A Correlation Model of Mixed Service Qoe and Qos in Integration Network Environment

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Abstract: With the rapid development of Internet and gradual enriched multimedia services, diversified needs of internet services are put forward. At the same time, people's requirements on quality of service are more stringent, traditional QoE only considers the evaluation method of network quality has not fully response service quality. At present, many research study association model of QoE and QoS only for single network and service. In this paper, a correlation model of mixed service integration network based on the environment is proposed.

Keywords- QoE;QoS; Path selection; mixed service; correlation model

1 Introduction

With the gradually mature of wireless communication technology and rapid development of digital multimedia technology such as network television (IPTV), video on demand (VOD), and the growing demand of dynamic services and the services based on IP, such as telemedicine, video surveillance and data center protection. But all these services need high quality, however, the current wireless communication technology and network is clearly unable to meet the growing demand of user for service and the rate, the importance of high speed broadband access technology is more and more outstanding. On the other hand, for service providers, is more concerned about the capacity of new system service. How to evaluate the service quality? All the time, it tends to use the QoS parameter to measure network traffic carrying capacity, such as single index of bandwidth, delay, packet loss. However, from the existing network can be found that high bandwidth does not represent the system providing high quality service, and for fusion network, many network damaging factors such as delay and jitter, can affect service performance, thereby affect service performance and quality of the whole network. However, each service sensitive index is different, For example, for voice service, sensitive index is time delay,

response service capacity accurately and comprehensively, On the other hand, from the user's perspective, the user cares not the number of packet loss, delay but weather the call is clear, image is a Mosaic and video playback is smooth. In this case, the evaluation method for user experience quality QoE emerges as the times require.

The user experience is not only universal impact of service, but also the operators in the market competition ability; It is an important factor of the successful transformation of theory research to practice. In addition, to explore QoE evaluation method of researched integration network can monitoring network real-time and accurately for the operator, improve the quality of user experience, apply the theory research to practice, realize the industrialization of new technology.

2 Technical analysis and the method

A. Background

With the rapid development of Internet, and gradual enriched multimedia services, diversified needs of Internet services are put forward. At the same time, people's requirements on quality of service are more stringent, traditional QoE only considers the evaluation method of network quality has not fully response service. The traditional QoS generally respond to the quality of the network through discrete indexes and parameters, such as packet loss, delay, jitter, bandwidth, etc. But these parameters are not separate, unrelated, but interaction. For example, when the loss exceeds a certain threshold, jitter will increase exponentially [1]. This QoS single indexes and parameter are not sufficient to evaluate network performance quality accurately, for some parameters of QoS, such as packet loss, if the lost packet is not critical, it will not affect the transmission of video, from the user's perspective, the user is not concerned with packet loss but has or not influent on video quality, So, service providers gradually shifted the interest to the user

experience quality. In the face of this trend, the concept of QoE emerges as the times require.

Various organizations and literature has not a uniform definition of QoE. For example, in ITU-T P P.10/G.100, QoE is defined as terminal user's subjective overall satisfaction for used service [2]. It is closely related and end-users feeling experience, including the overall network end-to-end performance of the system. In literature [3], QoE is described as the user experience on the application layer, among them，application layer experience is similar to the overall results of the individual quality of service. The literature [4] indicated that QoE is used for total quality assurance Service mechanism to guarantee sound and smooth video transmission in IP network. In literature [5], QoE refers to the "performance" evaluation of the whole system from the user's point of view, QoE is from end to end performance levels to measure the user's experience, it implies the user satisfaction with the system. But the narrow sense QoS usually refers to the underlying data transmission performance indicators, including the packet loss rate, delay, delay jitter, bandwidth, error etc. QoS stands in the view of the network, and QoE is standing in the user angle to experience QoS. The all definition of QoE showed that QoE is standing on a higher level than the narrow QoS concept, if you want to get better QoE, you must provide a good QoS. Therefore, in a sense, QoE can be regarded as an extension and expansion of QoS narrow definition on terminal user perspective [6].

