International Telecommunication Union

# Basic requiremenst to Quality of Service (IP centric)

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Workshop on Standardization in E-health
Geneva, 23-25 May 2003

# QoS and NP activities at ITU-T

- SG 12 : End to end quality, as perceived by the users. It is fully addressed to Quality, and WP3/12 is dedicated to QoS for IP.
- SG 13 : WP4/13 is dedicated to Network Performance
- SG 2 : Mainly on operational aspects of QoS and SLA. New QoS handbook and activities on the impacts of routing on QoS.
  - QSDG : 1 forum meeting each year and QSDG Magazine
- SG 4 : Management of QoS and SLA.
- SG 9 : QoS for cable networks and video assessment.
- SG 11 : QoS signalling.
- SG 15 : System-specific requirements for network and transport equipment.
- SG 16 : QoS Mecanisms for H.323-based multimedia systems. Quality of speech and video coders.
- SG 17 : Frame Relay QoS.

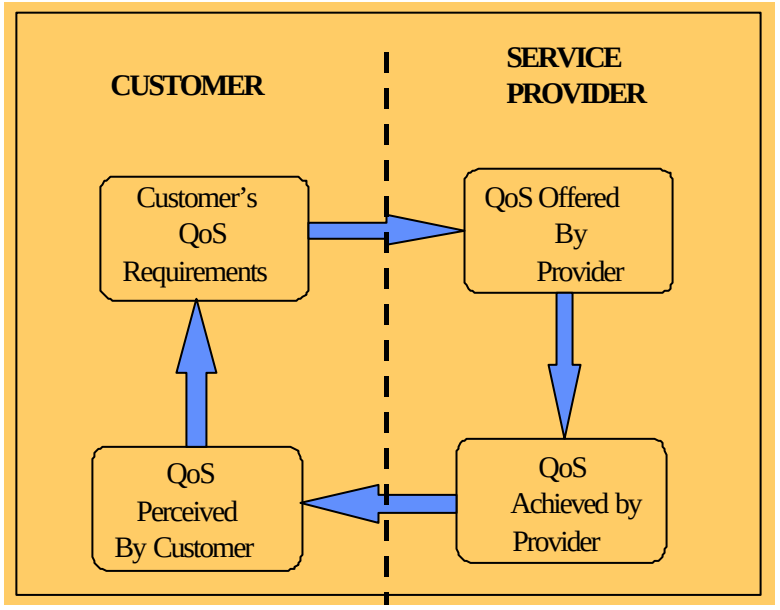
# QoS and NP. Definitions

- E.800 definitions:
  - QoS : "The collective effect of service performance which determines the degree of satisfaction of a user of a service"
  - NP :"The ability of a network or network portion to provide the functions related to *communications* between *users*."
- New Concept : QoE

(Quality of Experience)

4 viewpoints on QoS Rec. G.1000

(Communications Quality of Service : a framework and definitions)



# A selection of Recommendations approved during the study period

- G.1000 «Communications Quality of Service : A framework and definitions »
- G.1010 «End-User multimedia QoS categories »
- E.860 “Framework for service level agreement”
- Y. 1541 “IP Performance objective and allocations”
- Revised Y.1540 « IP Packet transfer and availability performance parameter”
- M.3341 « Requirements for QoS/SLA management over TMN X-interface for IP-based services
- M.2301 *IP Network Provisioning & Maintenance*

# A selection of works in progress in the ITU-T SGs

- On terminal equipments for VOIP (IP Terminals, Gateways)
- On Quality parameters, modelling and classes: G.IPP (Transmission performance pameters for IP ...), G.MMPerf (Multimedia performance requirements), H.mmclass,

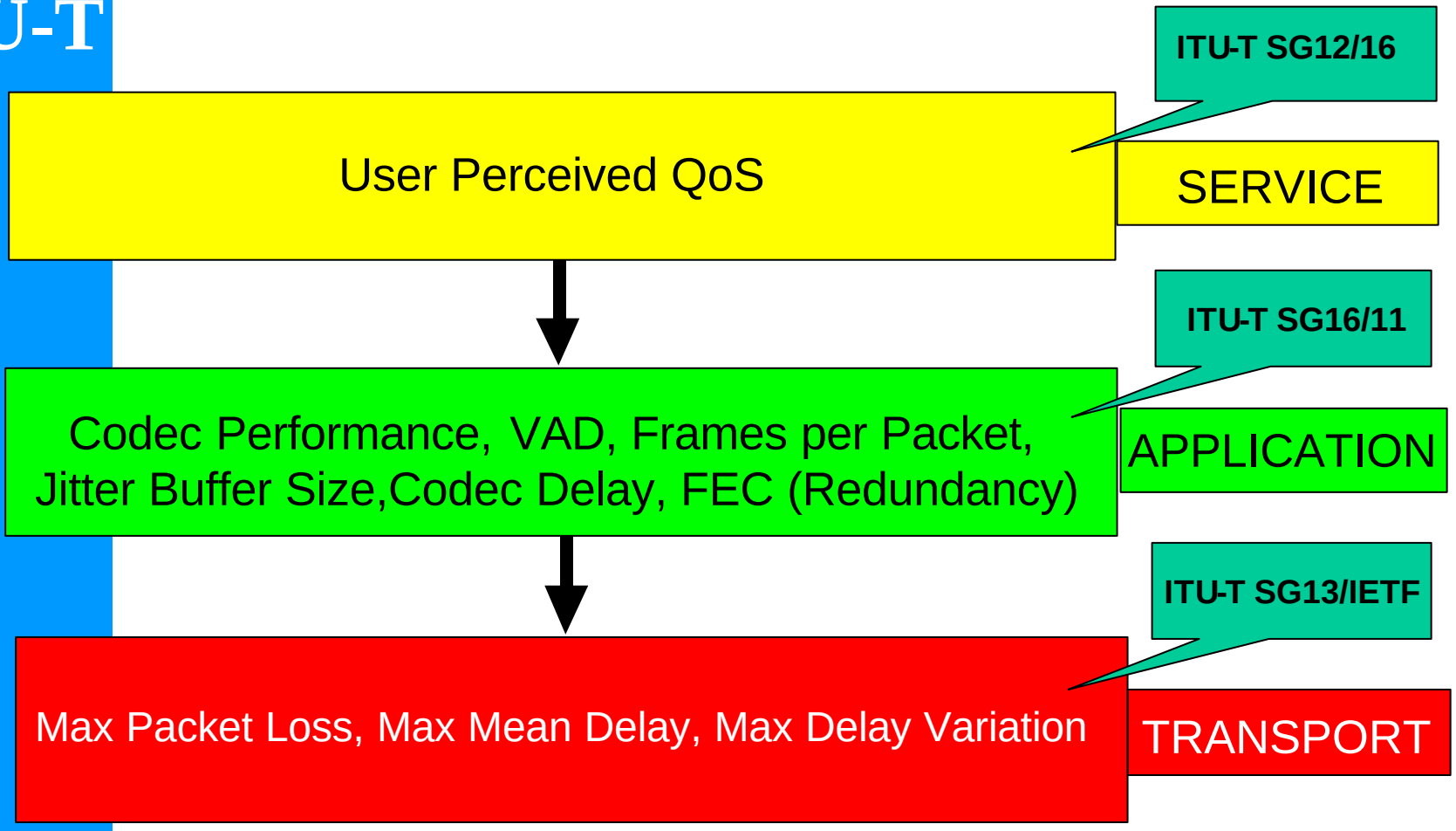
  Several Rec. for perceptual Video Quality.

