Central Scientific Research Telecommunication Institute

International Telecommunication Union

Introduction to QoS Concepts
Transmission Planning, QoE, User Perception, Distinction & Selection of Appropriate Regulatory Approaches; Best Practice

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Workshop

IMPLEMENTATION EXPERIENCE OF NETWORK PERFORMANCE PARAMETERS CONTROL SYSTEMS AND GRANTING REQUIRED LEVEL OF SERVICES QUALITY ON THE OPERATOR NETWORKS. SENSOR NETWORKS – AS OPTIMIZATION TOOL FOR VEHICULAR TRAFFIC FLOW

Moscow

27-29 April 2011

Contents

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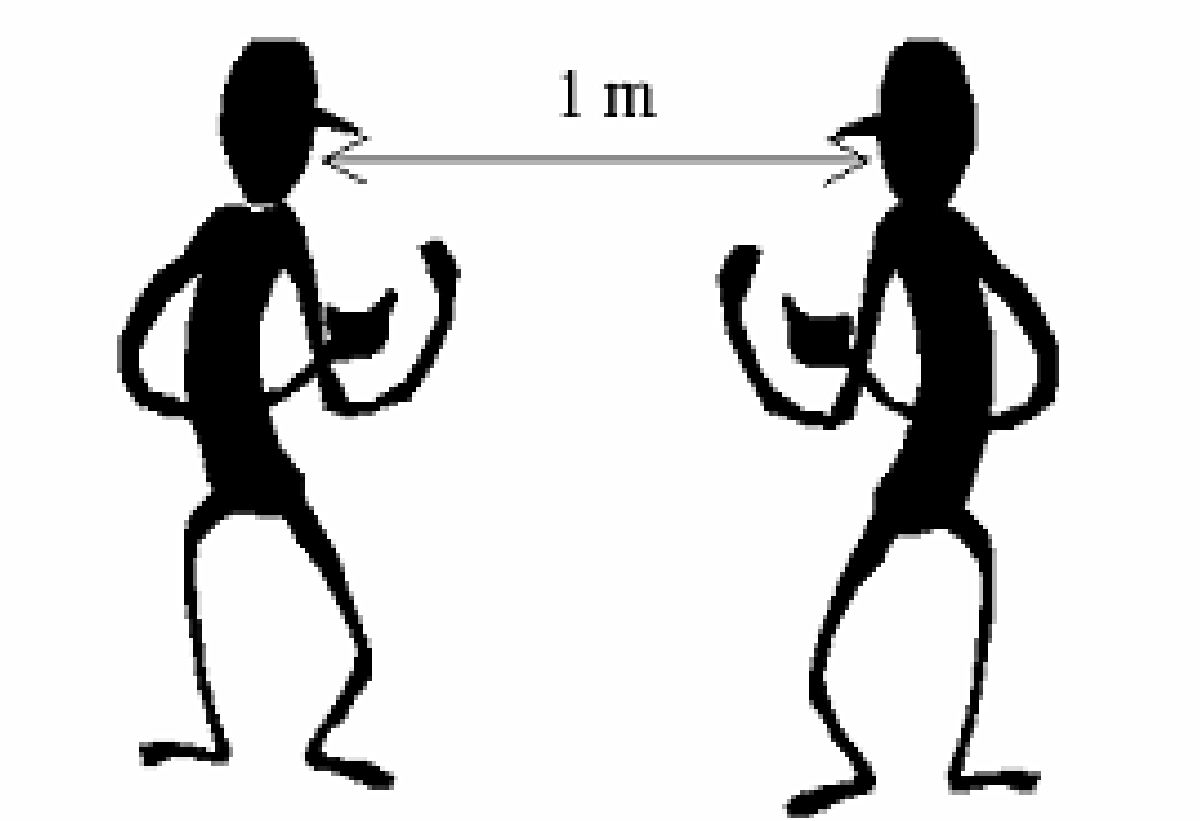
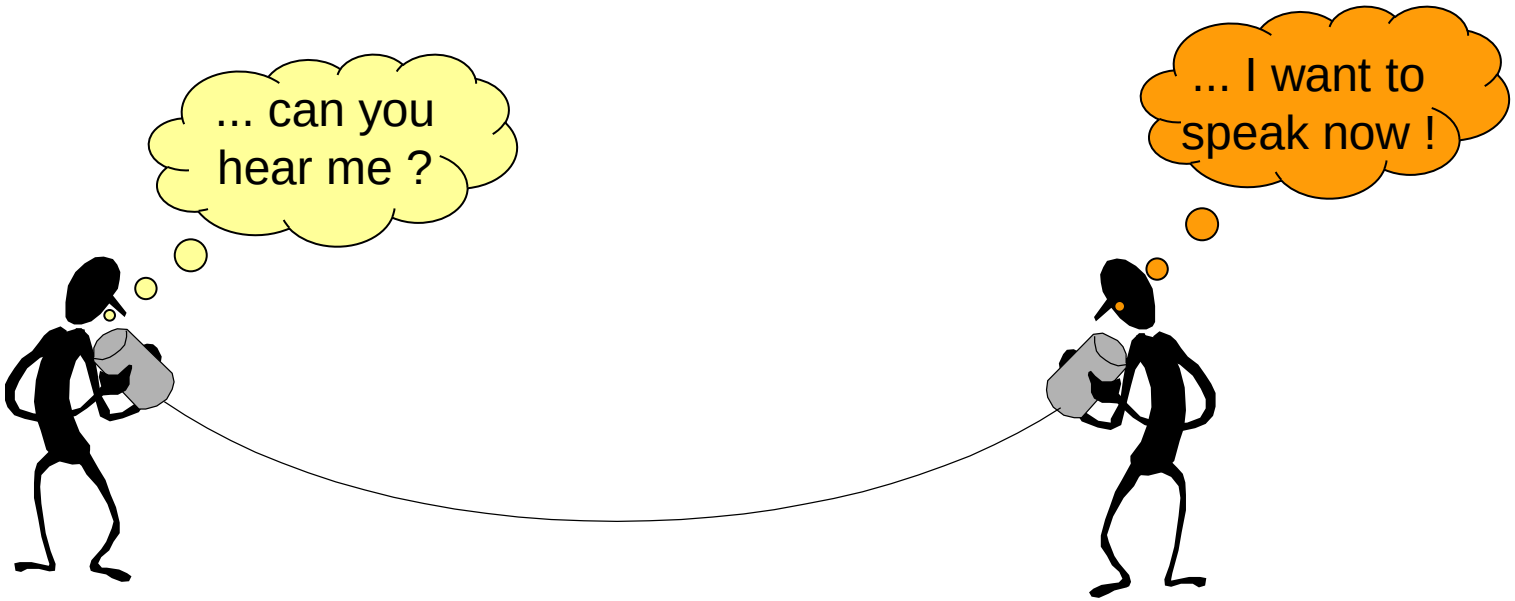
- **Quality of Experience (QoE)**
- **User Perception**
- **Distinction & Selection of Appropriate Regulatory Approaches**
- **Best Practice**

