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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

Next Generation Networks – Quality of Service and performance

Service restoration priority levels in Next Generation Neworks

ITU-T Recommendation Y.2172

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ITU-T Recommendation Y.2172

Service restoration priority levels in Next Generation Networks

Summary

ITU-T Recommendation Y.2172 proposes three levels of restoration priority for services in Next Generation Networks. This indicator is intended as a guidance for the development of appropriate signalling protocol extensions and the restoration/re-route mechanisms.

Source

ITU-T Recommendation Y.2172 was approved on 13 June 2007 by ITU-T Study Group 13 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Service restoration priority levels in Next Generation Networks

1 Scope

As stated in [ITU-T Y.1271], enhanced priority treatment is an essential requirement for the assured capabilities needed for emergency telecommunications. One critical component is admission control and associated priorities as described in [ITU-T Y.2171]. Another critical component is service restoration particularly during emergency conditions with potentially reduced network bandwidth/resources. Under such conditions, emergency telecommunications interrupted by network failures require preferential restoration treatment. In the NGN, assured restoration can be enabled by:

1) development of service restoration priority levels based on the criticality of services;
2) development of the necessary extensions in signalling protocols that can indicate the restoration priority levels during call/session set-up;
3) development of restoration mechanisms that can recognize the signalled priority levels and undertake the necessary restoration/re-routing action.

The scope of this Recommendation is limited to the development of priority levels for service restoration in the NGN. This guidance can be helpful in the development of the subsequent signalling extensions and restoration mechanisms.

Administrations may require operators and service providers to take into account national regulatory and national policy requirements in implementing this Recommendation.

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 E.361] ITU-T Recommendation E.361 (2003), *QoS routing support for interworking of QoS service classes across routing technologies.*

[ITU-T Y.1271] ITU-T Recommendation Y.1271 (2004), *Framework(s) on network requirements and capabilities to support emergency telecommunications over evolving circuit-switched and packet-switched networks.*

[ITU-T Y.1291] ITU-T Recommendation Y.1291 (2004), *An architectural framework for support of Quality of Service in packet networks.*

[ITU-T Y.2171] ITU-T Recommendation Y.2171 (2006), *Admission control priority levels in Next Generation Networks.*

3 Definitions

This Recommendation defines the following terms:

3.1 emergency telecommunications: An umbrella term for telecommunications of an "extraordinary nature" under abnormal and potentially adverse network conditions.

3.2 service restoration: A set of automated or manual methods, invoked after a network failure, to enhance the ability of successful communications reroute and completion around the failed network element(s).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DS-TE	DiffServ-Aware MPLS-Traffic Engineering
G-MPLS	Generalized Multi-Protocol Label Switching
IP	Internet Protocol
ISP	Internet Service Provider
LSP	Label Switched Path
MIB	Management Information Base
MPLS	Multi-Protocol Label Switching
NGN	Next Generation Network
PD-FE	Policy Decision Functional Entity
RACF	Resource Admission Control Functions
SCF	Service Control Function
SLA	Service Level Agreement
TRC-FE	Transport Resource Control Functional Entity
VoIP	Voice over IP
VPN	Virtual Private Network

5 Conventions

None.

6 Introduction and rationale

All forms of communications traffic are expected to be carried by NGN networks – control plane traffic (e.g., routing and signalling messages), emergency telecommunications, real-time voice and video services, data services, virtual private network (VPN) services, as well as traditional "Best effort" traffic. In such an environment, it is important to assign priority classifications and establish rules for service restoration such that critical services (e.g., control plane traffic and emergency telecommunications) are recognized and restored over other services in case of network overloads or failures [ITU-T E.361], [ITU-T Y.1291]. As service flows can be expected to traverse multiple network domains, priority classification is an important step in the development of the necessary signalling protocol extensions as well as of the mechanisms for enabling preferential restoration of critical services [b-IETF RFC 4090].

The priority level classification is based on the following premise: Under reduced bandwidth conditions resulting from network failure, the critical issue for an NGN is the ability to recognize and restore higher priority traffic flows over others. The priority level recommendations proposed in this Recommendation strictly relate to the relative importance of traffic classes from this perspective. They do not reflect implementation-specific priority definitions. For example, there are mechanisms utilizing generalized multi-protocol label switching (G-MPLS)-based recovery that define specific recovery capabilities such as 1+1 protection and 1:N protection [b-IETF RFC 4426].

Such mechanism-specific priority definitions do not apply to the recommendations in this Recommendation.

To summarize, the priority levels being recommended in this Recommendation are completely independent of the restoration mechanisms that a network operator may utilize.

7 Recommendation for restoration priority levels

Three restoration priority levels are recommended for traffic in NGN:

- *Priority level 1:* Traffic with this priority receives the highest assurance of restoration. This class must include control services crucial to the operation of a network and emergency telecommunications. Other services may be included depending on availability of restoration capacity and service level agreements (SLA) between network operators and customers for the desired service.
- *Priority level 2:* Traffic with this priority will receive lower assurance than priority level 1 traffic but will receive higher assurance than priority level 3 traffic for restoration. Examples include real-time services (VoIP, video), VPN and data services. The selection of this priority class is expected to be determined by appropriate SLA agreements between network operators and customers for the desired service.
- *Priority level 3:* Traffic with this priority receives the least assurance for restoration. Examples include "traditional" Internet service provider (ISP) services (e-mail, web surfing). The selection of this priority class is expected to be determined by appropriate SLA agreements between network operators and customers for the desired service.

