ITU-T Kaleidoscope 2009
Innovations for Digital Inclusion

# QoS Management for ISP: A Model and Implementation Methodology based on ITU-T Rec. E.802 Framework

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Mar del Plata, Argentina, 31 Aug – 1 Sep 2009

# Outline

- Introduction
- Background
- Proposal
- QoS management model
- Deployment methodology
- Case study
- Results
- Conclusions

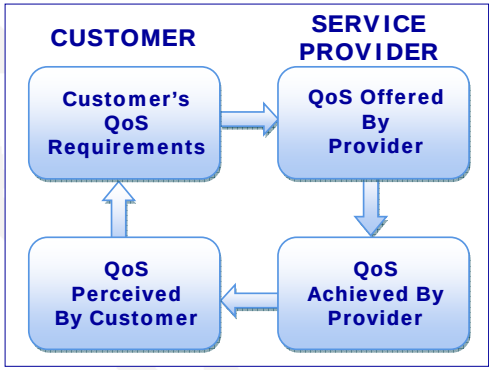
# Introduction

- New broadband services
- Competitive condition
- QoP differential factor among ISPs
- From “best effort” to “user centered”
- Quality of service (E.800):
  - “… its ability to satisfy stated and implied needs of the user of the service.”
- Appropriate QoS policies required

# Background

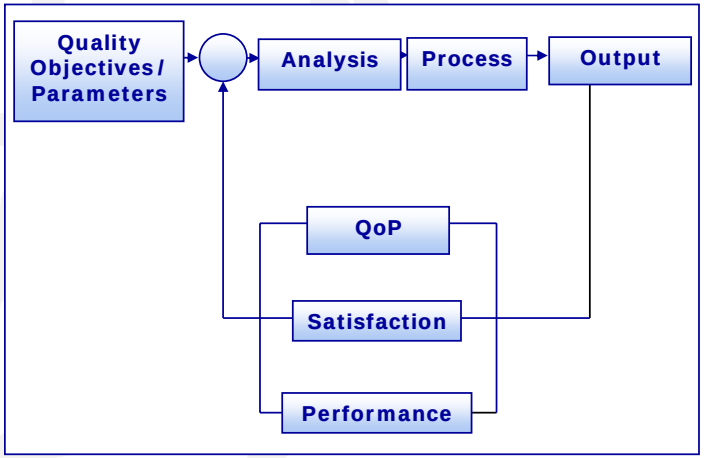
- ITU-T QoS Framework: Rec. G.1000
  - Four points of view
  - Regulator's approach
  - Difficult to deploy