Where it All Begins: Real Communication Situation



... and where End-to-End Quality comes to Play: Employing a Telecommunication System



Definitions start here: ITU-T Rec. E.800

- Network Performance (NP)
  - Pre-requisite to Quality of Service (QoS)
  - Not directly visible to the user
- Quality of Service (QoS)
  - Performance of the Service offered to the User
  - Some QoS Aspects directly perceivable, some indirectly

The ability of a *service* to be obtained

Network Performance

- Charging Performance
- Provisioning Performance
- Administration Performance
- Availability Performance
- Transmission Performance

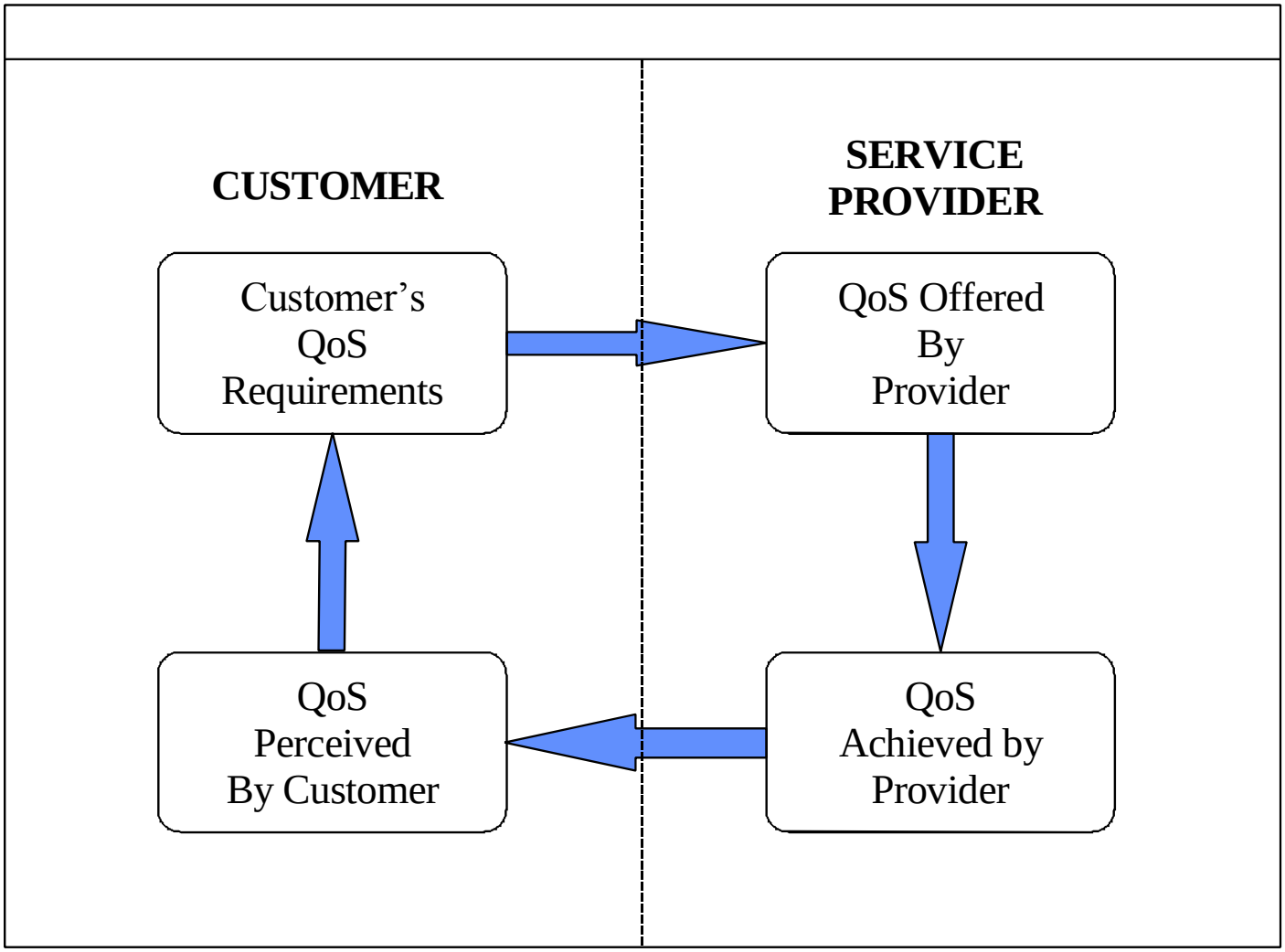
Quality of Service

- Service Support Performance
- Service Operability Performance
- Serveability
- Service Security Performance

Four Viewpoints of QoS

- Consistent Approach to QoS
  - Well-defined and Relevant (e.g. Customer-affecting)
  - Used to Plan and Deploy Networks
  - Includes Monitoring Service Quality
- ITU-T Rec. G.1000 Defines four Viewpoints of QoS
  - Customer's QoS Rrequirements
  - Service provider's offerings of QoS (or targeted QoS)
  - QoS achieved or delivered
  - Customer survey ratings of QoS
- Ideally there would be 1:1 Correspondence between Delivered QoS and Perceived QoS