The choice of the offered priority levels and the priority implementation mechanisms in the transport stratum is up to the network operator.

The total number of restoration priority levels may be extended in the future.

8 Security considerations

The nature of this Recommendation does not raise new security considerations.

Appendix I

Illustrative example of restoration priority use for call/session setup with RACF

(This appendix does not form an integral part of this Recommendation)

[b-ITU-T Y.2111] defines the functional architecture for the resource and admission control functions (RACF) for NGN. RACF is intended to serve as the arbitrator between the service control function (SCF) and the transport function in the NGN for QoS-related transport control in access and core networks. Arbitration decisions will be based on transport subscription information, SLAs, network policy rules, service priority, and transport resource status and utilization information.

Restoration priority levels can be used in the RACF decision-making process to determine appropriate resource allocation for incoming calls/sessions depending on the type of the underlying transport technology. To illustrate the usage, consider the example of how two types of incoming video applications – IPTV and multimedia video conferencing – are considered by RACF based on the following assumptions:

- The transport technology deployed is a DiffServ-Aware MPLS-TE (DS-TE) network [b-IETF RFC 3564] having an aggregated set of Label Switched Path (LSP) tunnels, each with an assigned class type attribute, into which incoming calls/sessions are directed based on the traffic type and admission control priority [ITU-T Y.2171] of the incoming call/session. A network operator may decide to group all video applications in tunnels of the same class type (e.g., class type 2). This may be necessary as the total number of class types for DS-TE tunnels is restricted to eight.
- The DS-TE tunnels are protected against failures by the MPLS-Fast Reroute [b-IETF RFC 4090] mechanism whereby each tunnel is assigned backup tunnels having pre-determined set-up and holding priority attributes. These tunnel attributes are stored in appropriate management information bases (MIB) [b-IETF RFC 3812]. This flexibility allows for DS-TE tunnels of the same class type to have different restoration priorities.
- An IPTV session is initiated requiring level 2 (normal) admission control priority and level 1 (high) restoration priority. The high level 1 restoration priority is necessary due to very stringent availability requirements for IPTV sessions [b-ID-ServClasses].
- A multimedia video conferencing session is initiated requiring level 2 (normal) admission control priority and level 2 (normal) restoration priority. This application can be rate adaptive and hence availability requirements are not as stringent as IPTV [b-ID-ServClasses].
- The transport resource control functional entity (TRC-FE) can obtain information about the underlying transport technologies via the Rc interface. This interface has yet to be defined. It is assumed that the fast reroute backup tunnel priorities stored in the MIBs will be available to the TRC-FE via the Rc interface.

The policy decision functional entity (PD-FE) communicates the requirements for these incoming sessions to the TRC-FE via the Rt interface (see Figure 5 of [ITU-T Y.2111]). The TRC-FE can then map these requirements to the DS-TE tunnel attributes. Thus the IPTV application can be mapped into a class type 2 tunnel having priority attributes that support level 1 restoration priority. The video conferencing session can be mapped into another class type 2 tunnel having priority attributes that support level 2 restoration priority. Assuming that sufficient bandwidth is available in the respective tunnels, the incoming applications flows are admitted into the specified tunnels.

To complete the illustration, if both class type 2 tunnels carrying the IPTV and video conferencing sessions are rendered inoperable due a network failure, then the fast reroute mechanism restores the tunnel flows over backup tunnels in the order of the pre-established set-up and holding priorities. Thus, the tunnel with the IPTV application is restored first along with all other level 1 restoration priority tunnels. The tunnel with the video conferencing application is restored next along with all other level 2 restoration priority tunnels.

Bibliography

[b-ITU-T Y.2111] ITU-T Recommendation Y.2111 (2006), *Resource and admission control functions in Next Generation Networks.*

[b-ITU-T Q.Sup.51] ITU-T Q Series Supplement 51 (2004), *Signalling requirements for IP QoS.*

[b-ATIS TR 100003] ATIS Technical Report 0100003 (2004), *User Plane Priority Levels for IP Networks and services.*

[b-ATIS TR 100006] ATIS Technical Report 0100006 (2006), *Service Restoration Priority Levels for IP Networks.*

[b-ID-ServClasses] IETF Internet Draft, *Aggregation of DiffServ Service Classes*, draft-ietf-tsvwg-diffserv-class-aggr-02, March 2007, work in progress.

[b-IETF RFC 3209] IETF RFC 3209 (2001), *RSVP-TE: Extensions to RSVP for LSP Tunnels.*

[b-IETF RFC 3564] IETF RFC 3564 (2003), *Requirements for Support of Differentiated Services-aware MPLS Traffic Engineering.*

[b-IETF RFC 3812] IETF RFC 3812 (2004), *Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Management Information Base (MIB).*

[b-IETF RFC 4090] IETF RFC 4090 (2005), *Fast Reroute Extensions to RSVP-TE for LSP Tunnels*.

[b-IETF RFC 4426] IETF RFC 4426 (2006), *Generalized Multi-Protocol Label Switching (G-MPLS) Recovery Functional Specification.*

[b-IETF Internet Draft] IETF Internet Draft, *Y.1541 QoS Model for Networks Using Y.1541 QoS Classes*, draft-ietf-nsis-y1541-qosm-04.txt, G. Ash, *et al*, April 2007, work in progress.

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