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OF ITU

Y.1221

Amendment 2
(11/2005)

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

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

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Traffic control and congestion control in IP-based networks

Amendment 2: Further extension to transfer capabilities

ITU-T Recommendation Y.1221 (2002) – Amendment 2

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ITU-T Recommendation Y.1221

Traffic control and congestion control in IP-based networks

Amendment 2

Further extension to transfer capabilities

Summary

This amendment contains a new clause 6.5 "Conditionally dedicated bandwidth (CDBW) transfer capability" to be inserted in ITU-T Rec. Y.1221 when it is next revised. With this amendment, the summary of ITU-T Rec. Y.1221 remains unchanged as:

"This Recommendation provides a general description as well as objectives and procedures for traffic control and congestion control for IP-based networks. In particular, it describes the concepts of the traffic contract between a user and the network. It specifies the IP transfer capabilities (IPTCs) including, for each IPTC, the service model, the associated traffic patterns and conformance definition."

Source

Amendment 2 to ITU-T Recommendation Y.1221 (2002) was approved on 29 November 2005 by ITU-T Study Group 12 (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, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

ITU-T Recommendation Y.1221

Traffic control and congestion control in IP-based networks

Amendment 2

Further extension to transfer capabilities

Add the following text as a new clause 6.5:

6.5 Conditionally dedicated bandwidth (CDBW) transfer capability

6.5.1 Description

The Conditionally Dedicated Bandwidth (CDBW) transfer capability is intended to support applications with stringent delay and varying (application-dependent) loss requirements. However, it is aimed at applications that usually require very low losses or which can tolerate infrequent and short-duration bursts of losses. It would not be likely that these applications would include broadcast quality video but it could support voice and lower quality video (including, potentially, home movie) transmissions.

CDBW aims to support with a minimum of negotiation using simplified in-band signalling:

- on most flows, throughout their duration, very low packet losses; roughly equivalent to the network "acceptance" of such flows into this QoS commitment category;
- a worse level of packet loss on (typically) a small percentage of flows that cannot yet be accepted into the above category but are not denied a transmission path;
- low delay of IP packets along an edge-to-edge path of the network.

The CDBW transfer capability recognizes the existence of one or several IP flows sharing a common physical link. An IP flow consists of a sequence of one or more packets that have the same source IP address, destination IP address, source and destination port numbers and experimental/ diffserv value. Every IP flow of CDBW has a policed Maximum Rate. Flows exceeding this Maximum Rate should have their excess packets discarded.

Each flow is assigned a Flow State at each network node appropriate to how it will be handled. There are only two possible states: "discard first" and "discard last". Flows in the "discard last" state always have preemptive priority with respect to the available link capacity. In other words, they may rob flows in the "discard first" state if necessary but subject to the policed Maximum Rate.

The current Flow State of a flow is not conveyed from node-to-node or from network-to-user. Users of this service will expect the provider to make reasonable efforts to ensure that they are infrequently and preferably randomly selected to be in the "discard first" state at the time of network congestion. Furthermore, users will expect that instances of network congestion are infrequent due to appropriate capacity management.

Flows in the "discard first" state are typically, but not necessarily, the latest flows to start. A flow that starts and is assigned a "discard first" state may progress to the "discard last" state subject to the policy conditions that apply. Different rules may be used by administrations governing how and when a flow may progress to the "discard last" state. Some rules may be captured in this Recommendation for information only. Similarly, not all flows that are the latest to start need be assigned to the "discard first" state. Certain flows may be treated preferentially, as determined by the service options of the provider.

Signalling aspects of the CDBW transfer capability will not be described in detail in this Recommendation. In summary there is:

- An in-band signal termed the "Start Packet", recognized by network nodes supporting the CDBW transfer capability that indicates a new flow is starting and specifies its requested Maximum Rate and any preference-level request. Authentication information is also included.
- An in-band Acknowledgement Packet, that confirms that all nodes along the edge-to-edge route have either accepted, rejected or modified the request.
- An in-band Congestion Notification packet sent to the receiving edge in the event that packet discards are applied to a flow.

A receiving user who does not at any time receive any congestion notification message relating to a specific flow, and yet perceives packet losses on that flow above the loss limits advertised for this service, would be entitled to complain.

The aim of this transfer capability is not to spread losses across all flows during moments of congestion but, instead, to focus losses consistently on a small set of flows and provide congestion notification signals to the receiving end of such flows.

If, during moments of heavy congestion, all packets from flows in the "discard first" state are being discarded, and if this is insufficient to recover from congestion, then different implementations may limit the extent of packet losses spread among the "discard last" group. For example (and again for information), an implementation may randomly select a small number of "discard last" flows and change their state to "discard first".

The percentage of flows which, at any one time, are in the "discard first" state is a network provider's choice. A qualitative aim for this service is that any one end-user should not experience this bandwidth loss frequently. Flows that request, and are accepted to have, a high preference marking almost never experience discards.

Figure 1 shows how the parameter "% of discard first flows" shifts the service commitment from best effort towards low loss commitments achieved 100% of the time, as experienced by the user.