4 Viewpoints of QoS



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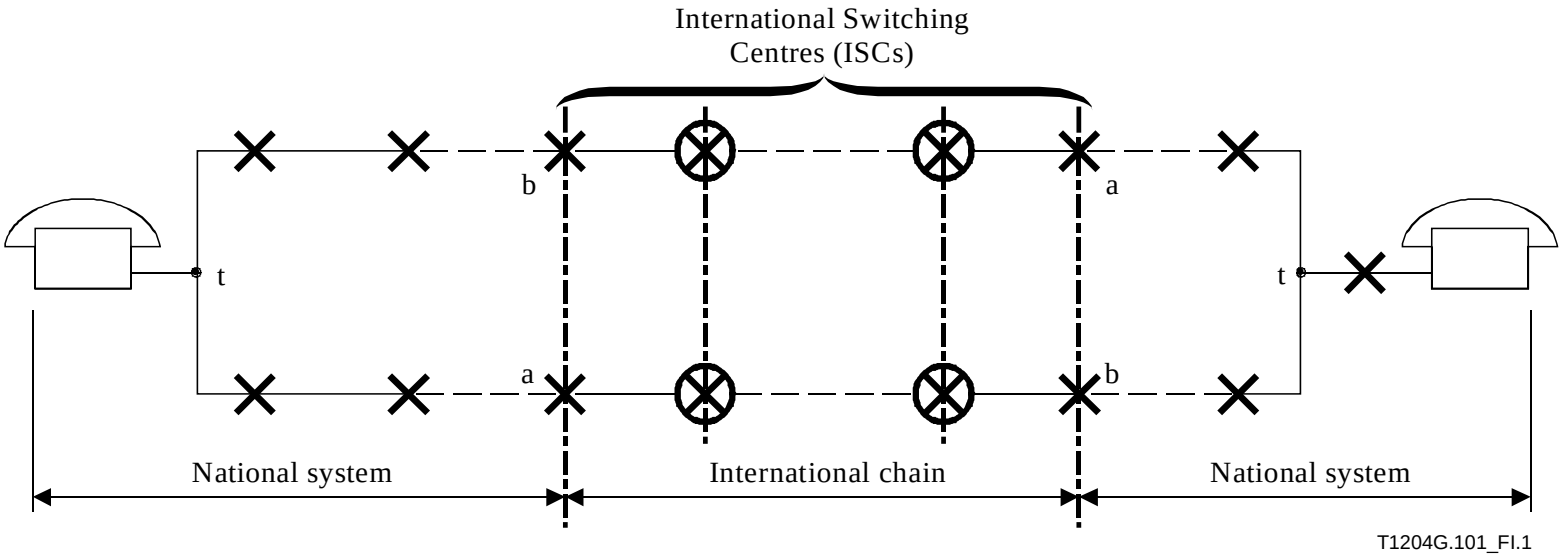
ITU-T Rec. G.101

- The Transmission Plan
  - Fundamental principles of transmission planning
  - a good transmission plan is set up in order to deliver to users signals that are at a desirable level and free from objectionable amounts of delay, echo and distortion
  - has to take into account transmission parameters and impairments, different network configurations and elements
  - specific transmission plans have to be set up in order to take care of specific transmission impairments and conditions e.g. for
    - traditional narrow-band telephone networks
    - mobile networks
    - packet switched networks
    - multimedia applications