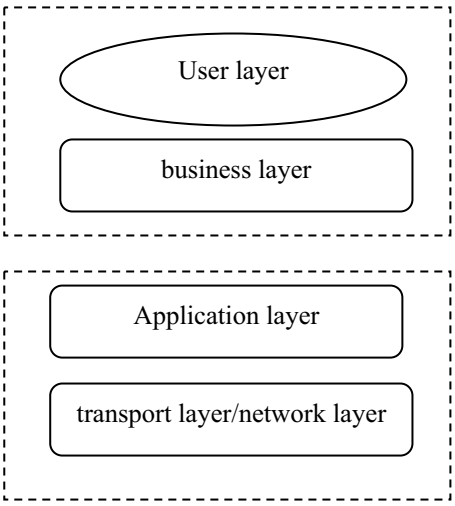

Figure 1. Hierarchical model of QoS and QoE

The relationship between QoE and QoS can be depicted as Figure 1, QoE is defined at the user level, the user is actually feel QoS, and QoS is closely related with application layer and the transport/network layer, from the user and the service level, QoS is a kind of demand, in order to meet this demand, the network layer adopts corresponding mechanism.

B. Research on related technology

In recent years, the international organizations and research institutions have an evaluation method on the network performance of QoE. ITU-T P.861 puts forward the method of PSQM (Perceptual Speech Quality Measure), British Telecom proposes PAMS (Perceptual Analysis Measurement System), PESQ and E-Model methods.

ITU-T initially definite QoE on IPTV service, ITU-T TP.10/G.100 defines QoE as "terminal user's overall subjective perception and satisfaction to their using service ". Among them, 12th study group set up a sub topic of "multimedia QoS/QoE performance evaluation method". ITU-T is currently working on a parametric model of video quality assessment, and has released the ITU G.1070 model; the model indicates the Five-point scale MoS value quality of experience. The QoE header field is added before some extended field of real-time stream media protocol In 3GPP R6 specification to ensure end-to-end negotiation of QoE parameters.

The influence factor of IPTV QoE is classified by ATIS-0800004 (Alliance for Telecommunications Industry Solutions), the QoE influence factors are divided into the objective evaluation and subjective evaluation, the objective QoE corresponds to the related factor of service provider, and it can be understood as IPTV QoS; and the subjective QoE corresponds to user related factors. The IPTV QoS parameter is divided into two layers: QoS of application layer and network layer. The application layer QoS represents the quality and performance of the application layer; network layer QoS represents network transmission quality. According to the characteristics of the application layer QoS it is further divided into three sub layers: the transmission quality, content quality, and multimedia stream quality.

Digital subscriber line forum (DSL Forum) divided IPTV QoE directly into three layers: service layer, application layer and the transport layer.

Index of service layer includes availability, reliability, and robustness.

The application layer includes the control level and the data level, the control level index includes channel change rate, scalability with certain load and responding time of user application interface. The data level includes bit rate, video codec quality of application layer, pretreatment, rate matching index.

The transport layer also comprises a control level and data level, the control level includes IGMP (The Internet Group Management Protocol) processing time, cross flow time, the data level indicators include delay, packet loss, jitter.

C. A correlation model of mixed service QoE and QoS in integration network environment

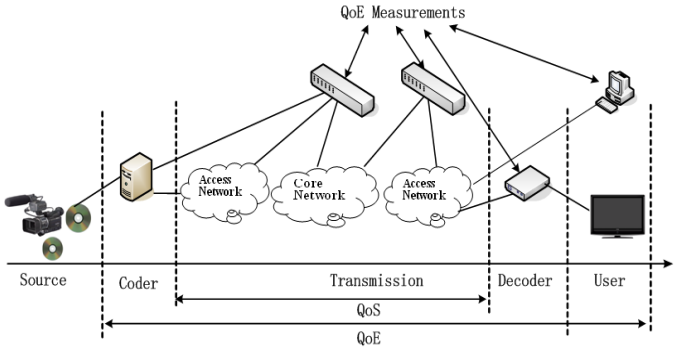

Figure 2. Application of association of QoE with QoS

At present, many research on association model of QoE and QoS only consider a single service, study a single network, the paper proposes a correlation model of mixed service based on the integration network environment, the specific method and described as follow(mixed service with IPTV and VoIP two kinds of service (representing the interaction class and conversational services)).

