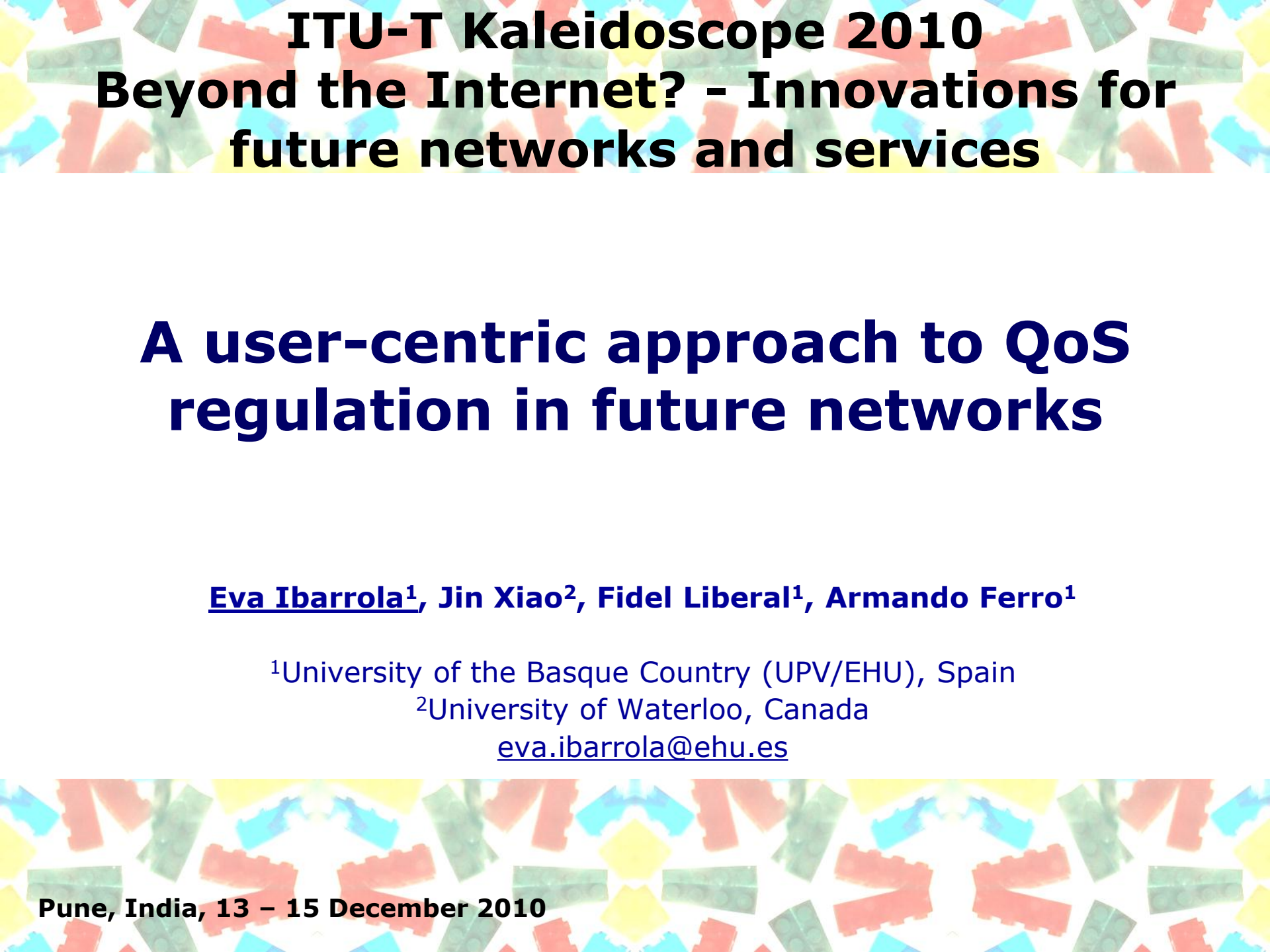




ITU-T Kaleidoscope 2010

Beyond the Internet? - Innovations for future networks and services

A user-centric approach to QoS regulation in future networks

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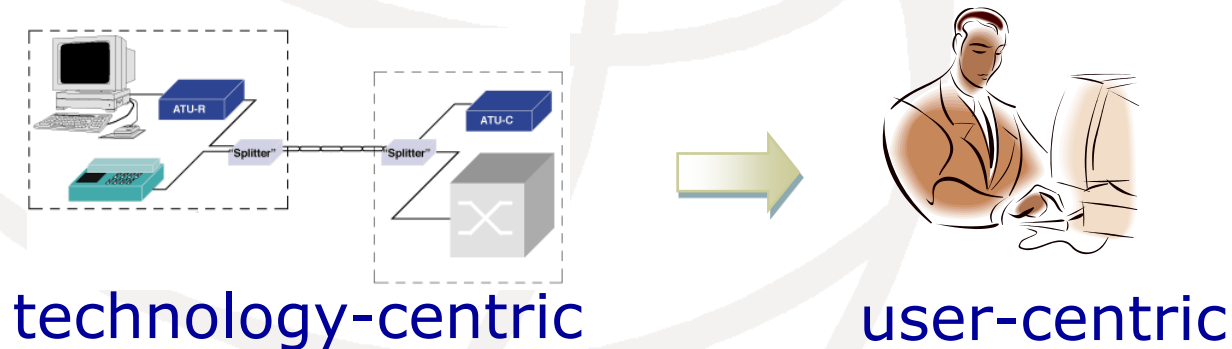
Pune, India, 13 – 15 December 2010

Outline

- Introduction
- Background
- Proposal
- Case study
 - Spanish regulation
 - New approach implementation
 - Results