Traditional Transmission Planning



Exchange

ISC that carries international transit traffic

a, b Virtual International Connecting Points

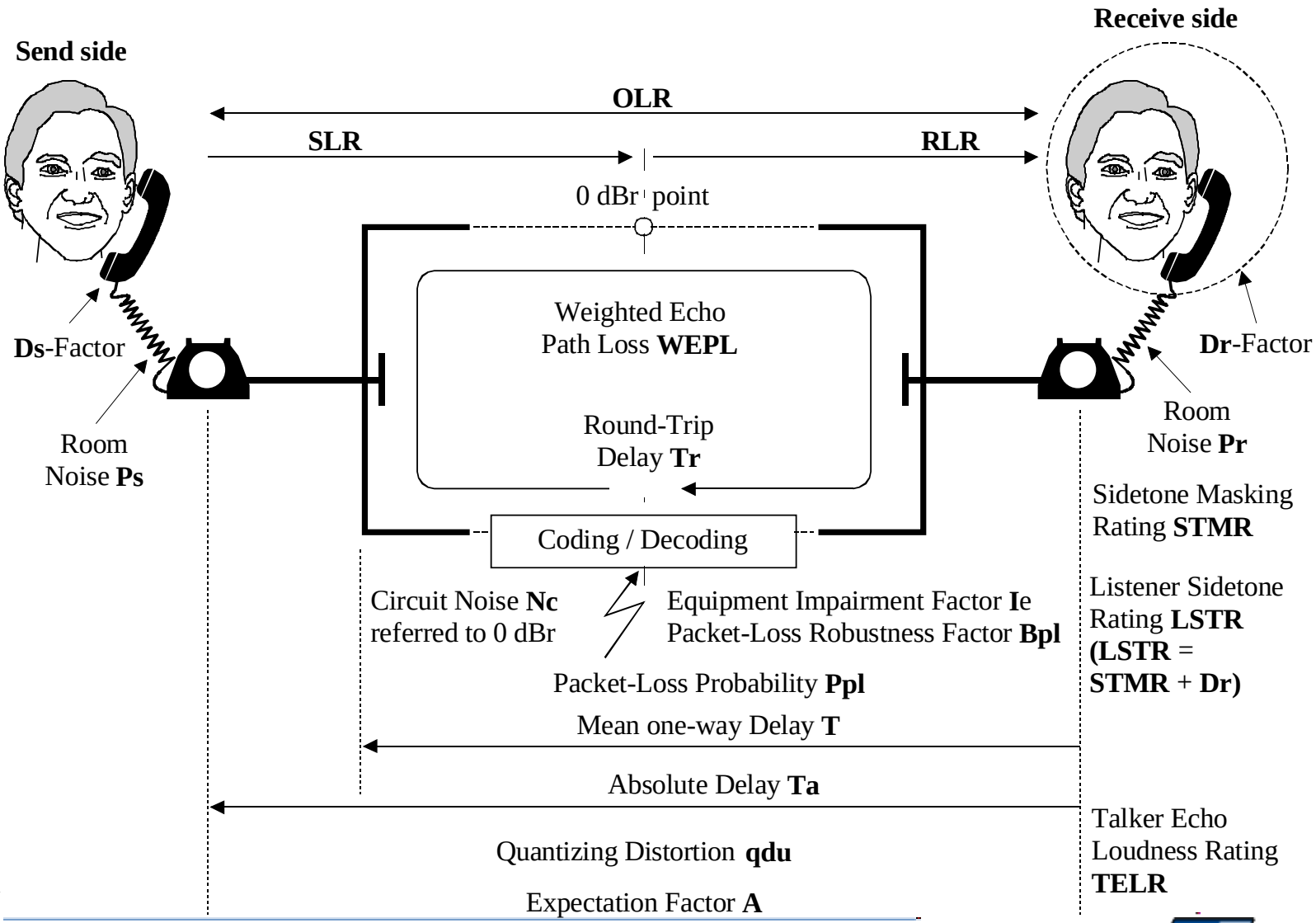
Transmission Planning Today

- ITU-T Rec. G.108: Transmission Planning with the E-Model
- Traditional transmission planning methodologies no longer flexible enough to account for new factors
  - Multinational networks require planning which takes into account regional differences in loss plan requirements and inter-network transmission plans
  - Due to liberalization of the telecommunication markets (e.g. in Europe) there are no longer laid down ranges of values for transmission parameters by regulation
  - The changing scenario in the public network operator domain is impacting transmission performance
  - G.108 is applicable to the use of new technology within the networks, including wireless (cordless or mobile), IP transmission etc.
  - G.108 provides planning methods and contains necessary information and tools which will enable the planner to design the network transmission plan
  - Guidelines and planning examples are based on the use of the E-Model

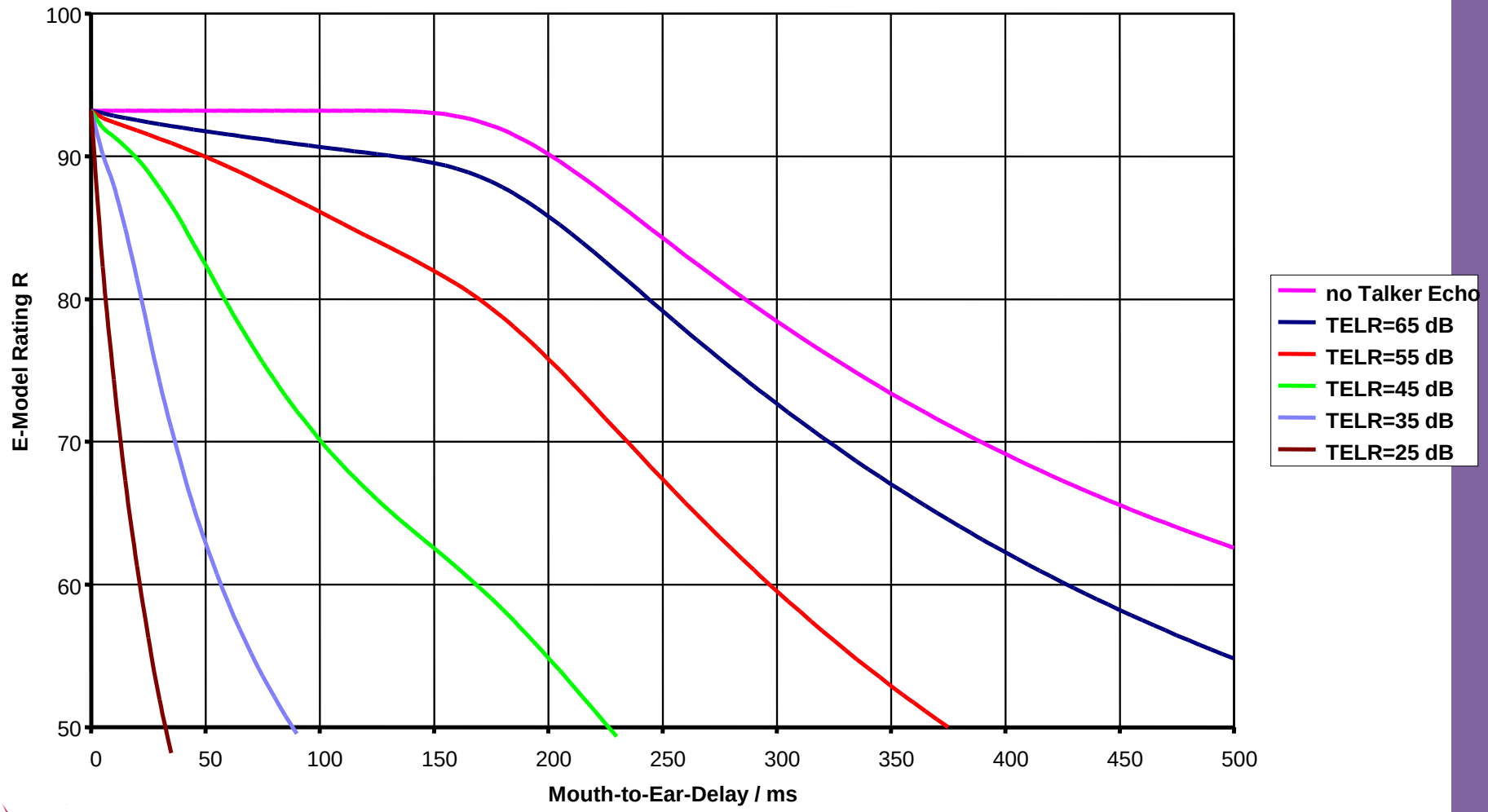
E-Model - ITU-T Rec. G.107

- Computational model for use in transmission planning
- Assessing the combined effects of variations in several transmission parameters that affect conversational quality of 3.1 kHz handset telephony
- Covers also packet loss
- For many combinations of high importance to transmission planners, the E-model can be used with confidence
- Caution must be exercised when using the E-model for some conditions