**Methodology needed!**



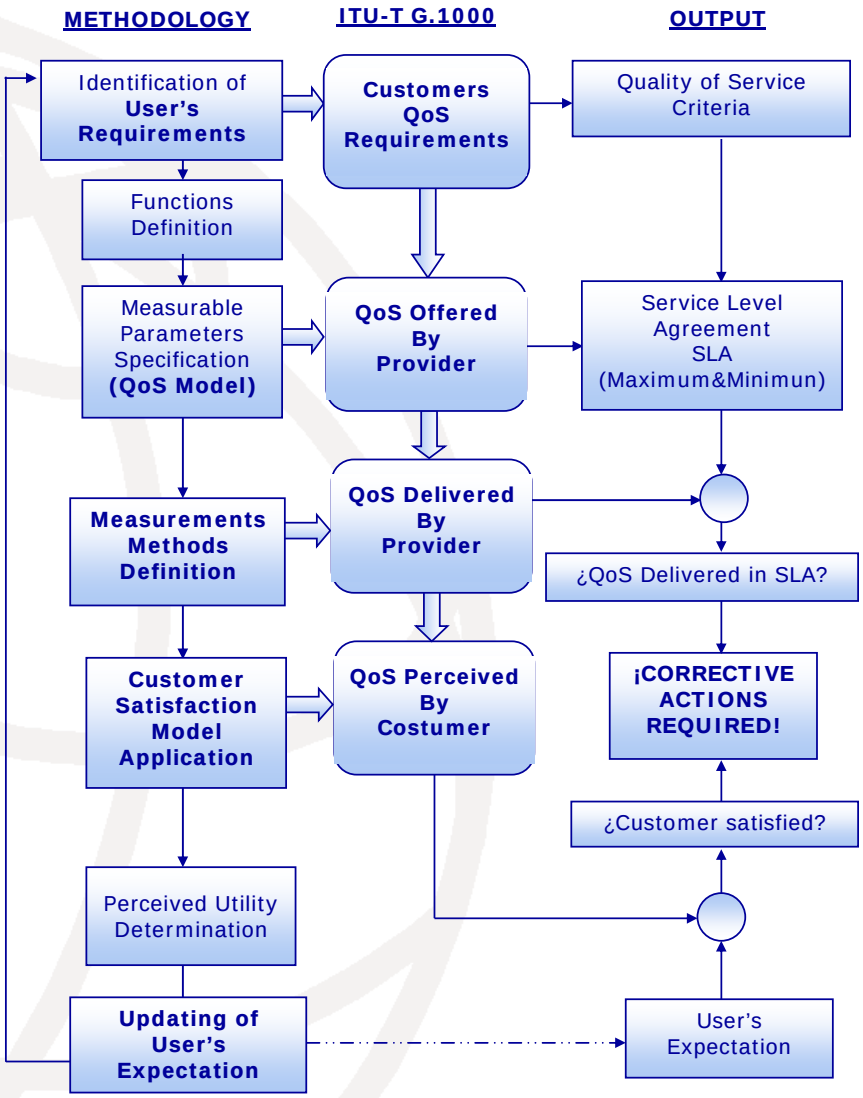

- QoS management process: Rec. E.802
  - QoS procedures
  - Well detailed
  - Theoretical stage

**Strategy needed!**



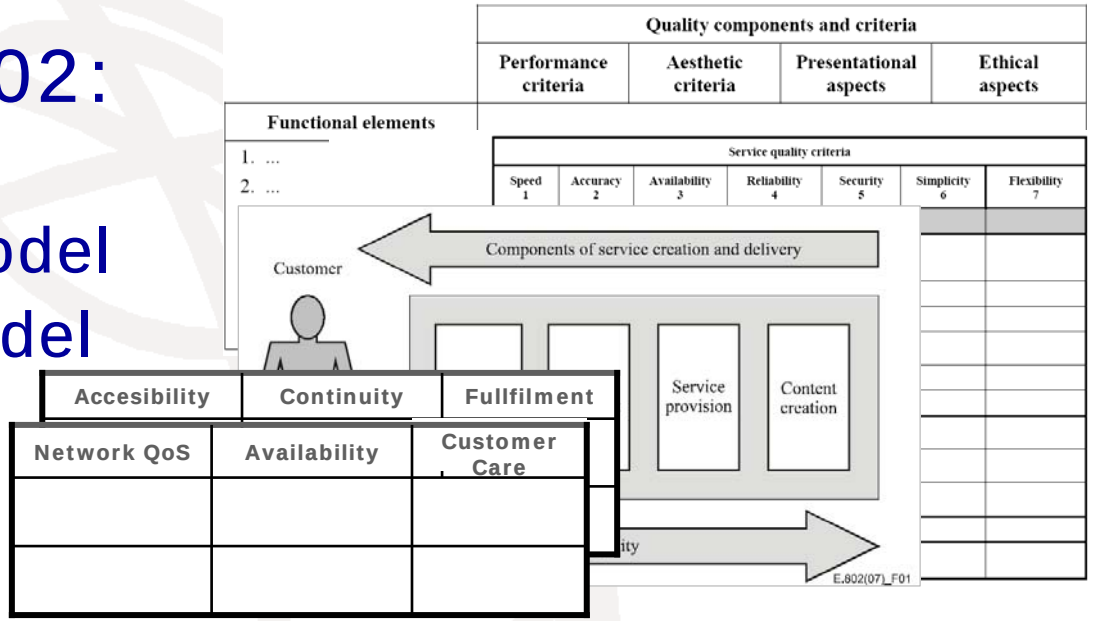
# QoS Management Proposal

- QoS Model
- QoS Criteria
- Methodology
- Satisfaction
- Expectation



# QoS Models

- ITU-T Rec. E.802:
  - Universal Model
  - Performance Model
  - Four Market Model
- ACF model
- CSAT Model



