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Partie 8: Qualité de service

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Foreword

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A list of all parts in the ISO/IEC 29181 series, published under the general title *Information technology — Future network — Problem statement and requirements*, is available on the ISO website.

Introduction

ISO/IEC/TR 29181-1 describes the definition, general concept, problems and requirements for the Future Network (FN). The other parts of ISO/IEC 29181 provide details of various components of the specific technology areas.

This document examines the problems of the Quality of Service (QoS) issues of current networks, and describes the requirements in Future Network QoS architecture and functionality perspectives. It also gives some examples of technical issues for QoS realization in Future Network (see Annex A).

Information technology — Future Network — Problem statement and requirements —

Part 8: Quality of Service

1 Scope

This document describes the problem statements of current networks and the requirements for Future Network (FN) in the Quality of Service (QoS) perspective. This document mainly specifies:

— problems of the current networks for QoS;

— requirements for QoS support in Future Network.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
Future Network Quality of Service
FNQoS
overall performance of a Future Network, including two aspects: QoS (Quality of Service) and QoE (Quality of Experience)

3.2
Future Network Proxy
FNProxy
entity, which replaces task submitter to execute particular assignments and shields them from implementation details and processes

Note 1 to entry: FNProxy may contain sub-proxies.

4 Abbreviated terms

3G	3rd generation
AF	assured forwarding
BE	best-effort service
CoS	class of service
CR-LDP	constrain based routing- label distribution protocol
Diff-serv	differentiated service
EF	expedited forwarding
GoS	grade of service
HC	hybrid coordinator
Int-serv	integrated service
IP	internet protocol
IPTV	internet protocol television
IPv4	internet protocol version 4
IPv6	internet protocol version 6
LER	label switching edge router
LSP	label switching path
MAC	media access control
MPLS	multi-protocol label switching
QoE	quality of experience
QoS	quality of service
TE	traffic engineering
VoIP	voice over IP
VPN	virtual private network
WCDMA	wide band code division multiple access
WLAN	wireless local area network
WMAN	wireless metropolitan area network

5 General

5.1 QoS in Future Network (FN)

Distinguished from the traditional communication technology or information technology services, the services of the future are various. A large number of real-time applications are emerging. Multimedia applications such as video conference and IPTV have strict requirements to delay, jitter, bandwidth, and so on. High speed mobile data services need service convenience and stability. Therefore, there is an urgent requirement to FN to provide the corresponding QoS assurance.

In addition, the meaning of the QoS concept has undergone profound changes, from network performance parameters to those related to the user's experience, perception of end-to-end QoS. A new approach to QoS has been developed, strengthening the thinking that the isolated study of each QoS term can't bring about an effective QoS management. In the new telecommunication environment, a more complex analysis is needed to cover the interests of all the different actors involved in the service provision. The standardization and regulation bodies have realized that a new QoS regulatory framework is needed to encompass the evolution of the QoS and combine with the user's point of view.

Therefore, there is a need for a global and general QoS framework to unify criteria in terms of concepts and terminology and to cover all the different aspects that should be considered for a practical QoS management model in the FN environment. FN should support QoS from user and/or application perspectives. In addition, FNQoS should also take full account of the requirements of the FN user and applications, such as user-customization, heterogeneous networks, context-awareness, autonomy, mobility, and service composition, etc.

5.2 Related works on QoS

5.2.1 ISO/IEC JTC1

JTC1/SC 21 (which was disbanded and its work transferred to JTC 1/SC 6) published a QoS framework: ITU-T/Recommendation X.641(1997)|ISO/IEC 13236:1998 to define a QoS framework under the OSI Reference Model: QoS framework concept; QoS characteristics with respect to the user requirements; QoS management; and QoS mechanisms. Multiple QoS entities coordinate mutually to accomplish QoS tasks. Entities receive QOS requirements and analyse them, then determine the QOS management mechanisms or functions that are required to meet them.

