International Telecommunication Union

ITU-T Study Group 12

Multimedia QoS requirements from a user perspective

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End to end performance from a user perspective

- A user is not concerned with the details of how a particular service is implemented
- However, the user is interested in comparing the same service offered by different providers in terms of universal, user-oriented performance parameters
- This implies that performance should be expressed by parameters that:
  - Focus on user-perceivable effects, rather than their causes within the network
  - Are independent of the specific network architecture or technology
- User requirements form the basis of network QoS classes

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Important parameters from a user perspective

- Delay
  - Very direct impact on user satisfaction depending on the application
  - Includes delays in the terminal, network, and any servers
  - From a user point of view, delay also takes into account the effect of other network parameters such as throughput

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Important parameters from a user perspective

- Delay variation
  - Often included as a performance parameter since it is very important at the transport layer in packetised data systems due to the inherent variability in arrival times of individual packets
  - However, services that are highly intolerant of delay variation will usually take steps to remove it by means of buffering, effectively eliminating delay variation as perceived by the user, although at the expense of adding additional fixed delay

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Important parameters from a user perspective

- Information loss
  - Very direct effect on the quality of the information finally presented to the user, whether it be voice, image, video or data.
  - Not limited only to the effects of bit errors or packet loss during transmission, but also includes the effects of any degradation introduced by media coding for more efficient transmission (e.g. the use of low bit rate speech codecs for voice).

Performance considerations for different applications

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- Audio
  - Conversational voice
    - Heavily influenced by one-way delay. which may result in echo and impact conversational dynamics
    - Very intolerant to delay variation
    - Human ear is tolerant to a certain amount of information loss
  - Voice messaging
    - Requirements for information loss are similar to conversational voice
    - More tolerance for delay since there is no direct conversation involved.
  - Streaming audio
    - Expected to provide better quality than conventional telephony, so requirements for information loss in terms of packet loss will be tighter
    - No conversational element involved, and delay requirements for the audio stream itself can be relaxed, even more so than for voice-messaging

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Performance considerations for different applications

- Video
  - Videophone
    - Implies a full-duplex system, carrying both video and audio and intended for use in a conversational environment
    - Same delay requirements as for conversational voice, i.e. no echo and minimal effect on conversational dynamics
    - Human eye is tolerant to a certain amount of information loss
    - Added requirement that the audio and video must be synchronised within certain limits to provide “lip-synch”
  - One-way video
    - No conversational element involved, meaning that the delay requirement will not be so stringent, and can follow that of streaming audio

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Performance targets for audio and video applications

Medium	Application	Degree of symmetry	Typical data rates	Key performance parameters and target values			
				One-way delay	Delay variation	Information loss**	Other
Audio	Conversational voice	Two-way	4-64 kb/s	<150 msec preferred* <400 msec limit*	< 1 msec	< 3% packet loss ratio (PLR)	
Audio	Voice messaging	Primarily one-way	4-32 kb/s	< 1 sec for playback < 2 sec for record	< 1 msec	< 3% PLR	
Audio	High quality streaming audio	Primarily one-way	16-128 kb/s	< 10 sec	< 1 msec	< 1% PLR	
Video	Videophone	Two-way	16-384 kb/s	< 150 msec preferred <400 msec limit		< 1% PLR	Lip-synch : < 80 msec
Video	One-way	One-way	16-384 kb/s	< 10 sec		< 1% PLR	

* Assumes adequate echo control

** Exact values depend on specific codec, but assumes use of a packet loss concealment algorithm to minimise effect of packet lo ss

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Performance considerations for different applications

- Data
  - From a user point of view, the prime requirement for any data transfer application is to guarantee zero loss of information
  - Delay variation is not generally noticeable to the user, although there needs to be a limit on synchronisation between media streams in a multimedia session (e.g. audio in conjunction with a white-board presentation)
  - The different applications distinguish themselves on the basis of the delay which can be tolerated by the end-user from the time the source content is requested until it is presented to the user

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Performance considerations for different applications

- Tolerance to delay for data applications
  - Distinguish between "urgent" applications
    - E-commerce
    - Command/control functions
    - Interactive games
  - and "less urgent" applications
    - File downloads
    - Images
    - Messaging

Performance targets for data applications

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Medium	Application	Degree of symmetry	Typical amount of data	Key performance parameters and target values		
				One-way delay*	Delay variation	Information loss
Data	Web-browsing - HTML	Primarily one-way	~10 kB	Preferred < 2 sec /page Acceptable < 4 sec/page	N.A	Zero
Data	Transaction services – high priority e.g. e-commerce, ATM	Two-way	< 10 kB	Preferred < 2 sec Acceptable < 4 sec	N.A	Zero
Data	Command/control	Two-way	~ 1 kB	< 250 msec	N.A	Zero
Data	Interactive games	Two-way	< 1 kB	< 200 msec	N.A	Zero
Data	Telnet	Two-way (asymmetric)	< 1 kB	< 200 msec	N.A	Zero
Data	E-mail (server access)	Primarily one-way	< 10 kB	Preferred < 2 sec Acceptable < 4 sec	N.A	Zero

* In some cases, it may be more appropriate to consider these values as response times.