Reference connection of the E-model

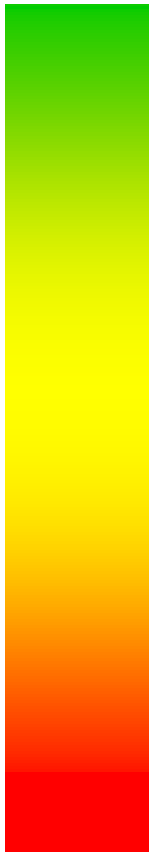


Effects of Talker Echo in the Presence of Delay



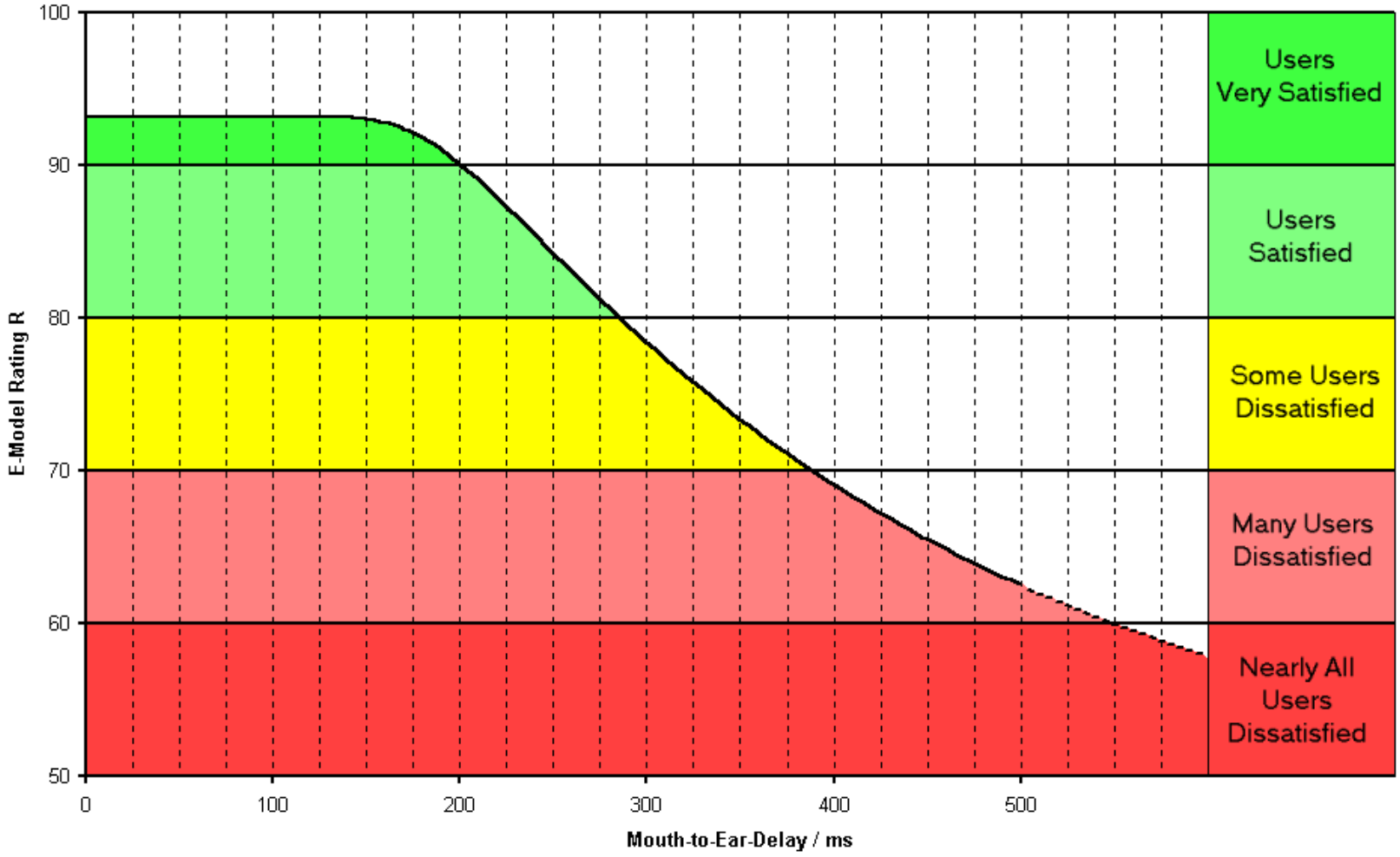
Categories of Communication Quality in Terms of Users' Satisfaction Classes

R	MOS-CQE	
100.0	4.5	Very satisfied
93.2	4.4	
90.0	4.3	Satisfied
85.0	4.2	
80.0	4.0	Some dissatisfied
75.0	3.8	
70.0	3.6	Many dissatisfied
65.0	3.4	
60.0	3.1	Nearly all dissatisfied
55.0	2.8	
50.0	2.6	
0.0	1.0	



Voice Quality Continuum

Example with Delay as Impairment



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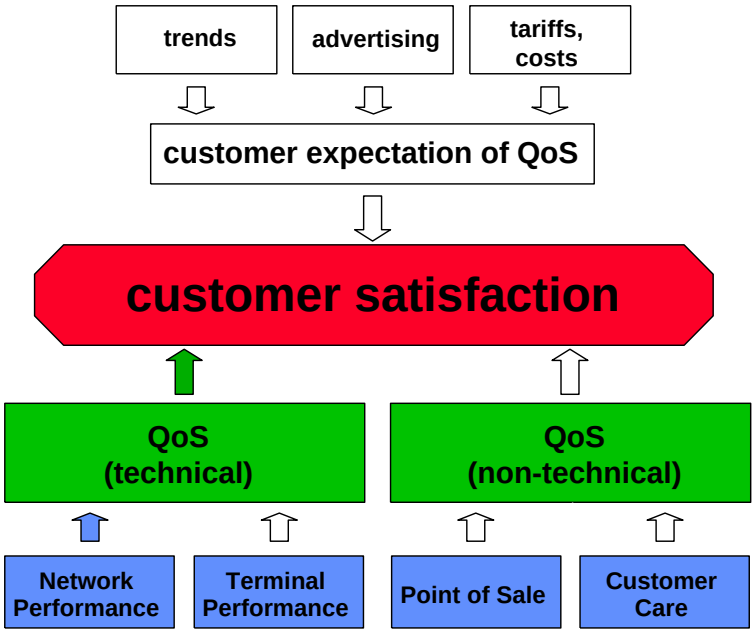
QoE Definition

- ITU-T Rec. G.100 / P.10 defines
  - **Quality of Experience (QoE)**: The overall acceptability of an application or service, as perceived subjectively by the end-user.
  - NOTE 1 – Quality of experience includes the complete end-to-end system effects (client, terminal, network, services infrastructure, etc.).
  - NOTE 2 – Overall acceptability may be influenced by user expectations and context.

