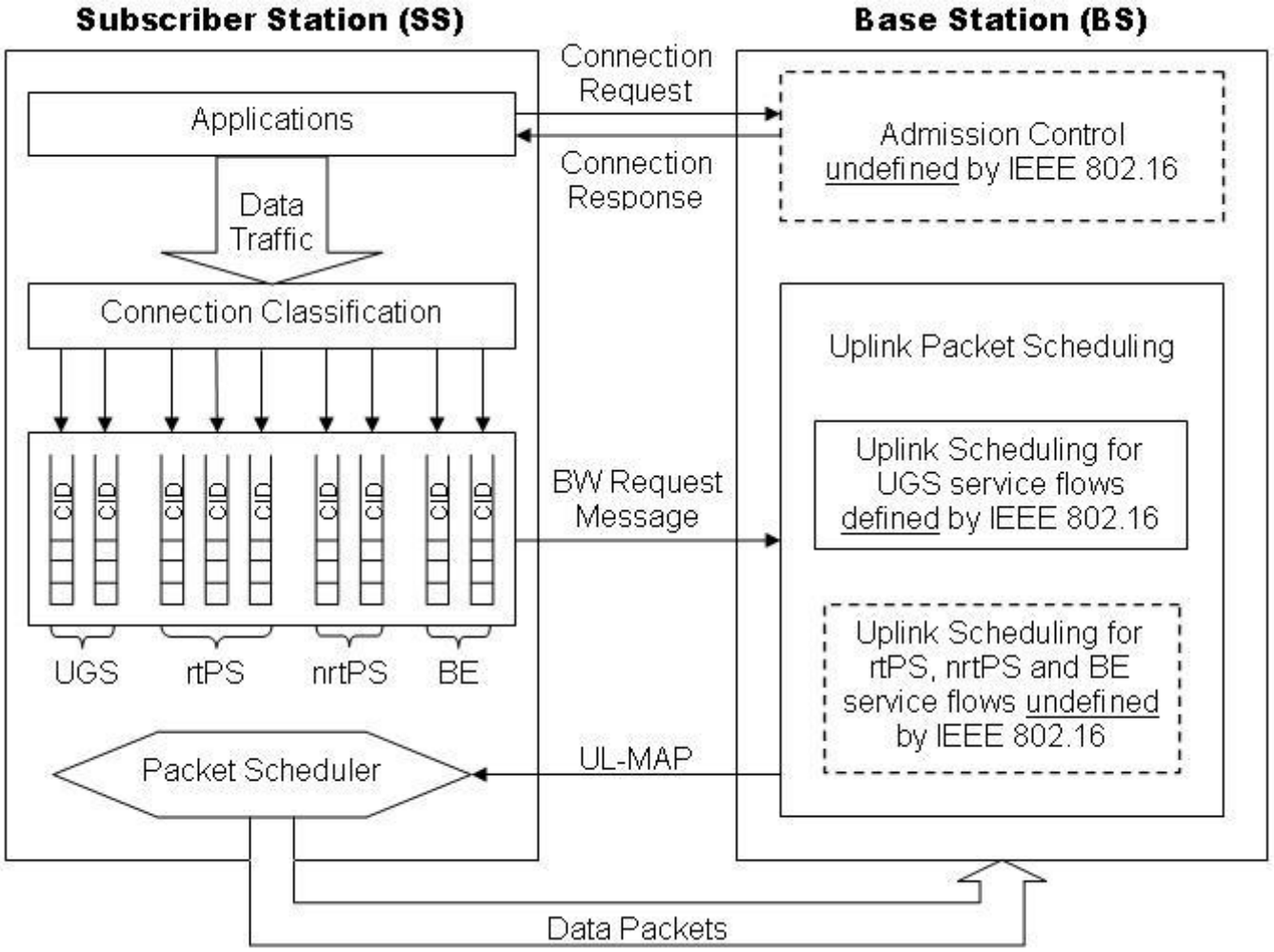

Fig.1: QoS Architecture for IEEE 802.16 MAC Protocol

III. QoS Service Classes in WiMAX:

WiMAX Standard 802.16 mentions following 5 QoS classes:

- Unsolicited Grant Service(UGS)
- Real-Time Polling Service(rtPS)
- Non- Real Time Polling Service(nrtPS)
- Best Effort Service(BE)
- Extended Real Time Polling Service(ertPS)

Each of these WiMax QoS classes has their own parameters such as bandwidth request type, min. throughput requirement as well as delay or jitter constraints.