- Conclusions

Introduction

- Evolution to NGN
- In ITU's vision:
 - ➔ "The move to NGNs represents an opportunity to establish in advance ground rules for ensuring the continued passage to effective competition and minimize damage during transition."
- QoS regulation: a key issue

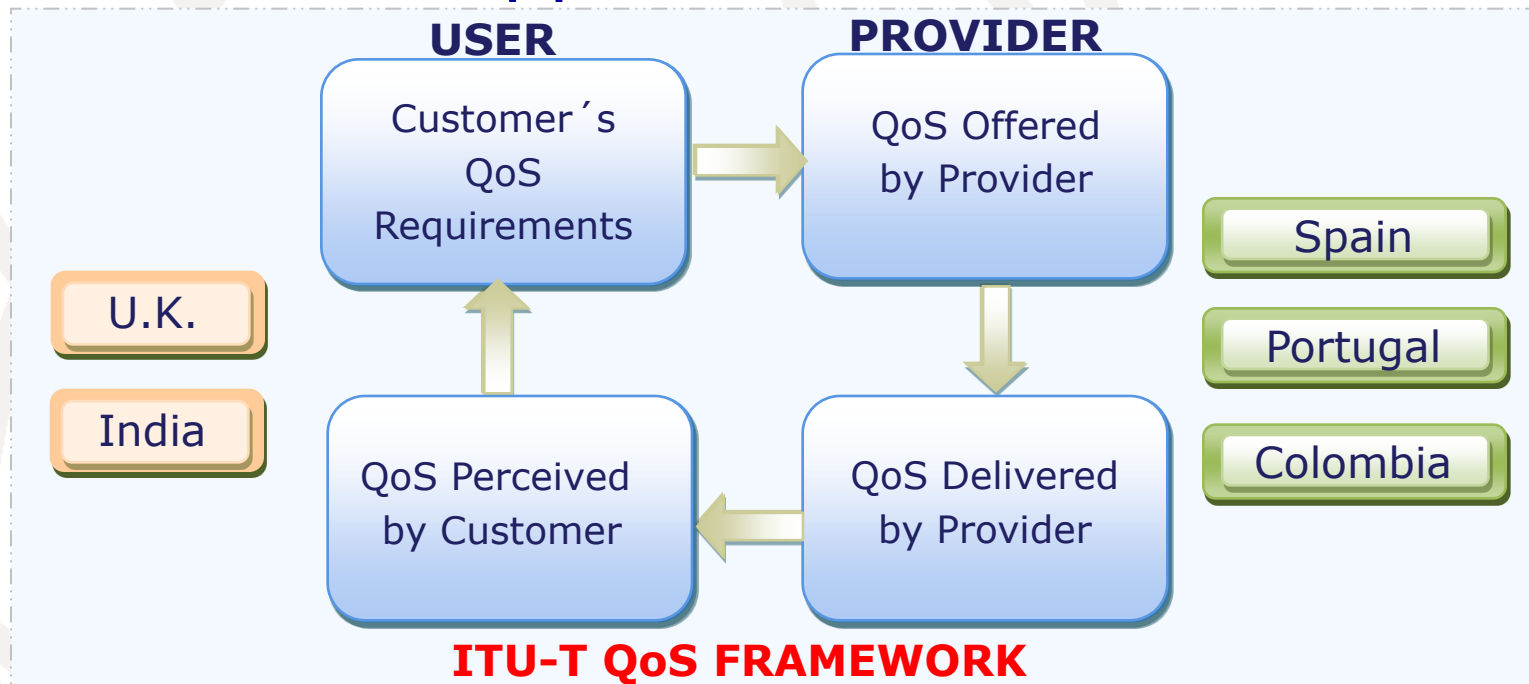


Background

■ Internet QoS regulation

- ➔ A recent notion
- ➔ Applied to Internet Access Service
- ➔ Different approaches for each NRA