  Several Questions on Quality evaluation and Modelling (Subj./Obj.; intrusive or non intrusive)
- QoS Handbooks
- On Performance: MPLS Perf, Ethernet Perf
- On Management : H.QoS.m
- On QoS Signalling Draft TRQ "Signalling Requirements for IP-QoS", E-QSC (Signalling of proposed QoS services classes...)
- On QoS Architecture : H.QoSarch End to End QoS Control , Y.qosar

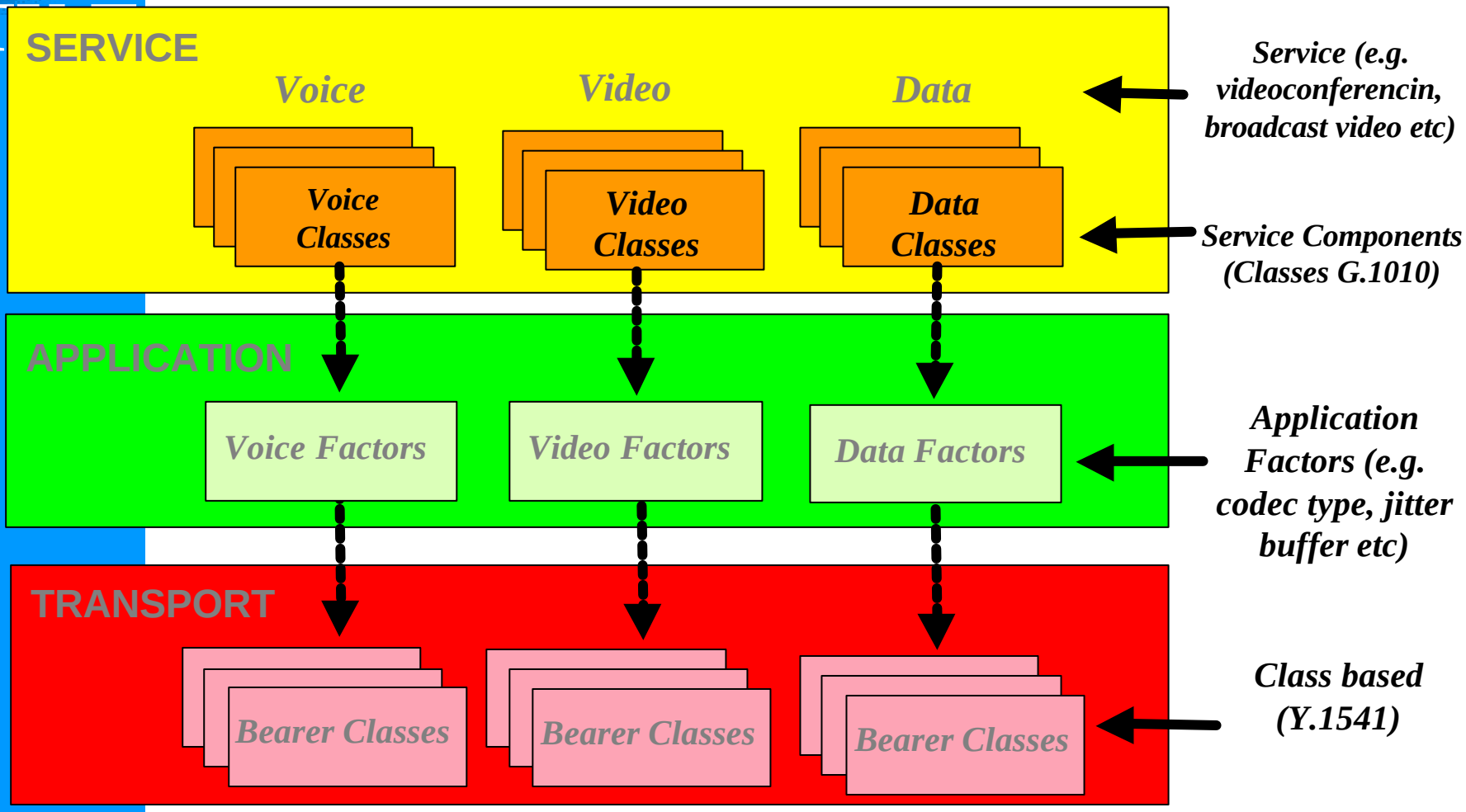
# New activities under progress in SG 12 (related to user)

- Subjective Quality Evaluation of Telephone Services Based on Spoken Dialogue Systems
- Transaction performance of applications running over IP- and Web-oriented networks
- How and to what extent should the ITU deal with standardising definitions of parameters used in SLAs and other performance-related reports?