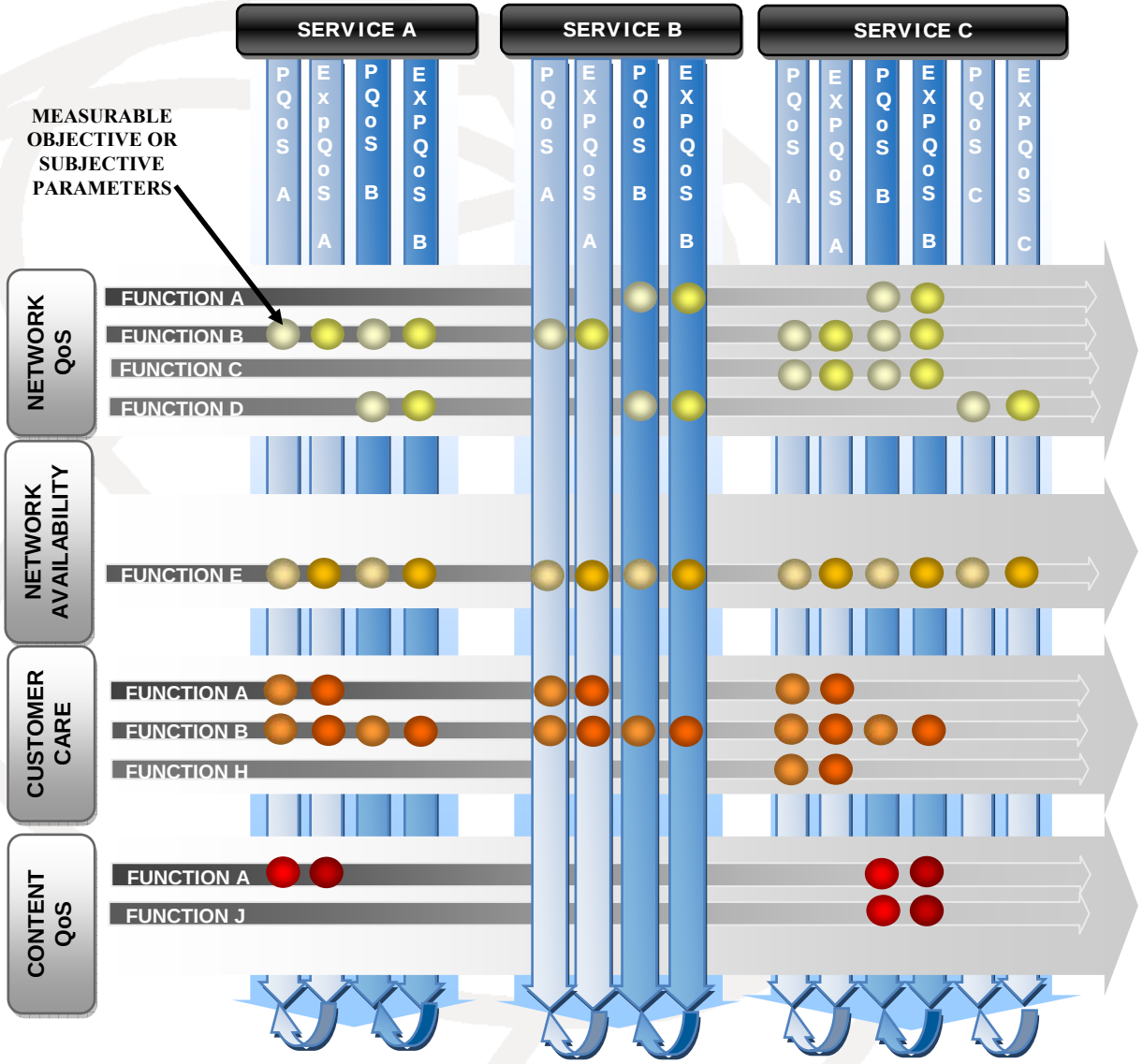

**Need for simplification**

- Network QoS
- Availability
- Customer Care
- Content

# QoS Management Model

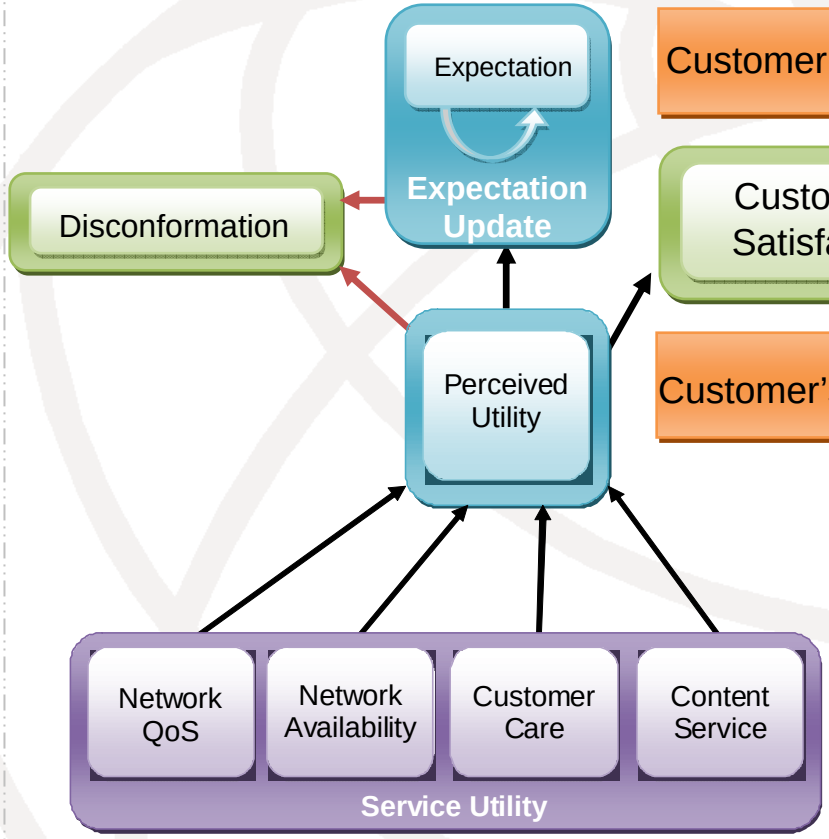
- Identification of QoS criteria
  - Considered on a service by service basis
  - Specified on an end-to-end basis
  - Different population segments may have different QoS preferences
  - QoS profile for customers are time dependant
- A set of functions to cover the QoS criteria
- Measurable indicators/parameters
- QoS perceived can be modeled

# QoS Model


SERVICE A
SERVICE B
SERVICE C
MEASURABLE OBJECTIVE OR SUBJECTIVE PARAMETERS
PQoS A
EXPQoS A
PQoS B
EXPQoS B
PQoS C
EXPQoS C
NETWORK QoS
FUNCTION A
FUNCTION B
FUNCTION C
FUNCTION D
NETWORK AVAILABILITY
FUNCTION E
CUSTOMER CARE
FUNCTION A
FUNCTION B
FUNCTION H
CONTENT QoS
FUNCTION A
FUNCTION J