5.2.2 European Telecommunication Standards Institute (ETSI)

The TIPHON Working Group (which was disbanded) of ETSI developed the next-generation telecommunications network architecture, which is characterized by the convergence of telecommunications and IP. In the QoS architecture of ETSI TIPHON, TRM (Transmission Resource Manager) is introduced in the core IP network to dynamically manage the resource scheduling of the core network, and achieve the capability of real-time traffic engineering. TRM accepts business resource applications of the access layer, allocates and manages the resources of core backbone and the forwarding path for business.

5.2.3 Internet Engineering Task Force (IETF)

IETF has defined several models and mechanisms to achieve IP QoS, such as Int-serv/Diff-serv, MPLS, QoS routing, etc. In order to satisfy user requirements and provide better QoS guarantee in the future, the basic QoS models can be complementary each other and combined on different network layers. For example, Int-serv and Diff-serv combination can be taken into account, which Diff-serv is used in the core network and Int-serv is used in access network. Similarly, MPLS and Diff-serv combination or MPLS and QoS routing combination can be considered.

5.2.4 Internet 2

A major goal of Internet 2 research was to create a scalable, interoperable and manageable QoS architecture so that it can achieve some applications that can't be realized in the existing Internet, such as telemedicine, digital libraries and virtual laboratories. A test bed called QBone had been set up for testing, developing and deploying the QoS of the next generation Internet. Diff-serv mechanisms enhanced the QoS in Internet 2. The research result of Internet 2 showed that any viable QoS architecture must scale well both with respect to the large numbers of flows and high forwarding rates of core routers.

5.2.5 Telecommunication Standardization Sector of International Telecommunications Union (ITU-T)

ITU-T SG 12 and 13 groups are committed to studying QoS, and many recommendations have been already developed. Recommendation ITU-T Y.2113 specified service definitions and general requirements, a QoS control architecture, and a control coordination protocol acting as a bridge between a single end-to-end request and the heterogeneity of the admission control mechanisms that are already deployed in the network. Recommendation ITU-T Y.2237 introduced a functional model and service scenarios related to the support of QoS-enabled mobile voice VoIP service in WLAN, 3G, and WMAN networks. Recommendation ITU-T Y.1566 specified a limited set of classes that provide a basis for interworking between the different traffic class aggregates of different service providers which aims on enabling end-to-end QoS across different packet networks. Recommendation ITU-T Y.1545 provided the roadmap for the QoS interconnected networks that use the Internet protocol.

5.3 Prospect of QoS architecture in FN

From the point of the research works of the standards organizations, the unified QoS implementation of the whole network still lacks the framework files for the converged heterogeneous networks in the future, and there is also not the implementation of the specific technical specifications. This will be the focus of international standards organizations to research and develop in the next few years. Operators, research institutions and equipment manufacturers in the world are positive to develop the QoS mechanisms and technologies of FN.

FN is a combination of various heterogeneous networks, and is open, high speed, high performance. To a variety of terminals and a variety of business requirements of user under different scenarios, FNQoS architecture need to be based on the features of user needs, the perception of network configuration, and network real-time running status to provide services for user intelligently and dynamically. And the architecture should eventually quantify the QoS and feed this back to the user. That architecture is a complete system, which could achieve a unified service access control and unified strategy control. The FNQoS architecture should contain multiple components inside. Each component has a certain QoS function. They can provide QoS services to each other, and effectively enhance the business QoS and quality of the user experience. In short, FNQoS architecture should meet all the future requirements of user and try to provide satisfactory services for them.

6 Problem statement of current networks for QoS

6.1 QoS in current networks

6.1.1 IPv4/IPv6 network

The definition of QoS given by ITU-T is that QoS is the total effect of service performance, which determines the degree of satisfaction of a user with the service. From a technical perspective, QoS is a set of parameters required by services. Network must meet these requirements in order to ensure the appropriate service level of data transmission. QoS technology may guarantee that applications can share network resources effectively.