# QoS Parameters



# Multimedia QoS Classification



# QoS Classes

- The concept of QoS classes should be preferred to individual parameters for signalling end-to end QoS.
- It is important that the parameters that make up a a given QoS class are independent of one another.
- Existing Recommendations : G.109 (for VoIP), G.1010, Y.1541
- Progress in the use QoS classes:
  - signalling for end-to-end QoS
  - management of QoS Classes

# Recommendation G.1010

- **End-User** Multimedia QoS Requirements
- Performance expressed by parameters
  - Focused on **user perceivable effects**
  - **Independent of the networks** internal design
- Parameters
  - Delay
  - Delay variation
  - Information loss (Expressed as PLR -Packet loss Ratio-)

From P. Coverdale, WP 3/12 Chairman

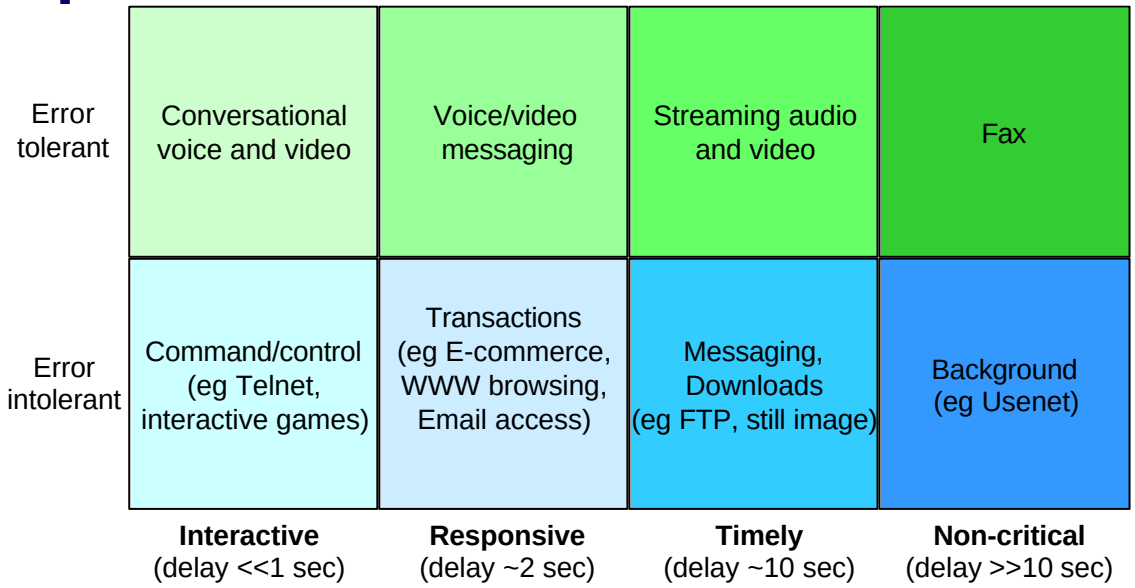
# Performance considerations for different applications

- 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

# Recommendation G.1010

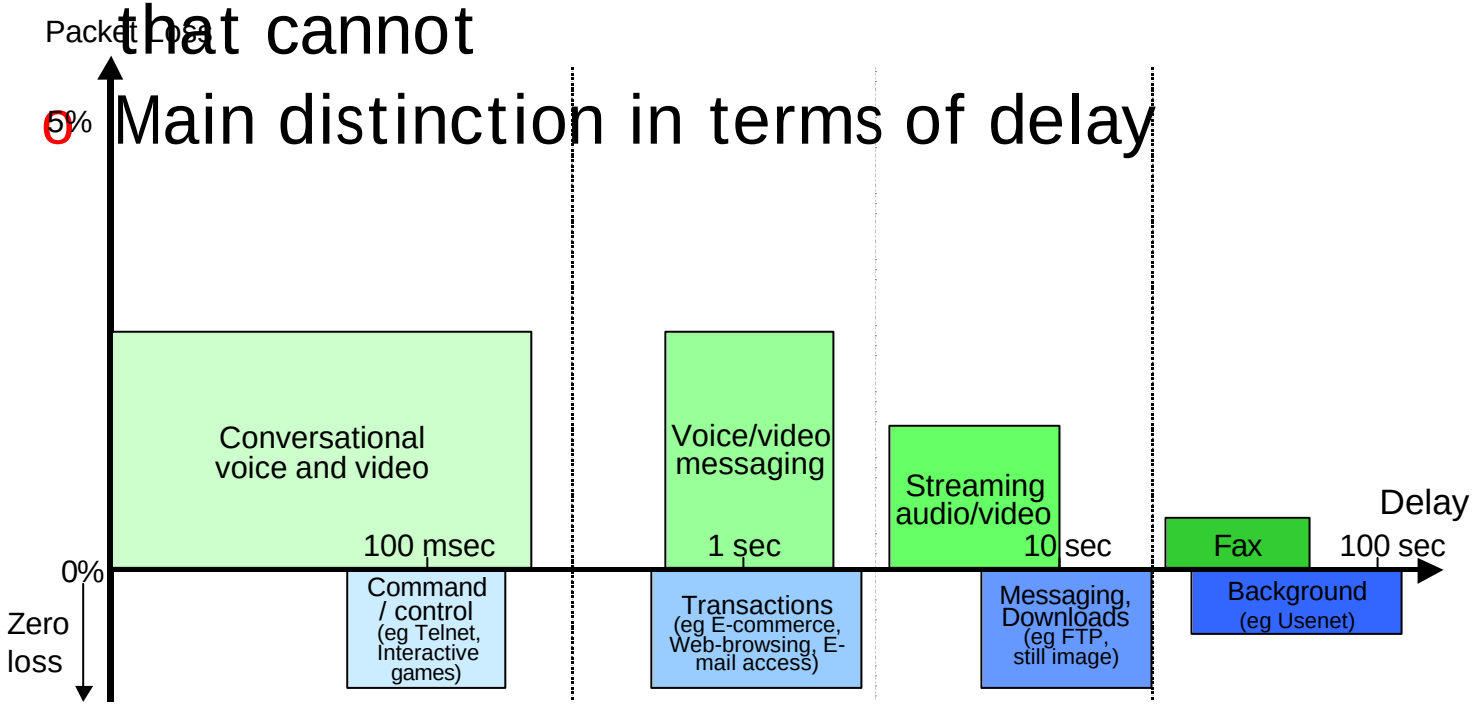
## End-User **Multimedia QoS Requirements**

- Performance expressed by parameters
  - Focused on **user perceivable effects**
  - **Independent of the networks** internal design
- Parameters
  - Delay; Delay variation; Packet loss Ratio
- **Model for user-centric performance requirements** Mapping can be formalised into model for QoS categories



# 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



# 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 basis for realistic network QoS classes (eg ITU-T Rec. Y.1541)
- Rec. G.1010 provides an indication of the upper and lower boundaries for applications to be perceived as essentially acceptable to the user (A new Recommendation G.Mmperf is under developpment)
- Shows how the underlying impairments of information loss and delay can be grouped appropriately, without implying that one class is “better” than another