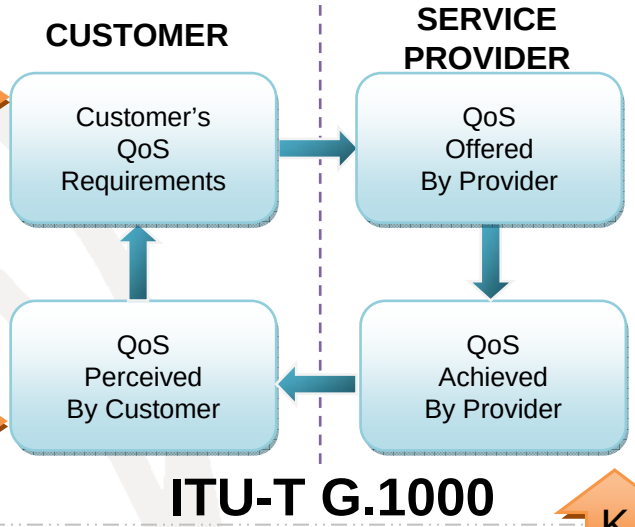
# Methodology Proposal

## Satisfaction Model




CSAT

## Framework

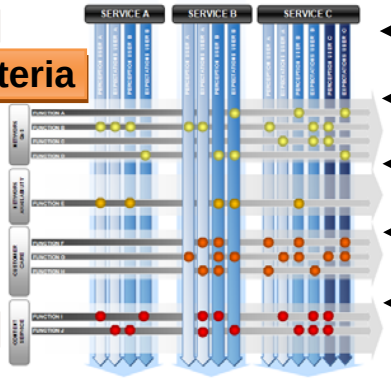



ITU-T G.1000

## Methodology

KQI

QoS criteria




- Four Market Model
- Performance Model
- Universal Model
- ACF Model
- CSAT Model

QoS Model

ITU-T E.802

# Case Study

- Web service
- Residential users
- Sample data results from experiment
- Steps:
  - Identification of user's requirements
  - Specification of functions and parameters
  - Customer satisfaction analysis

# User's QoS Requirements

- Network QoS criteria
  - Maximum download and upload speed
- Availability criteria
  - Availability of web service
- Customer Care criteria
  - Premium service support
- Content criteria
  - No gathered data

# Functions and Parameters

| Functions | Parameters |
| --- | --- |
| Session Time | Throughput |
| Service Availability | Percentage of time service available |
| Service Support | Response time for service support |

# QoS offered

- Maximum throughput
  - Upload $P^{o}_{uij}$
  - Download $P^{o}_{dij}$
- Maximum Availability
  - Availability $W^{o}_{ij}$
- Best response time
  - For premium service support: $RT_{br}$
- Defective Service Instance (DSI):
  - Notion to quantify the negative effect of offering beyond user's requirements

# QoS Delivered

- Measured throughput
  - Average upload: $P^{a}_{uij}$
  - Average download: $P^{a}_{dij}$
  - DSI penalization factor for session time: $D_{STij}$
- Measured availability
  - Percentage of time considered available: $W_{ij}$
  - Total access time: $A_{ij}$
  - DSI penalization factor for availability: $D_{Aij}$
- Measured average response time
  - Average response time measured: $RT^{a}_{rtit}$
  - DSI penalization factor for support: $D_{SSit}$

# QoS Perceived by User

- User's Preferences

$\gamma_1, \gamma_2$ – download and upload $(\gamma_1 + \gamma_2 = 1)$

$\alpha 1, \alpha 2, \alpha 3$ – Network QoS, availability and customer care $(\alpha 1 + \alpha 2 + \alpha 3 = 1)$

- Session Time

$$Q_{ij}^{ST} = \gamma_1 \frac{P_{dij}^a}{P_{dij}^o} + \gamma_2 \frac{P_{uij}^a}{P_{uij}^o} - D_{STij}$$

- Availability

$$Q_{ij}^{A} = \frac{\sum_j \left(W_{ij} \times A_{ij}\right)}{\sum_j A_{ij}} - D_{Aij}$$