1. Gained the weights of each service

First of all, according to the network specified service priorities determine the weight of each service. Secondly, establish the hierarchical model of QoE index determine the transmission service in the network, as well as the sensitive different index for each service. Then establish the priority relation matrix X, according to the formula (1) for the line and get r_i, then use the formula (2), converted r_i into r_{ij}, and get fuzzy consistent matrix.

$$X=\begin{bmatrix} r_{11} & r_{12} & \mathrm{L} & r_{1p} \\ r_{21} & r_{22} & \mathrm{L} & r_{2p} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ r_{n1} & r_{n2} & \mathrm{L} & r_{np} \end{bmatrix}_{n\times p}$$

$$r_i=\sum_{k=1}^{n} r_k, i=1,2,...,n \quad (1)$$

$$r_{ij}=\frac{r_i-r_j}{2n}+0.5 \quad (2)$$

Plug r_{ij} into (3) get ω_i, then get the weight corresponding to each service sensitive index. Where $a=(n-1)/2$.

$$\omega_i=\frac{1}{n}-\frac{1}{2a}+\frac{\sum_{j=1}^{n} r_{ij}}{na}, i=1,2,...n \quad (3)$$

For the convenience of calculation, the influence factor of network QoE only consider the IPTV, VoIP PLR, delay and jitter the three QoS parameters.

2. To obtain the correlation of single service from The IQX (exponential interdependency of quality of experience and quality of service) hypothesis.

$$QoE=a\cdot e^{-\beta\cdot QoS}+\gamma \quad (4)$$

The QoS index in the IQX hypothesis represents the packet loss rate, delay, and jitter. These single indexes represent the QoS damage, the damage is bigger, and the user satisfaction is lower. QoS and QoE is Negative exponential relationship.

3. The mathematical relationship between IQX and QoE

To the IPTV service, the mathematical model of relationship between PLR, delay, jitter and QoE is shown as:

$$QoE_{IPTV}(PLR)=a_1\cdot e^{-\beta_1\cdot PLR}+\gamma_1$$
$$QoE_{IPTV}(delay)=a_2\cdot e^{-\beta_2\cdot delay}+\gamma_2$$
$$QoE_{IPTV}(jitter)=a_3\cdot e^{-\beta_3\cdot jitter}+\gamma_3$$

To the VOIP service, the mathematical model of relationship between PLR, delay, jitter and QoE is shown as:

$$QoE_{VOIP}(PLR)=a_4\cdot e^{-\beta_4\cdot PLR}+\gamma_4$$
$$QoE_{VOIP}(delay)=a_5\cdot e^{-\beta_5\cdot PLR}+\gamma_5$$
$$QoE_{VOIP}(jitter)=a_6\cdot e^{-\beta_6\cdot jitter}+\gamma_6$$

4. By (3) to obtain the weight ω_i of each service sensitive index, calculated for each serviceQoE_i:

$$QoE_{IPTV}=\omega_1 QoE_{IPTV}(PLR)+\omega_2 QoE_{IPTV}(delay)+\omega_3 QoE_{IPTV}(jitter) \quad (5)$$

$$QoE_{VOIP}=\omega_1 QoE_{VOIP}(PLR)+\omega_2 QoE_{VOIP}(delay)+\omega_3 QoE_{VOIP}(jitter) \quad (6)$$

5. To obtain Service weight by network service priority (normalized according to the standard) and gain ω_{IPTV} and ω_{VOIP}, then the QoE of the whole system.

Plug (5), (6) into (7),

$$QoE=\sum_{i=1}^{n} QoE_i\cdot\omega_i \quad (7)$$

For the fusion network, QoE is shown as:

$$QoE=\omega_{IPTV}*QoE_{IPTV}+\omega_{VoIP}*QoE_{VoIP} \quad (7)$$

3 Conclusion

This paper for hybrid service transmission in IMT-A heterogeneous network fusion environment proposes a association model of QoE and QoS, the method is in the application of the original single service and single network, introduce scenarios of mixed service and heterogeneous network, and for each parameters in the related model, explains the method of obtaining.

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