# 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 loss

# 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 | 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 |

Provisional values

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

# 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 |

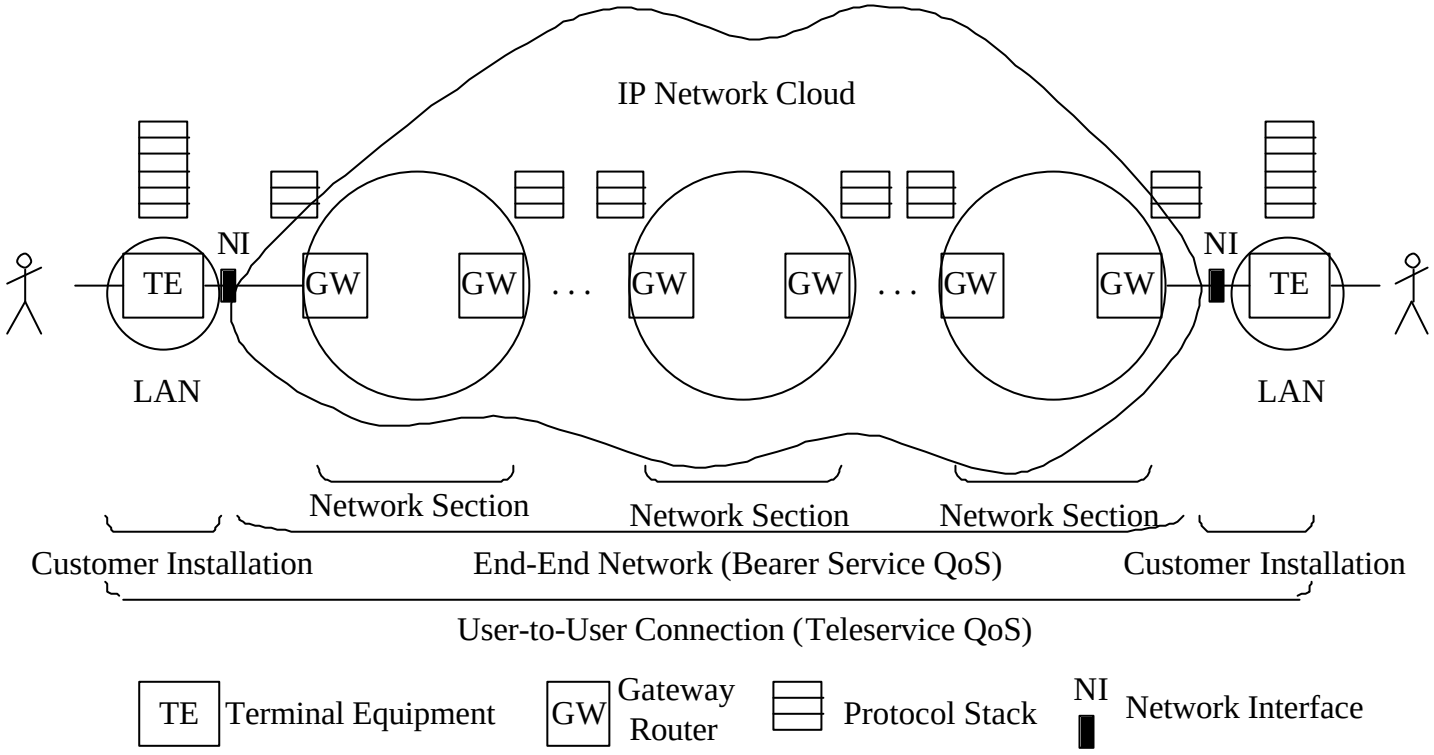
* In some cases, it may be more appropriate to consider these values as response times.

Provisional values

ITU-T

- The previous tables (now under reconsiderations) could be reconsidered for telemedecine applications.

# Recommendation Y.1541 QoS Classes: A Basis for IP Network QoS Control




**NI-to-NI Reference Path** for network QoS Objectives

NOTE : Customer installation equipment is shown for illustrative purposes, only

# Recommendation Y.1541 QoS Classes: A Basis for IP Network QoS Control

| Network Performance Parameter | Nature of Network Performance Objective | Class 0 | Class 1 | Class 2 | Class 3 | Class 4 | Class 5 (Un-specified) |
|---|---|---|---|---|---|---|---|
| IPTD | Upper bound on the mean IPTD | 100 ms | 400 ms | 100 ms | 400 ms | 1s | U |
| IPDV | Upper bound on the $1\text{-}10^{-3}$ quantile of IPTD minus the minimum IPTD | 50 ms | 50 ms | U | U | U | U |
| IPLR | Upper bound on the packet loss probability | $1*10^{-3}$ | $1*10^{-3}$ | $1*10^{-3}$ | $1*10^{-3}$ | $1*10^{-3}$ | U |
| IPER | Upper bound | $1*10^{-4}$ | | | | | U |