1. **Unsolicited Grant Service (UGS):** Unsolicited Grant Service supports real-time constant bit-rate (CBR) data flows. This WiMax QoS class provides fixed bandwidth allocation on a periodic basis. Once the connectivity is established, no more requests are needed. UGS is good for those applications that require a constant bandwidth and limited delay variation. This service can be used to replace the T1/E1 wired line or a constant rate service. It also can be used to support real-time applications such as VoIP or streaming applications. The main QoS parameters are the maximum sustained rate(MST), maximum latency, tolerated jitter (maximum delay variation), uplink grant scheduling type, unsolicited grant interval.

2. **Real-Time Polling Service (rtPS):** Real-Time Polling Service (rtPS) supports real-time applications, but with variable bit-rate (VBR) and less stringent delay/jitter requirements (e.g., video conferencing, video streaming, VoIP with silence suppression).The BS provides transmission opportunities to each SS periodically via a basic polling mechanism. The main QoS parameters are Min. reserved traffic rate, max. sustained traffic rate, max. latency and uplink grant scheduling type. In rtPS bandwidth is allocated on a need basis and is adaptive in nature.

3. **Non-Real-Time Polling Service (nrtPS):** Non-Real-Time Polling Service (nrtPS) is intended for use by non-real-time applications requiring better than best effort service in terms of bandwidth, but that does not delay sensitive. Examples include file transfer or database applications. nrtPS allows piggyback, bandwidth stealing and all kinds of polling.

4. **Best Effort (BE):** Best Effort (BE) service is for best effort applications with elastic traffic, such as email, Web browsing, and telnet. No guarantees in terms of bandwidth, delay, or request access are offered by the BS. This service has the lowest priority. This QoS class guarantees neither delay nor throughput. It allows min. reserved traffic rate and max. sustained traffic rate.

5. **Extended real-time polling service (ertPS):** Extended real-time polling service (ertPS) developed to support VOIP and Silence Suppression For variable rate and delay-dependent applications. there will be no traffic transmission during silence time. ertPS is a scheduling mechanism that builds on the efficiency of both UGS and rtPS.

QoS Category	Applications	QoS Parameters
UGS Unsolicated Grant Service	VoIP	Maximum Sustained Rate Maximum Latency Tolerance Jitter Tolerance
rtPS Real-Time Poling Service	Streaming Audio or Video	Minimum Reserved Rate Maximum Sustained Rate Maximum Latency Tolerance Traffic Priority
ErtPS Extended Real-Time Polling Service	Voice with Activity Detection (VoIP)	Minimum Reserved Rate Maximum Sustained Rate Maximum Latency Tolerance Jitter Tolerance Traffic Priority
nrtPS Non-Real-Time Polling Service	File Transfer Protocol (FTP)	Minimum Reserved Rate Maximum Sustained Rate Traffic Priority
BE Best-Effort Service	Data Transfer, Web Browsing, etc.	Maximum Sustained Rate Traffic Priority

Table 1: QoS Service Classes in WiMAX

IV. QOS Parameters for WiMAX Networks:

The QoS is majorly provided by the network itself and may be described by various objective parameters called as QoS parameters which affect the performance of WiMAX network. QoS more narrowly refers to meeting certain requirements typically, throughput, packet error rate, delay, and jitter associated with a given application or a service class.

1. **Delay:** Delay defined as the time taken by the packets to reach from source to destination. The main sources of delay can be categorized into many forms. the forms are defined as propagation delay, source processing delay, network delay and destination processing delay. In this term, we have calculated end to end delay which is a measure of elapsed time taken during modulation of the signal and the time taken by the packets to reach from source to destination. The delay measured in fractions of seconds. End to end delay could be measured as the difference of Packet arrival and packet start time.

2. **Packet Delay variance (Jitter):** Jitter defined as the variation in delay or packet delay variation. The value of jitter is calculated from the end to end delay. Measuring jitter is a critical element to determining the performance of the network and the QoS the network offers. It is the variation in the time between packets arriving. Jitter is commonly used as an indicator of consistency and stability of a network. A Jitter is basically a form of latency. Jitter is measured in the variability over time of packet latency across a network. Jitter could be termed as the variation in delay or packet delay variation.

3. **Packet Delivery Ratio (PDR):** Packet delivery ratio defined as the total number of packets successfully delivered to the destination.