QoE Implications

- QoE includes „everything“
  - Many aspects out of control of Operators
  - Includes Terminal Aspects
- Proper QoS and NP
  - technical prerequisites
  - For achieving desired QoE

Relationship between customer satisfaction, QoS and NP



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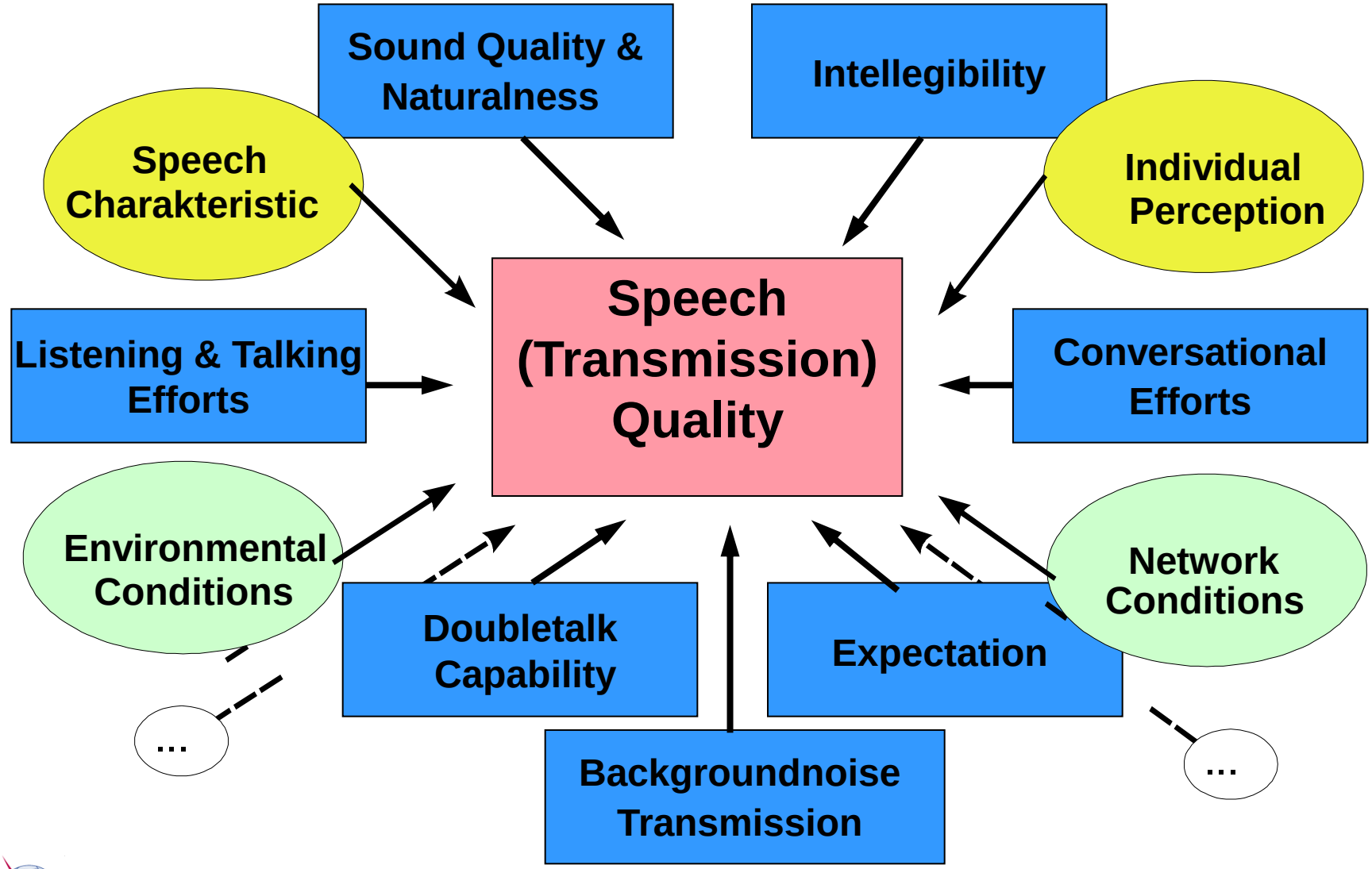
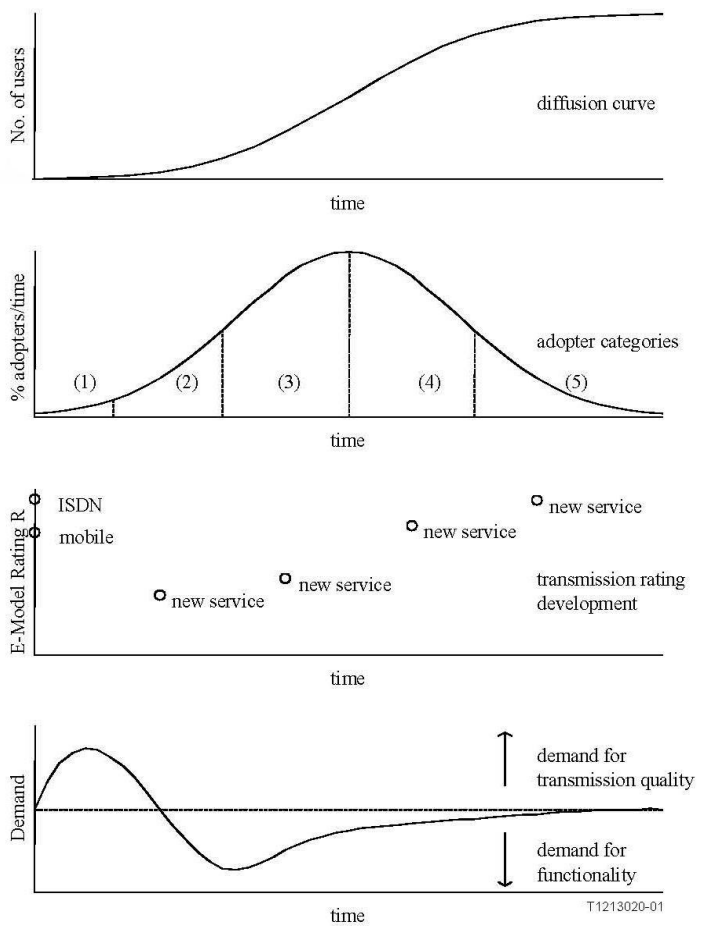
Users‘ Perception of Speech Quality