It can be seen from this figure that CDBW focuses on keeping as many flows as possible free of packet losses *for their duration.* To achieve this experience purely using best effort principles would require significant levels of over-provision. On the other hand, "circuit mode" principles create the possible experience of an unacceptable call rejection rate unless sufficient over-provision is used to accommodate the busy hour calling rate. CDBW operates with roughly the same level of over-provision as "Circuit Mode" (thus keeping the number of flows that receive Congestion Notifications low), but does not reject the flows. It takes advantage of any variable bit-rate aspects of these flows that implies the capacity demanded is less than the sum of the flow peak rates. Furthermore, the transmission path remains available for flows that have received a Congestion Notification on the grounds that an application would rather have this than outright rejection.

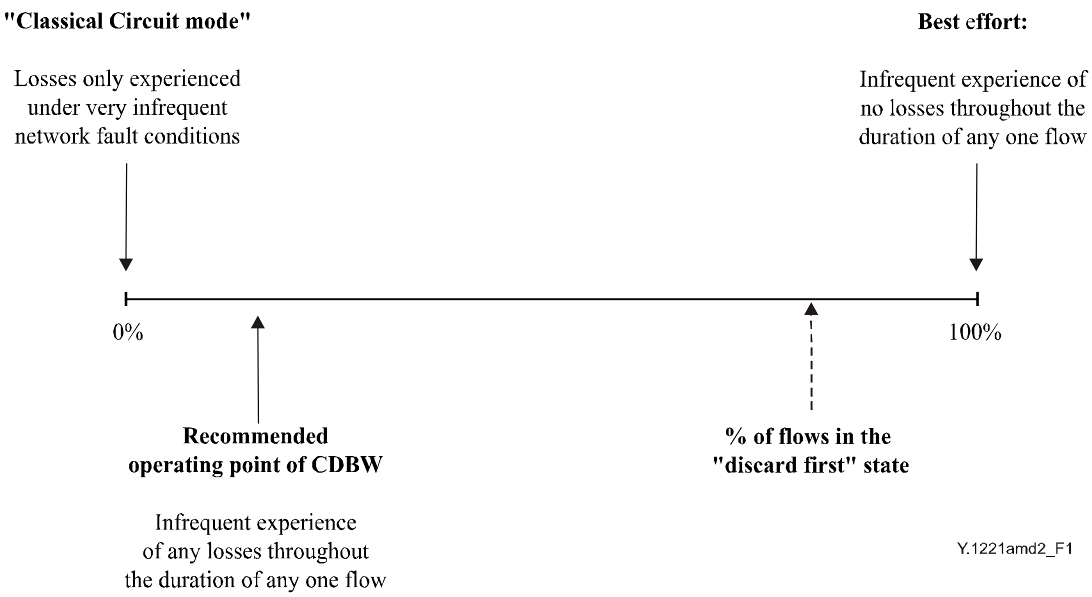

Figure 1/Y.1221 – CDBW transition from a best effort service to imperceptibly near a "circuit mode" service

6.5.2 Service model

The commitment made by the network is conditional depending on the designated Flow State. There is a loose analogy between these Flow States and "Accepted/Rejected" calls but, instead of rejection being outright and immediate, a flow may continue in the "discard first" state and the associated application may choose to compensate for any bursts of losses as and when they occur. These may frequently turn out to be only of short duration (or may not occur at all – there is no certainty that flows in the "discard first" state will experience any packet losses).

Therefore, very low packet loss levels are assured for all flows assigned to the preemptive priority "discard last" state. The network will signal a "discard first" receiving user only when its flow is about to experience packet discards. For such users (and associated applications), this signal indicates that, while the flow has not been totally rejected, the very low loss guarantee part of the negotiated QoS cannot be supported. It is up to the application whether to choose to terminate the flow or continue (possibly with a change of coding).

The CDBW user should expect that all non-conforming packets will be discarded by the network.

The CDBW capability for "discard last" flows can be associated with specified loss commitments (IP Loss Ratio, IPLR) and specified delay commitments (IP Transfer Delay, IPTD and IP Delay Variation, IPDV) (see ITU-T Rec. Y.1541).

The network does not fragment packets. In addition, the network commits to attempt, as long as possible (e.g., until there is a need to re-route the flow), to maintain packet sequence integrity.

6.5.3 Traffic descriptor

The peak rate of the flow is the only mandatory element of the traffic descriptor.

A traffic descriptor should be associated with each flow of this service type coming across a UNI or NNI. This Traffic Descriptor consists of the following parameters:

– The peak rate *Rp* and peak bucket size *Bp*.

– The maximum allowed packet size *M*.

6.5.4 Conformance definition

An IP packet is conforming if the aggregate arrival conforms to the following two parts:

– the arrival is conforming to the GBRA(Rp,Bp);

– the actual packet length does not exceed the maximum allowed packet size M.

The GBRA is updated for conforming packets only.

6.5.5 QoS commitments

The CDBW transfer capability may be associated with specified loss commitments and specified delay commitments, thus making it suitable for the provision of QoS Class 0 and Class 1, within the limits set by the conditional nature of this transfer capability.

If all packets are conforming, the QoS commitments apply to all IP packets of all flows accepted by the network as "discard last". For flows only accepted by the network to be allowed to continue as "discard first" flows, the loss guarantee part of the negotiated QoS does not apply.

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