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Performance targets for data applications

Medium	Application	Degree of symmetry	Typical amount of data	Key performance parameters and target values		
				One-way delay*	Delay variation	Information loss
Data	Bulk data transfer/retrieval	Primarily one-way	10 kB-10 MB	Preferred < 15 sec Acceptable < 60 sec	N.A	Zero
Data	Still image	One-way	< 100 kB	Preferred < 15 sec Acceptable < 60 sec	N.A	Zero
Data	E-mail (server to server transfer)	Primarily one-way	< 10 kB	Can be several minutes	N.A	Zero
Data	Fax ("real-time")	Primarily one-way	~ 10 kB	< 30 sec/page	N.A	<10-6 BER
Data	Fax (store & forward)	Primarily one-way	~ 10kB	Can be several minutes	N.A	<10-6 BER
Data	Low priority transactions	Primarily one-way	< 10 kB	< 30 sec	N.A	Zero
Data	Usenet	Primarily one-way	Can be 1 MB or more	Can be several minutes	N.A	Zero

* In some cases, it may be more appropriate to consider these values as response times.

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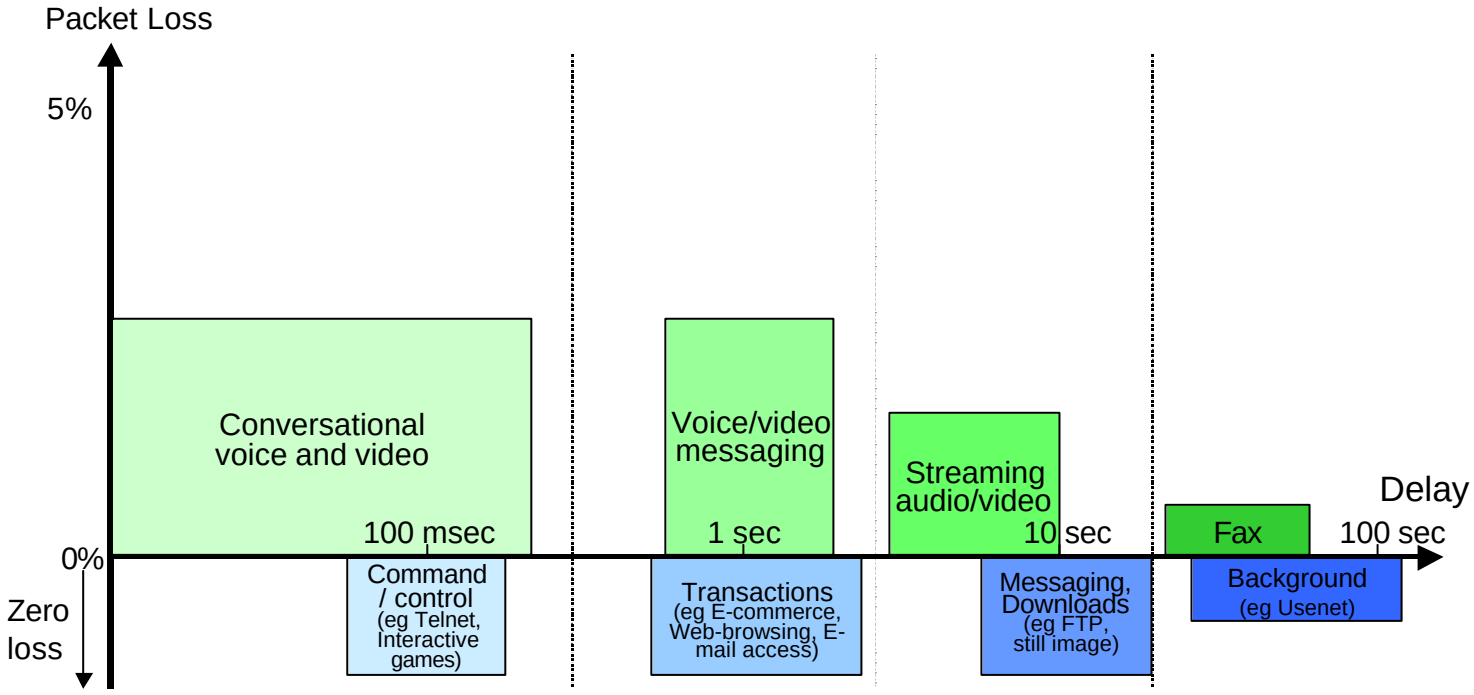
Mapping of user-centric QoS requirements

- 8 distinct groupings, covering the range of applications
- Distinction between applications which can tolerate some information loss and those that cannot
- Main distinction in terms of delay



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Model for user-centric performance requirements

- Mapping can be formalised into model for QoS categories

	Interactive (delay <<1 sec)	Responsive (delay ~2 sec)	Timely (delay ~10 sec)	Non-critical (delay >>10 sec)
Error tolerant	Conversational voice and video	Voice/video messaging	Streaming audio and video	Fax
Error intolerant	Command/control (eg Telnet, interactive games)	Transactions (eg E-commerce, WWW browsing, Email access)	Messaging, Downloads (eg FTP, still image)	Background (eg Usenet)

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Benefit of end-user QoS category model

- Model is based on end to end user perception of impairments, therefore not dependent on any specific technology for its validity
- Provides an indication of the upper and lower boundaries for applications to be perceived as essentially acceptable to the user
- Shows how the underlying impairments of information loss and delay can be grouped appropriately, without implying that one class is “better” than another
- Provides basis for realistic network QoS classes (eg new draft ITU-T Rec. Y.1541)
- Particular applications cited are examples rather than an exhaustive list

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Summary

- Need to define QoS categories from an end-user viewpoint, as starting point for network QoS classes
- New draft ITU-T SG12 Rec. G.QoSrqt"End-user multimedia QoS categories"
- Need to continue to update multimedia performance requirements