Motivation for Multimedia Quality

- Quality as perceived by the User
  - A Promotional Factor for the Market
- User compares Quality of New Telecommunication Services
  - With Quality experienced in the Past
  - With other Telecommunication Service offers
  - With Quality experienced for Entertainment Services
- Individual Quality Threshold
  - Users try new Service only few times (~ 3x … 5x)
  - If Quality below Indivdual Threshold Users give up
  - e.g. Download of a Website takes too long
    - User remembers this experience
    - Will try a few times and conclude this as Static Effect:
      "This website is not useable - let's try the Offer of the Competitor…"

Diffusion, Transmission Quality and Expectation for an Innovation



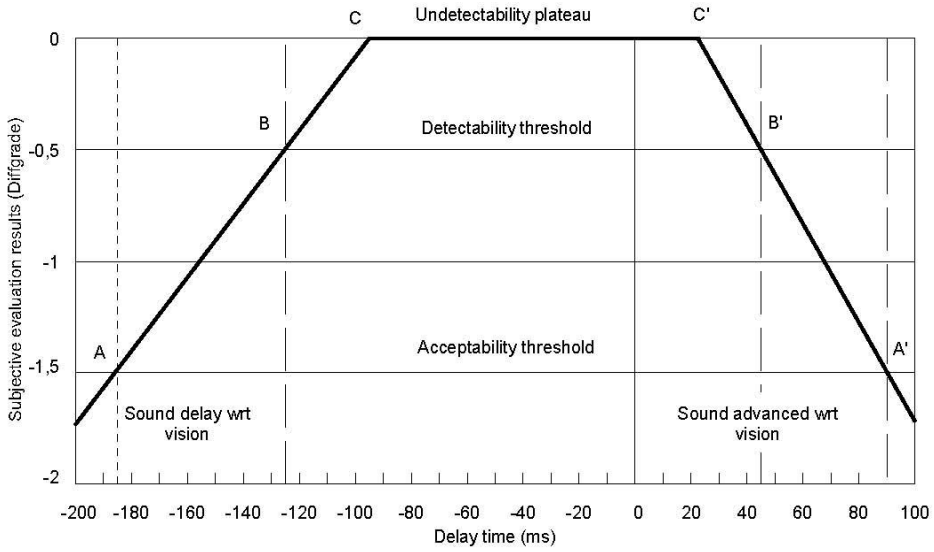
- Diffusion Theory generally accepted for describing Consumer Behaviour on the Introduction of an Innovation or New Service
- Number of Users develops in S-shaped Curve
- 5 Classes of Users:
  - (1) Innovators
  - (2) Early Adaptors
  - (3) Early Majority
  - (4) Late Majority
  - (5) Laggards
- Trade-off between Transmission Quality and New Functionality

Changes in Users' Behaviour

- Users tend to be much more reluctant to accept lower quality
  - This is quoted frequently
    - True for some sorts of social calls
    - Definitively NOT true for sensible business calls
  - Does it help network operators when defining QoS for their network ?
    - High quality has to be provided when demanded by business customers or other sensible clients
    - But the distribution of quality acceptance over time and areas cannot be matched with the occurrence of impairments in the network
  - Not really useful for designing networks
- Users switch between different communication devices
  - Wireline, wireless, PC, PDA etc
  - Depending on place, task, purpose
    - And depending on QUALITY

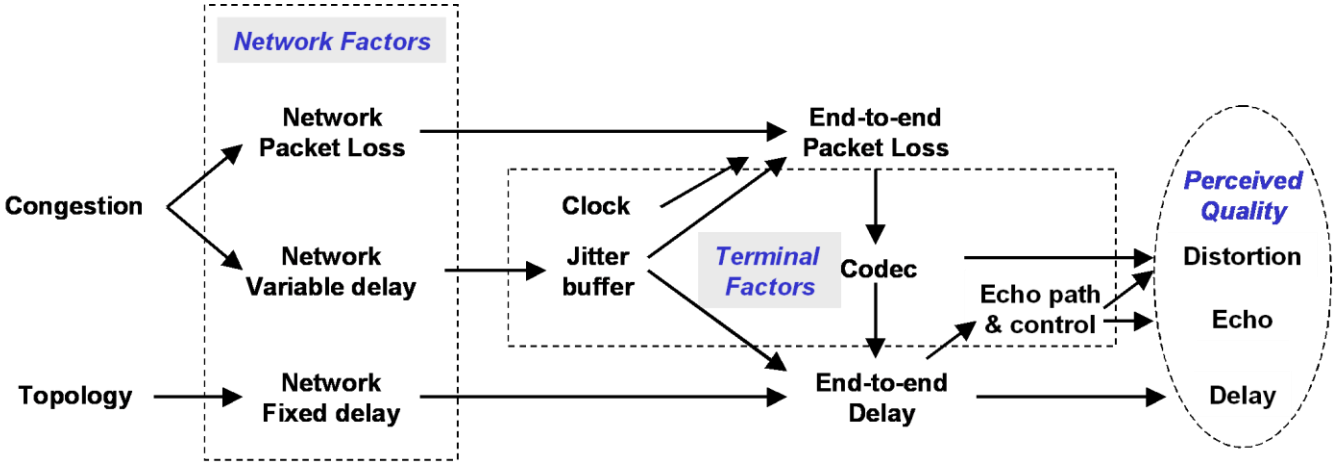
Key Parameters affecting MM Quality

- Media Distortion
- End-to-End Delay
- Echo Effects
- Information Loss
- Background Noise Distortion
- Loss of Synchronization between Media Streams



Impairments in packet networks

- Distinction between Effects
  - that occur in the Network and
  - Mechanisms in the Terminals that are affected
- Terminals can be used to correct for the Effects in the Network
- Remaining Issues are:
  - End-to-End Delay is increased when compensating for other Effects
  - Loss of Information can be Concealed but Not Recovered



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Regulatory approaches

	Regulation orientated	Customer orientated
Reporting	To regulator	To customer
Targets	In regulations	In contracts
Penalties	Fines	Compensation

…or a combination?