- Service Support

$$Q_i^{SS} = \frac{\sum_t RT_{brt}}{\sum_t RT_{rtit}^a} - D_{SSit}$$

## Perceived Utility

$$PU_i = \frac{\alpha_1 \sum_j (A_{ij} \times Q_{ij}^{ST})}{\sum_j A_{ij}} + \alpha_2 \times Q_{ij}^{A} + \alpha_3 \times Q_i^{ss}$$

# Customer Satisfaction

- Customer Satisfaction:

$$\Gamma_i = f_1(PU_i) + f_2(PU_i - EU_i)$$

  - Expectation: $EU_i$
  - Disconformation: $(PU_i - EU_i)$
  - Perception function: $f_1$
  - Disconformation function: $f_2$

# Experiment

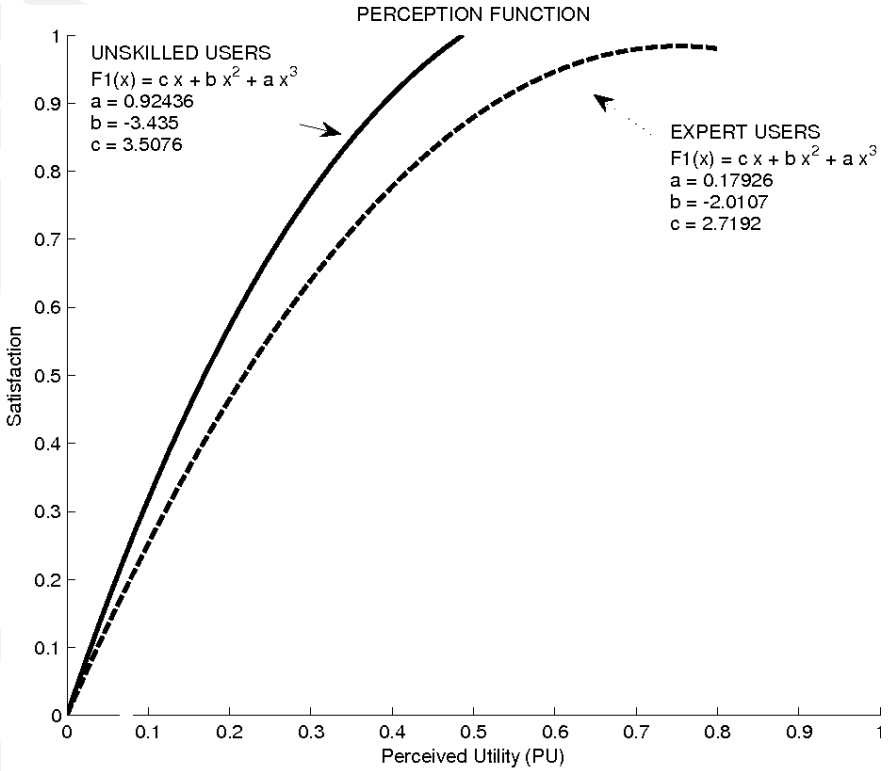
- Carried out on June 2008 on Web service
- Two kind of users: expert and unskilled
- Different network conditions (delay)
- Capture their preferences:

| User | Expert | Unskilled |
|---|---|---|
| *Download (γ1)* | *0,7* | *0,8* |
| *Upload (γ2)* | *0,3* | *0,2* |
| *Network QoS (α1)* | *0,75* | *0,7* |
| *Availability (α2)* | *0,20* | *0,10* |
| *Customer Care (α3)* | *0,05* | *0,20* |

- Satisfaction evaluation

# Results

- User's overall satisfaction closely linked to contextual parameters.
- User's requirements change over the time and under different conditions.
- Different users have different requirements.



# Conclusions (I)

- The QoS model and implementation methodology grants a lot of precision to the ITU-T QoS framework
- The results of the experiment demonstrate the usefulness of our approach
- Users, ISPs and regulators may find a lot of benefits when deploying the QoS management model

# Conclusions (II)

- The QoS management model and deployment methodology totally fulfill international standards
- The proposal could be used to complete the specification of QoS management processes in future standards or revisions
- Even applicable to NGN

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## Thank you!

## Any questions?

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