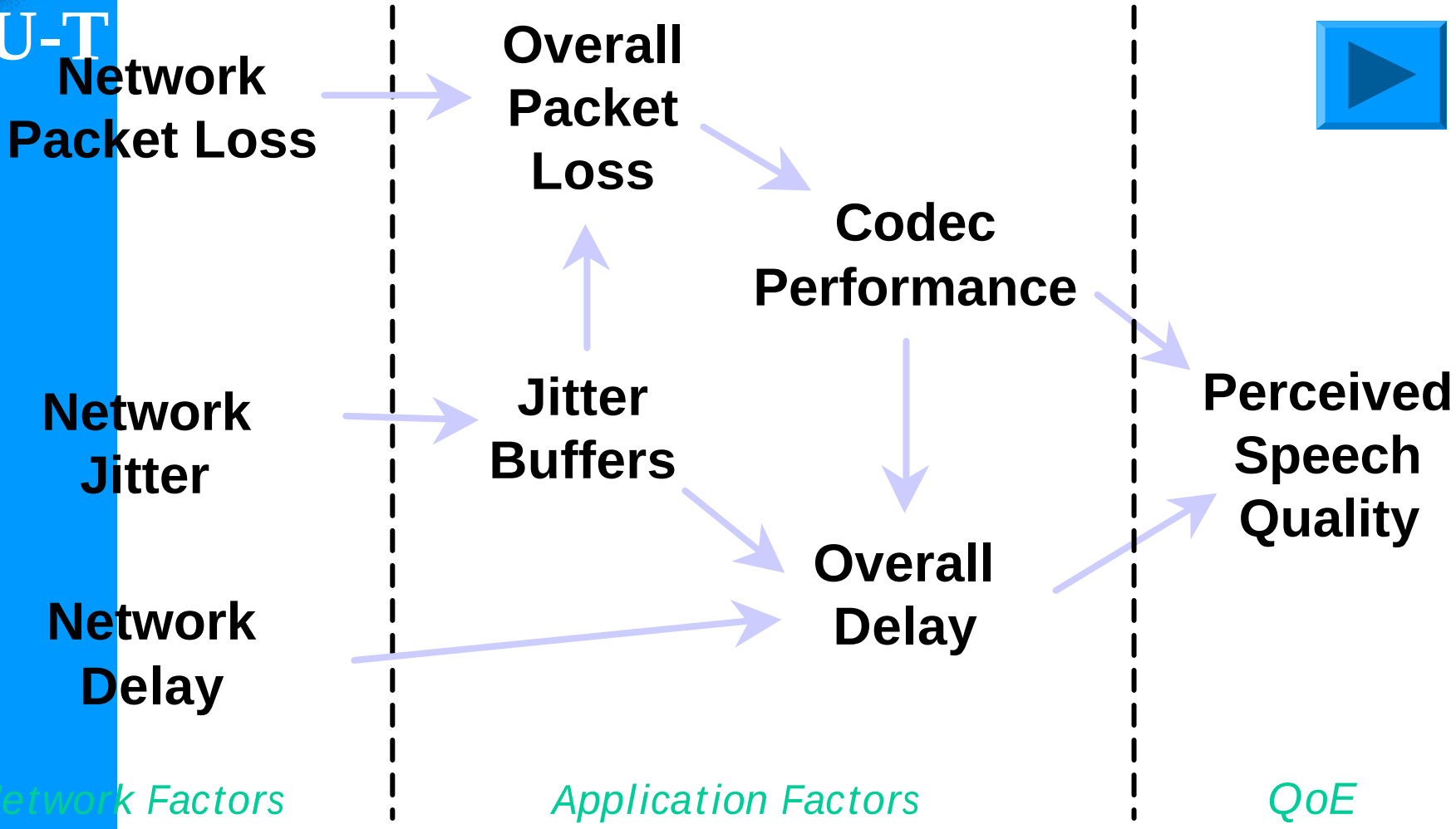
U means « unspecified » or « unbounded »

Note for IPVD : The value of 50ms is dependent on the capacity of inter-networks links. Smaller variations are possible where all the capacities are higher than primary rate, or when competing packet information fields are smaller than 1500 bytes

**A new parameter as been recently included in Y.1540** (the limits are still under study:

IPSLBR : IP Paket Severely Loss Block Ratio

# Inter-relationship of QoS Factors



# Future of QoS/NP in ITU-T

- *The basis for QoS Classes is available. Need to complete and to converge on complete figures (for the different services and layers)*

- *In the future, other mechanisms and protocols may enable dynamic QoS over multiple networks*
- *Emphasis on User'experience (that could be useful for eHealth*
- *To continue the cooperation with other standardization bodies (working on QoS, but also working on specific applications) to communicate our progress, to offer to solve some issues they meet on QoS and to improve the compatibilities of the standards. See the objective of the Workshop (1-3 october 2003, Geneva) on QoS.*

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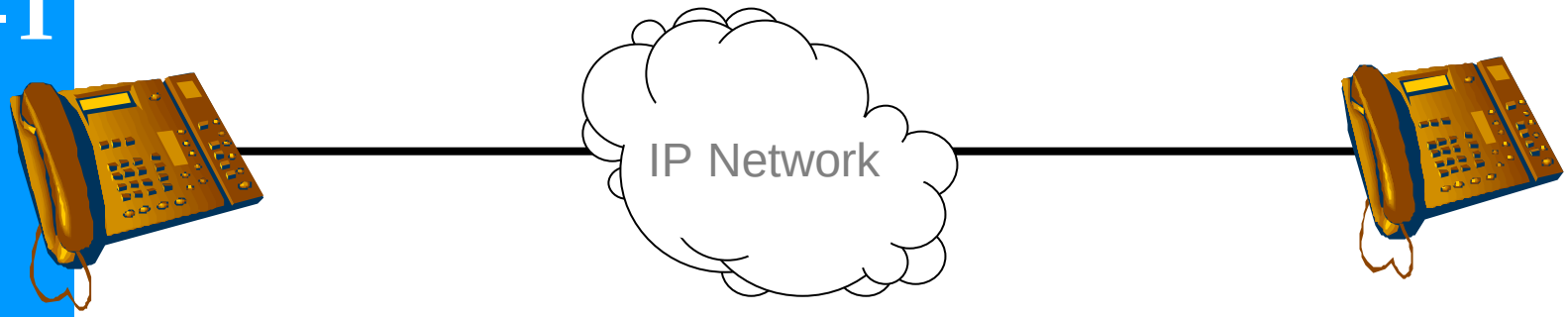
# Annex 1: QoS in IP Networks