Under the network hierarchy division, each pair of the upper layer and the lower layer needs to supply or request network resources for each other. There is an abstract relationship of services. So the concepts of QoS exist in each layer. Due to some historical reasons, the concept regarding IP QoS is very chaotic. Different research groups such as ITU, ETSI, ISO and IETF have different definitions for IP QoS, and connotations of these definitions are different. The definition on IP QoS of the IETF in the field IP technology research has been most widely recognized. But IETF did not give the uniform definition of IP QoS.

There are several models or mechanisms for the IP QoS:

(1) Int-serv

Int-serv mainly introduces an important network control protocol RSVP (Resource Reservation Protocol). RSVP makes IP applications provide the required end-to-end QoS. Although Int-serv provides guaranteed QoS, it has poor extensibility. Because Int-serv works based on each flow, it will need to maintain a lot of state information proportional to the number of packet queues. In addition, the effective implementation of the RSVP must depend on each router on the path. In the backbone of the Internet, the number of packet flows is quite large, so the router's forwarding rate is very high. This makes the Int-serv difficult to implement in the backbone network.

(2) Diff-serv

Diff-serv aims to define a way of implementing QoS that is easier to extend to overcome the problems of Int-serv. Diff-serv simplifies signalling, and makes more coarse granularity classification to IP packet flow. Diff-serv provides QoS by way of aggregating and PHB (per-hop behaviour). Aggregating refers to the fact that IP packet flows with similar QoS requirements are seen as a class. This can reduce the number of queue handled by scheduling algorithms. The IP packet is forwarded in the way of PHB. Each PHB defines the packet-forwarding properties associated with a class of traffic. Diff-serv does not need to reserve the information of flow status and signalling, and has better scalability. But there is lack of end-to-end bandwidth reservation. The service guarantee may be weakened in the congested link.

(3) Int-serv/Diff-serv combination

The basic idea of the Int-serv/Diff-serv combination model is that the Int-serv model and Diff-serv model are combined in the whole network. An end-to-end QoS guarantee is provided for applications and services according to the adoption of the Int-serv model in the edge network. The core network is still using the Diff-serv model. But the new model still has very obvious flaws, such as complex signalling, a complex operation management level, and so on. For the current point of view, although the Int-serv/Diff-serv combination model has theoretical feasibility, there is still a long period of exploration.

(4) MPLS (Multi-Protocol Label Switching)

MPLS combines IP routing and layer 2 label-switching, which adds a label between the head of data frame in layer 2 and the head of packet in layer 3. Network routers transmit and process data through the identification of labels. MPLS is obviously different to the traditional router in routing addressing, and packets can be forwarded along different paths to the same destination. MPLS makes up for the many defects of a traditional IP network and introduces an "explicit routing" mechanism to provide a more reliable guarantee of QoS. But the signalling of the connection established is very complicated and the flexibility of routing is not high. There is low efficiency when shorter data are transmitted.

(5) TE technology based on MPLS

When the traffic is mapped onto the physical topology of the network as well as the task of locating these resources for the traffic, this is known as Traffic Engineering (TE). It is also the important method to achieve network congestion control and implementation of QoS. MPLS is suitable to combine with TE. MPLS TE is an indirect technology to improve network performance. MPLS TE uses the ability that LSP support display routing to: guide the network traffic reasonably; make the real network traffic load match the physical network resources; and improve the network QoS indirectly. According to user requirements (display routing, bandwidth, etc.) and the situation of the network resources, MPLS TE automatically establishes a cross backbone and connects two LER tunnels through the CR-LDP signalling (or an RSVP extension), at the same time it completes the maintenance, statistics, property modification (such as bandwidth) and back-up of the tunnel. The MPLS TE tunnel can be widely used in VPN, all kinds of access and Internet traffic. However, the technical proposal has its own problems. The tunnel connecting two label edge routers is usually not able to perceive the type of traffic. If EF, AF and BE at the same time emerge in the tunnel, traffic will interfere with each other.

6.1.2 Next Generation Network (NGN)

ITU-T SG13 research team has developed a proposal draft on QoS reference architecture in NGN. The draft considered that the cooperation of a service control layer, bearer control layer and network bearer layer can provide the QoS guarantee in NGN.