Effective
Regulation of
QoS



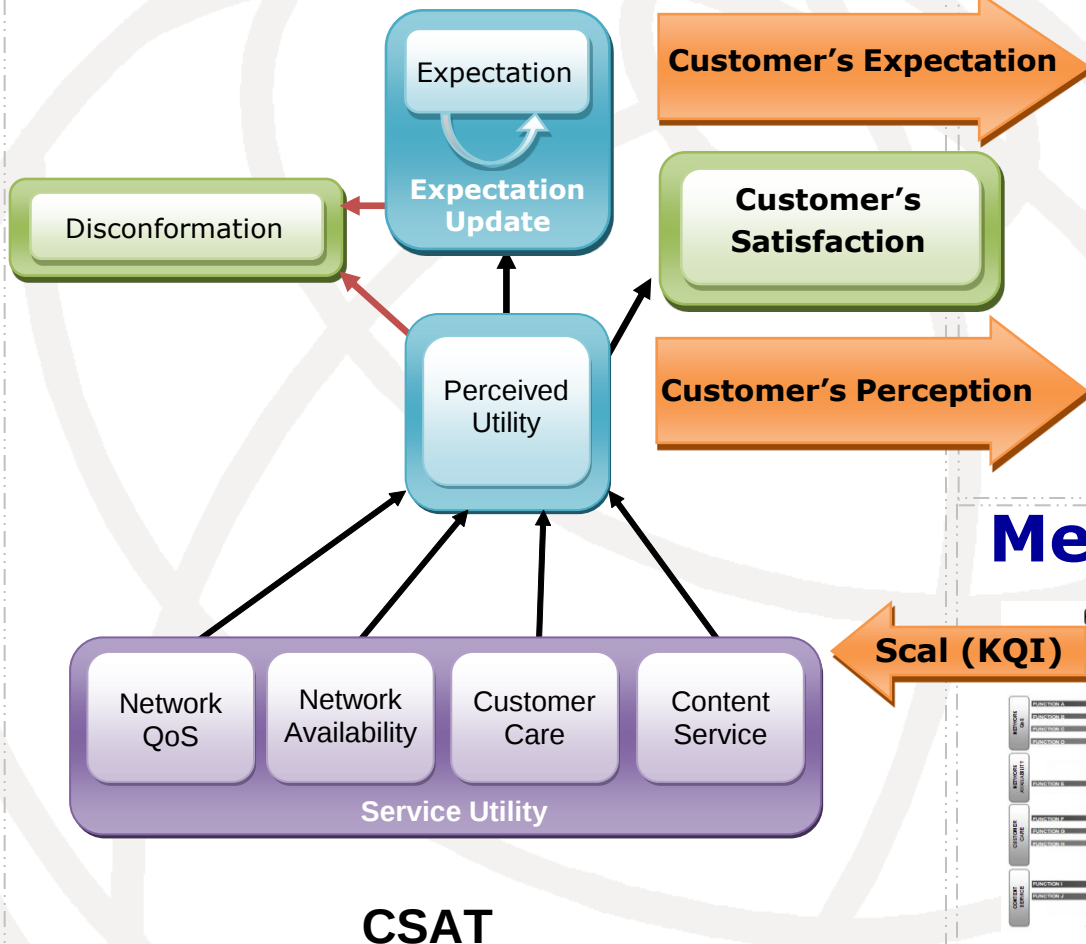
Challenges

- Evolution to NGN: a new opportunity
- NRAs should unify criteria
 - ➔ "The basic criterion for QoS evolution is 'subjective user satisfaction'..." (ITU-T)