## (From M. Buckley)

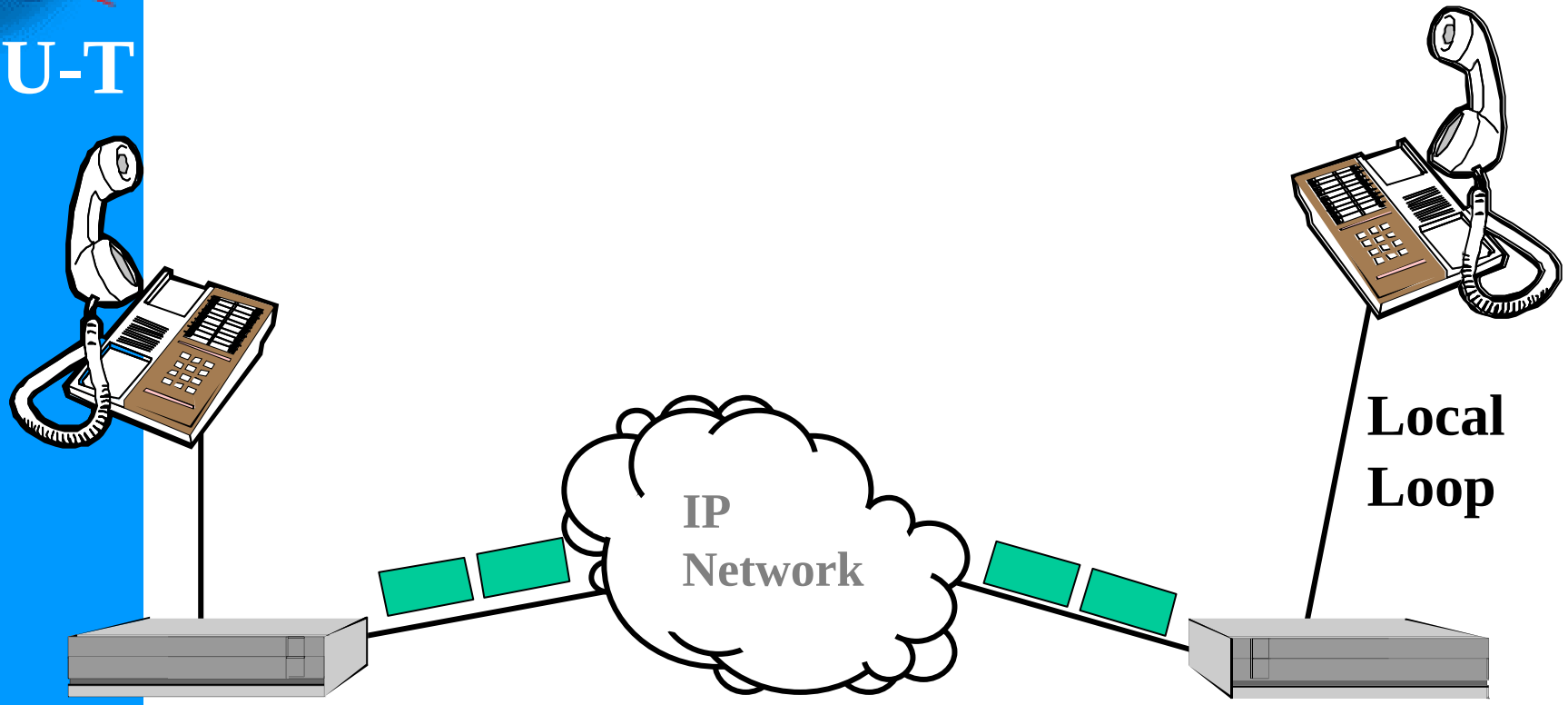
Workshop on Standardization in E-health
Geneva, 23-25 May 2003

# General Approach to IP Transmission




1. Information is digitally encoded via Codec
2. Data is transmitted in packets
3. IP Networks transmit packets end to end
4. Codecs reconstitute original signal