QoS regulations

- Measurement and reporting are expensive
- Do you scratch everywhere? or scratch where it itches?
- Need to focus on the known problem areas
- But the problem areas may change over time
- Issue of cost effectiveness

Service Level Agreements

- Considered highly important
- Indication of the level that the supplier aims to achieve
- Only tangible benefit if there is compensation for failure
- Is the compensation a token or a rebalancing of the failure
- A token at least imposes some incentive to perform
- Tokens are noticed by management

Criteria for QoS Parameters

- QoS parameters should be easily understood by the public, and be useful and important to them.
- All parameters are applicable at the network termination point. Where measurements are possible, they should be made on the customer's premises, using in-service lines. To be as realistic as possible, real traffic rather than test calls should be used as a basis of the measurements, wherever possible.
- Parameters should be capable of verification by independent organizations. This verification might be made by direct measurements or by audit of the operator's measurements.
- The accuracy of QoS parameter values should be set to a level consistent with cost effectively available measurement methods.
- The parameters are designed for both statistical and individual application. The statistical values should be derived by the application of a simple statistical function to the individual values. The statistical function should be specified in the standard. The standard should also contain guidelines on how statistically significant samples should be selected.

From ETNO: European incumbent's club

Regulation and Customer

- Initial levels of compensation should be low
  - Any such payments will be monitored by management of operators
  - Experience is that the benefit in alerting management to problems far exceeds the value of the sums paid as they expose mangers to internal criticism
- However for critical parameters that have a seriously damaging effect on customers
  - Levels of compensation should rise depending on the extent on the problem with higher payments to business customers than to residential ones
  - For example failure to repair a fault within a specified time would incur a penalty of say $X per day
    - this rate should not be capped at a maximum of say 5 days but continue
    - possibly rate per day should rise if the time exceeds say 10 days
  - This formulation is needed to ensure that the managers concerned take appropriate steps to resolve the issues and prepare adequately for the problems that inevitably will occur.

Regulatory Aspects (1)

- QoS parameters for Regulation should be
  - Limited in number
  - Focus to hot topics
    - where problems already exist or expected to occur soon
  - Taylored to the special situation in the Maldives

Regulatory Aspects (2)

- Network operators but also customers have experience
  - with regulation & resulting QoS in other countries of the region
- For National Regulators it is important to prove
  - customized regulation regime
  - but no re-invention of the wheel
  - no over burdening of operators

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Best Practice

- Some Advantages *(postulated)*
  - QoS Regulation not needed
  - Market Powers regulate overall Quality
- Some Requirements *(obvious)*
  - All Stakeholders Stick to Standards
  - Appropriate Standards are available in Time
  - QoS Responsibilities must be clear defined
- Some Problems *(surprise !)*
  - „connect your fridge to the network – it might be legal“

Market Mechanisms

- Forces of the Market will bring users into a position where they can obtain the end-to-end QoS they wish to perceive
  - Has been postulated for a long time in Europe
  - Has been proven to be more than questionable
  - Mostly, contracts between users and network operators
    - have a longterm binding character
    - do not contain any QoS provisions
- Currently, traditional Telcos have no incentive to provide high end-to-end QoS for their NGN customers
  - Number of customers remains stable
  - In parallel the commercial company value
- In contrast are Internet based communication service providers
  - Receive their revenue not directly from users
  - But by other business models which rely on a high (and increasing) number of users of the service every day
  - Customers not satisfied with end-to-end QoS will stop using the service
  - Consequently the number of customers decreases immediately and so the company value
  - Thus the incentive to offer high end-to-end QoS to the user is extremely high.

India

- Comprehensive regulation for fixed and mobile
- Some parameters are to be reported, others monitored and recorded
- Rent rebates for slow fault repair
- Publication in named newspapers
- Results collected and published separately for different cities and areas

Malaysia

- Parameters and targets for PSTN, mobile, Internet
- Self reporting subject to audit and independent verification by regulator
- No mention of penalties

Malaysia - Parameters

Common

Billing complaints	2%
Billing complaint resolution	90% in 15 business days 95% in 30 business days
Number of Complaints	50 per 1000 lines per 12 months
Emergency speed of answer	90% in 10 secs 100% in 20 secs

Mobile

Service availability Blocked + Dropped calls	90%
Dropped calls	5%
Number of Complaints	50 per 1000 lines per 12 months
Emergency busy	5% in busy hour

PSTN

Installation order fulfilment	80% in 24 hours 90% in 48 hours
On-net Lost calls = failed call attempts	6%
Off-net national Lost calls = failed call attempts	6%
Emergency busy	1%
Inter network post dialling delay	13 secs for 95% of calls
On-net post dialling delay	10 secs for 95% of calls
Fault repair	80% in 24 hours 90% in 48 hours
Fault rate	500 per 1000 lines per 12 months

Internet

Dial up access attempts	≤ 3
Log in time	95% less than 40 secs
Download time	80% modem line speed for 95% of the time

Pakistan

- Approach based on independent surveys
- Results reported separately for different areas
- Surveys cover mobile and ISPs
- Mobile is checking against licence obligations
- ISPs:
  - availability of service
  - connection setup time
  - Download speed
  - download time
  - connection stability during busy hours

Pakistan

Mobile voice

Parameter	Threshold
Network Accessibility	99.5%
Service Accessibility	96%
Call Completion Ratio	96%
Avg Setup Time	≤ 7 sec
Avg MOS	≥ 3

Mobile SMS

Parameter	Threshold
Service Accessibility	99%
Access Delay	≤ 2

Oman

- Major study around 2007
- Consultation 2009
- Comprehensive set of parameters developed for
  - Mobile
  - PSTN
  - Broadband and dial-up Internet
  - International voice
  - Leased lines etc
  - Internet
- Regulations in force or expected (website under translation)

European approach -1

- Universal Services Directive 2002/22/EC Articles 11 and 22
- Publication of performance for common list of parameters
- Target levels and additional parameters may be added by National Regulatory Authority
- Public communication network
  - Supply time for initial connection
  - Fault rate per access line
  - Fault repair time
- Publicly available telephone service
  - Call set up time
  - Response times for operator services
  - Response times for directory enquiry services
  - Proportion of coin and card operated public pay-telephones in working order
  - Bill correctness complaints
  - Unsuccessful call ratio

All according to ETSI EG 201 769-1 is 1.1.1 (April 2000)

European approach -2

- Nothing on mobile because mobile retail market is competitive
- Some regulators require(d) drive round surveys of coverage
- Nothing on broadband
- Ofcom (UK) - voluntary Code of Practice on broadband speeds
  - Accurate estimate of speed, Fair use policies must be clear
  - Monitor with mystery shopping, publish members of Code
- Germany
  - ?????????

Any Questions

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