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INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS
AND NEXT GENERATION NETWORKS

Internet protocol aspects – Architecture, access, network
capabilities and resource management

An architectural framework for support of Quality of Service in packet networks

ITU-T Recommendation Y.1291

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ITU-T Recommendation Y.1291

An architectural framework for support of Quality of Service in packet networks

Summary

This Recommendation provides an architectural framework for support of Quality of Service (QoS) in packet networks. Central to the architectural framework is a set of generic network mechanisms (or QoS building blocks) for controlling the network service response to a service request, which can be specific to a network element, or for signalling between network elements, or for controlling and administering traffic across a network. Distributed across three logical planes (namely the Control Plane, Data Plane and Management Plane), the building blocks can be used in combination to form various approaches for delivering the satisfactory collective effect of varying service performance required by a range of applications, such as file transfer and multimedia conferencing.

Source

ITU-T Recommendation Y.1291 was approved on 7 May 2004 by ITU-T Study Group 13 (2001-2004) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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ITU-T Recommendation Y.1291

An architectural framework for support of Quality of Service in packet networks

1 Scope

This Recommendation provides an architectural framework for support of Quality of Service (QoS) in packet networks. Central to the architectural framework is a set of QoS building blocks distributed across three logical planes (namely the Control Plane, Data Plane and Management Plane) to control network performance, even in case of network resource contention. Ultimately the building blocks are to help deliver "the collective effect of service performance which determines the degree of satisfaction of a user of the service".

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- ITU-T Recommendation E.360.1 (2002), *Framework for QoS routing and related traffic engineering methods for IP-, ATM- and TDM-based multiservice networks*.
- ITU-T Recommendation E.360.2 (2002), *QoS routing and related traffic engineering methods – Call routing and connection routing methods*.
- ITU-T Recommendation E.360.3 (2002), *QoS routing and related traffic engineering methods – QoS resource management methods*.
- ITU-T Recommendation E.360.4 (2002), *QoS routing and related traffic engineering methods – Routing table management methods and requirements*.
- ITU-T Recommendation E.360.5 (2002), *QoS routing and related traffic engineering methods – Transport routing methods*.
- ITU-T Recommendation E.360.6 (2002), *QoS routing and related traffic engineering methods – Capacity management methods*.
- ITU-T Recommendation E.360.7 (2002), *QoS routing and related traffic engineering methods – Traffic engineering operational requirements*.
- ITU-T Recommendation E.361 (2003), *QoS routing support for interworking of QoS service classes across routing technologies*.
- ITU-T Recommendation E.860 (2002), *Framework of a service level agreement*.
- ITU-T Recommendation G.114 (2003), *One-way transmission time*.
- ITU-T Recommendation G.1000 (2001), *Communications Quality of Service: A framework and definitions*.
- ITU-T Recommendation G.1010 (2001), *End-user multimedia QoS categories*.
- ITU-T Recommendation I.350 (1993), *General aspects of quality of service and network performance in digital networks, including ISDNs*.

- ITU-T Recommendation J.112 (1998), *Transmission systems for interactive cable television services*.
- ITU-T Recommendation J.162 (2004), *Network call signalling protocol for the delivery of time-critical services over cable television networks using cable modems*.
- ITU-T Recommendation J.163 (2004), *Dynamic quality of service for the provision of real-time services over cable television networks using cable modems*.
- ITU-T Recommendation J.170 (2002), *IPCablecom security specification*.
- ITU-T Recommendation J.174 (2002), *IPCablecom interdomain quality of service*.
- ITU-R Recommendation M.1079-2 (2003), *Performance and quality of service requirements for International Mobile Telecommunications-2000 (IMT-2000) access networks*.
- ITU-T Recommendation X.805 (2003), *Security architecture for systems providing end-to-end communications*.
- ITU-T Recommendation Y.1221 (2002), *Traffic control and congestion control in IP-based networks*.
- ITU-T Recommendation Y.1540 (2002), *Internet protocol data communication service – IP packet transfer and availability performance parameters*.
- ITU-T Recommendation Y.1541 (2002), *Network performance objectives for IP-based services*.

3 Definitions

This Recommendation does not define new terms.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

DiffServ	Differentiated Services
DQoS	Dynamic QoS
IETF	Internet Engineering Task Force
IntServ	Integrated Services
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
LSP	Label Switched Path
MPLS	Multi-Protocol Label Switching
MTA	Multimedia Terminal Adaptor
QoS	Quality of Service
RSVP	Resource ReSerVation Protocol
SLA	Service Level Agreement

5 Introduction

Quality of Service (QoS) ultimately is about supporting the characteristics and properties of specific applications. Yet different applications may have quite different needs. For example, for telemedicine, the accuracy of the delivery is more important than overall delay or packet delay

variation (i.e., jitter), while for IP telephony, jitter and delay are key and must be minimized. A number of ITU-T Recommendations deal with QoS. ITU-T Rec. E.800 defines QoS as "the collective effect of *service performance* which determines the degree of satisfaction of a user of the service". Given that ITU-T Rec. E.800 considers support, operability, serviceability and security all part of service performance, this QoS definition is comprehensive in scope. Expanding on the E.800 QoS concept, ITU-T Rec. G.1000 breaks down *service performance* (or service quality) into functional components and links it to network performance such as defined in ITU-T Recs I.350, Y.1540 and Y.1541. Complementary to ITU-T Rec. G.1000, which gives a framework, ITU-T Rec. G.1010 provides end-user-centric application requirements in terms of broad categories (such as interactive, error tolerant). Concerning specific applications or performance parameters, among related standards, ITU-R Rec. M.1079-2 defines the end-to-end speech and data quality and performance requirements for IMT-2000 access networks, while ITU-T Rec. G.114 specifies the bounds for transmission time for connections across a digital network.

To deliver required network performance, certain mechanisms need to be in place within the network. These network mechanisms are to control and deliver various network service responses, even in case of network resource contention. IETF RFC 2990 summarizes the possible characteristics of the controlled service response to a specific service request: *consistent and predictable, at a level equal to or above a guaranteed minimum, or established in advance*. For example, in case of network resource contention or congestion, to maintain the expected service response requires a variety of means working at different time-scales, from those for careful network planning based on traffic patterns over a long period to those for differential resource allocation and admission control based on the current network load condition. These and other mechanisms (e.g., a signalling method for indicating the desired level of network performance) are the focus of the architectural framework for QoS support. In particular, this Recommendation identifies a set of generic QoS network mechanisms and provides a structure for them. Ultimately the network mechanisms are to be used in combination to deliver the satisfactory collective effect of varying service performance required by a wide range of applications. The application-independent aspect of the identified architectural framework distinguishes it from application-specific QoS architectures such as defined in ITU-T Rec. H.360, which is specific to multimedia applications.

6 QoS building blocks

Key to the QoS architectural framework is a set of generic network mechanisms for controlling the network service response to a service request, which can be specific to a network element, or for signalling between network elements, or for controlling and administering traffic across a network. (Please note that the building blocks should not be deemed end to end.) As depicted in Figure 1, the building blocks are organized into three planes:

- Control Plane, which contains mechanisms dealing with the pathways through which user traffic travels. These mechanisms include admission control, QoS routing, and resource reservation.
- Data Plane, which contains mechanisms dealing with the user traffic directly. These mechanisms include buffer management, congestion avoidance, packet marking, queuing and scheduling, traffic classification, traffic policing and traffic shaping.
- Management Plane, which contains mechanisms dealing with the operation, administration, management aspects of the network. These mechanisms include Service Level Agreement (SLA), traffic restoration, metering and recording, and policy.