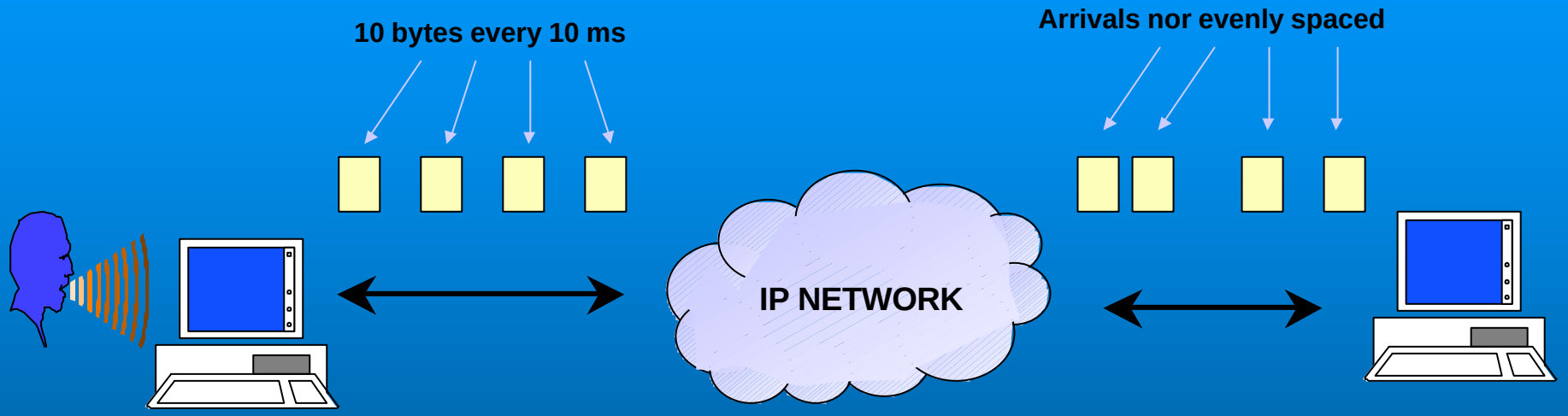
# Factors Affecting Quality



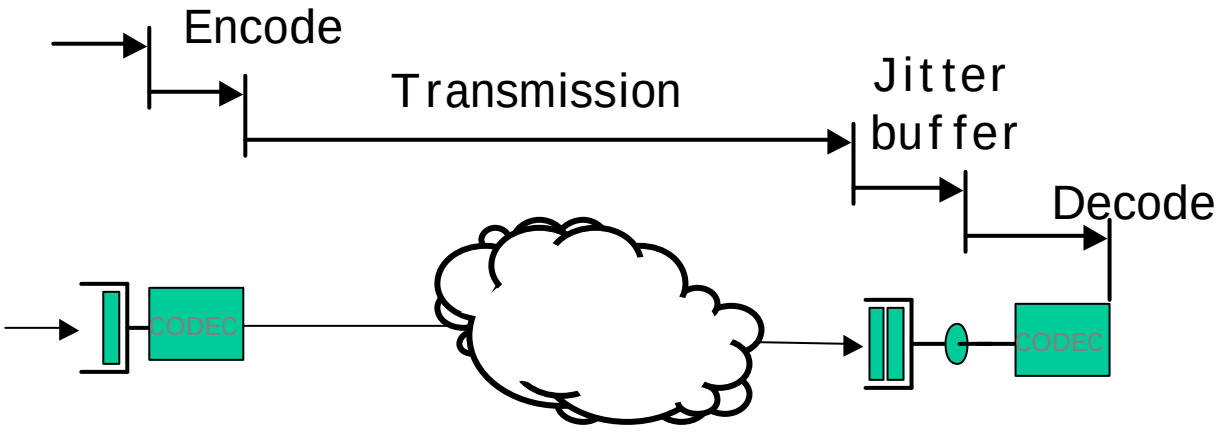

**CODEC type**

**Packet Loss, Delay, Jitter**

# Effect of Jitter

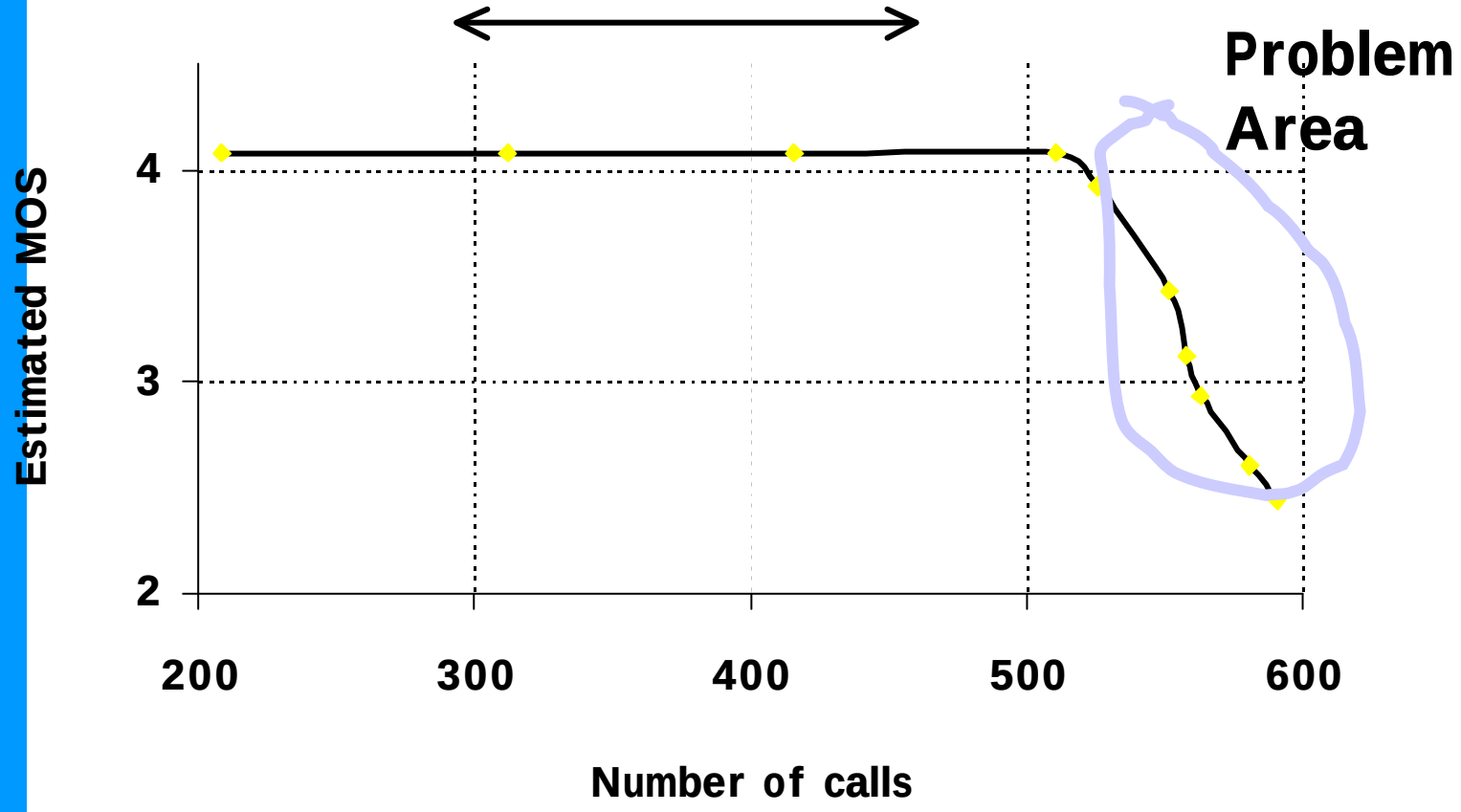


# Effect of Delay

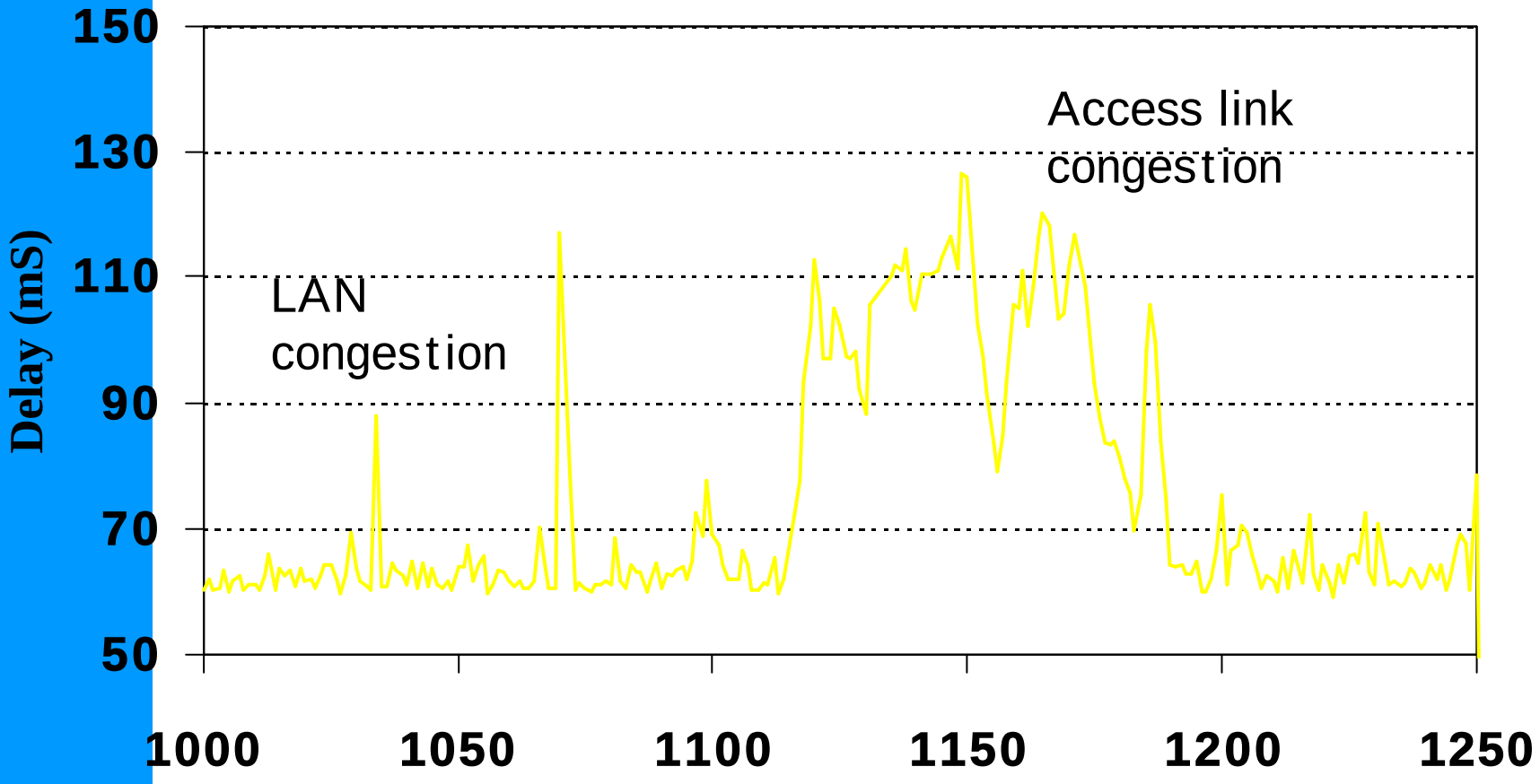


# Effects of overloading network

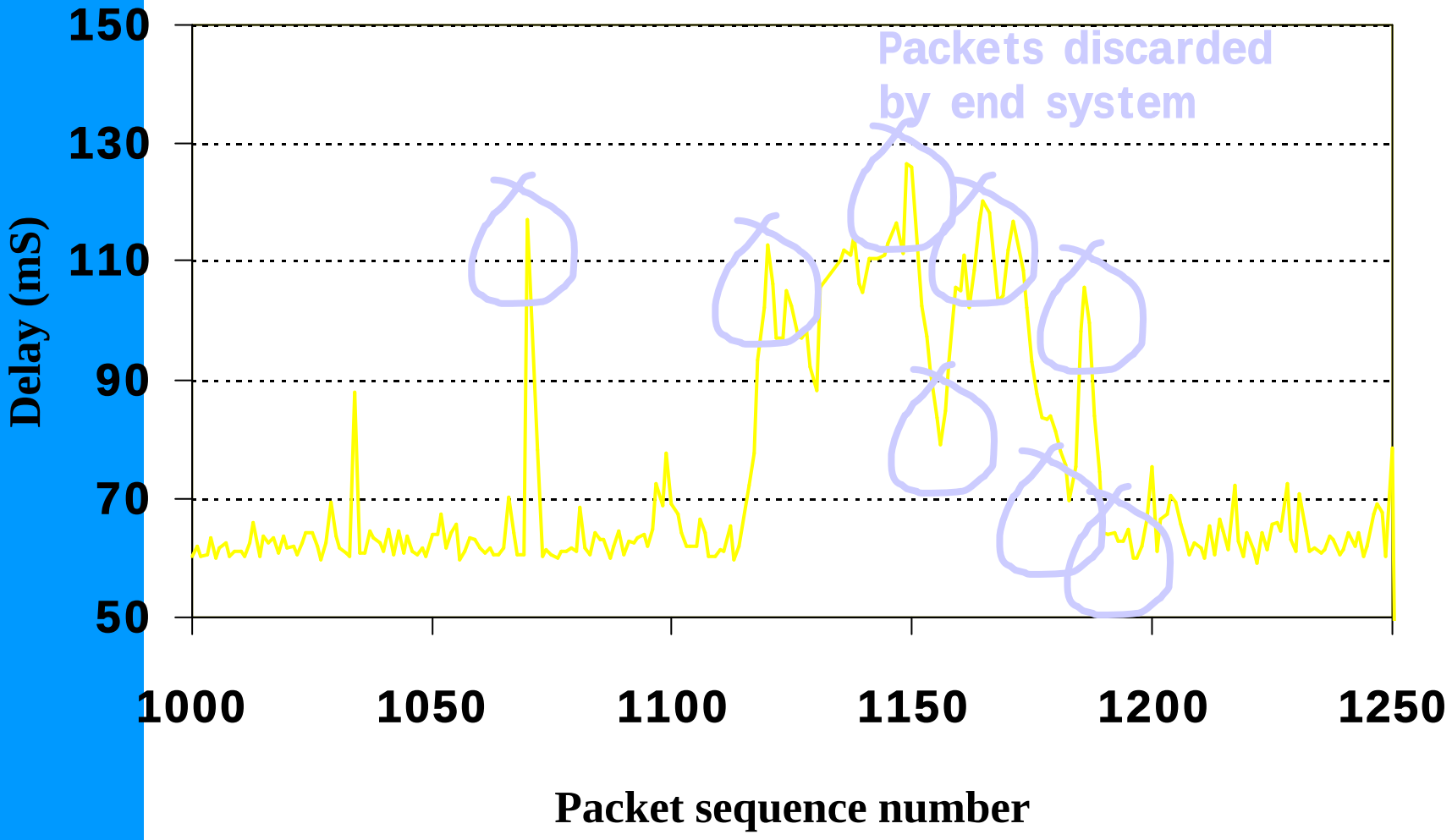
Quality depends on traffic level – time varying



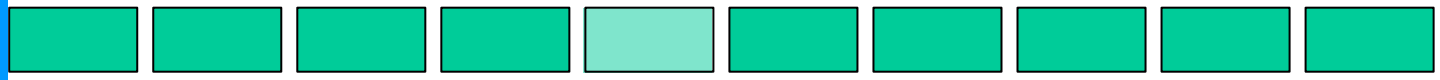
# Typical congestion events



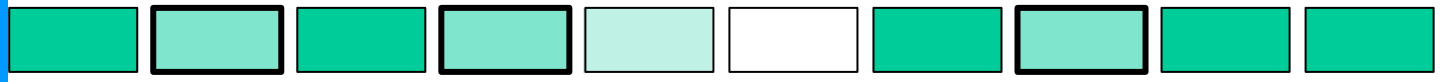
# Impact on packet stream



# Effects of Burstiness



Packet Loss Concealment works well for isolated lost packets



Periods of high packet loss result in audible sound Quality degradation

# Annex 2
# ITU-T Workshop « End to End Quality of Service. What is it? How do we get it?

- Geneva 1-3 Ocober 2003
  - Economic impacts and stakes of the QoS
  - User's experience
  - QoS approach in the different standardization bodies
  - Performance metrics and Measurement techniques
  - General concepts of QoS Classes. Definitions. Relations between layers. Signalling and Management
  - Overall Panel discussions and Action Plan for the future

ITU-T

- Thanks for your attention

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