4. **Packet Loss Ratio (PLR)**: Some of the packets are lost due to network congestion or due to noise. Packet loss ratio should be minimum for successful delivery of high QoS. According to ITU (International Telecommunication Union) standards, the value of packet loss should be kept at minimum level. Packet loss affects the perceived quality of the application.

5. **Throughput:** Throughput is measured by a number of packets successfully delivered in a network. It is measured in terms of packets/second. The value of throughput should be high then it affects every service class defined in WiMAX.

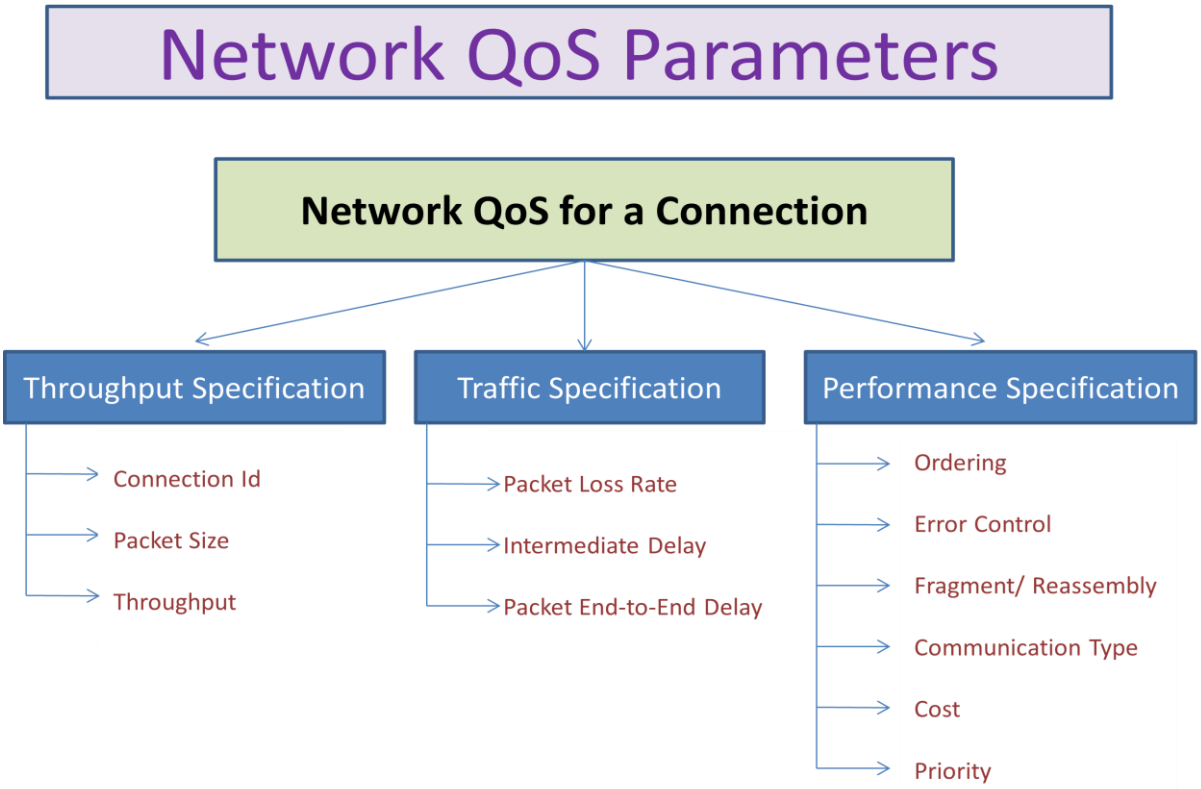

Fig 2: Network QoS Parameters

V. CONCLUSION:

The Quality of Service (QoS) has become an important parameter for various types of applications that utilize the network resources. QoS is a service that is used to measure the overall performance of the network. Performance of network is measured to check the speed, accuracy, and reliability. Measurement of QoS is essential for any wireless communication. In this paper, we define the Quality of Service (QoS) parameters, including guaranteed throughput and low delay, jitter and packet loss and quality of service classes ,UGS, rtps, nrtps, ertps, BE which helps in improving performance for a given WiMax network. Today in broadband wireless access (BWA) the perception is that as adoption grows, so does the need for guaranteeing a good QoS. The main issue of QoS, consequently, has become a critical area of concern for suppliers of broadband wireless access equipment and their customers too. QoS is an essential foundation for widespread acceptance of broadband wireless, since it allows for more efficient sharing of the operator‘s infrastructure, as demand for capacity increases with subscriber take-up.

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