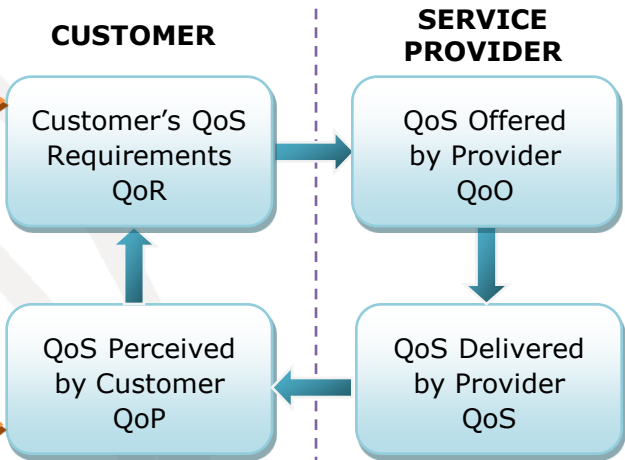


QoS Methodology

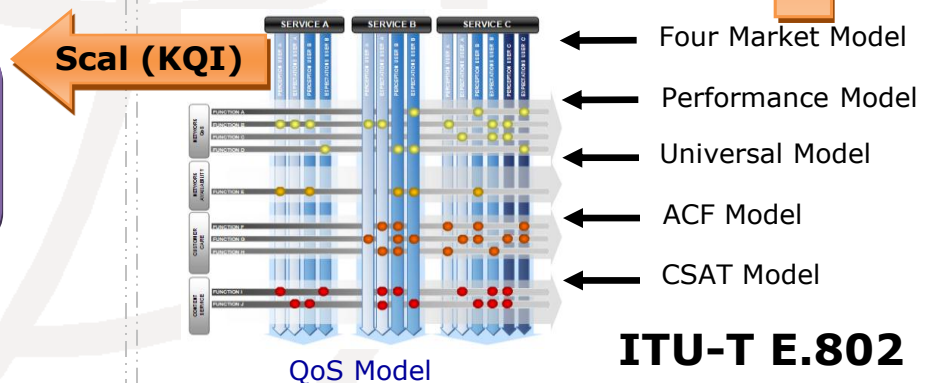
Satisfaction Model



Framework

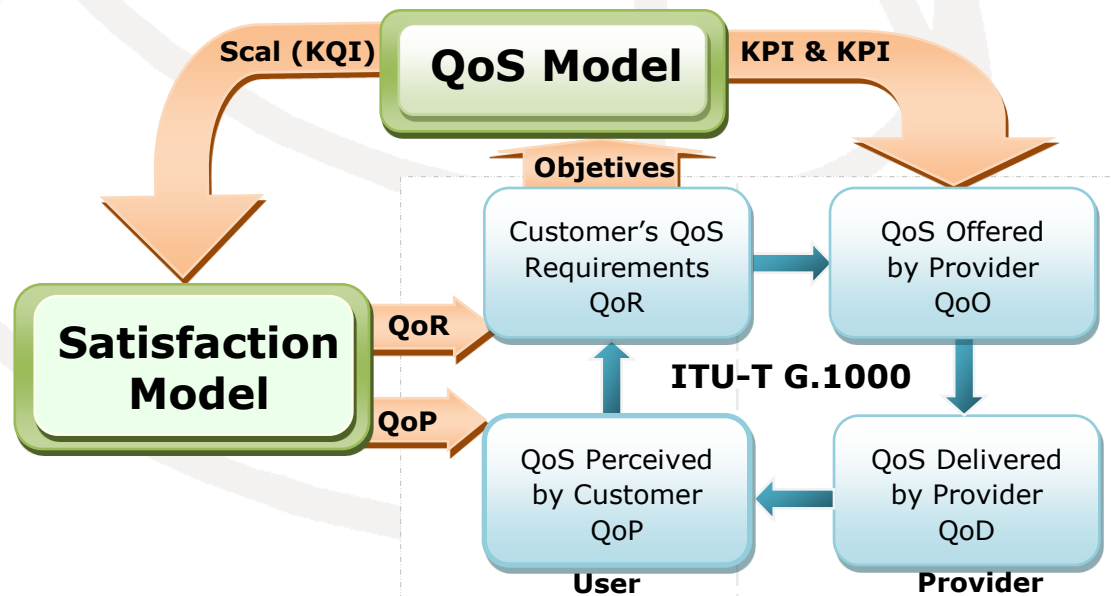


Methodology



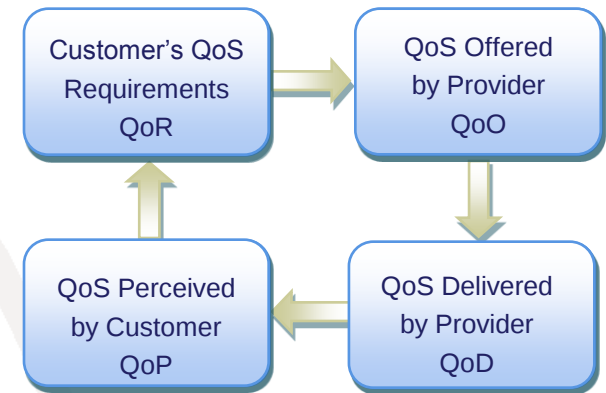
Principles of Regulation Proposal

- QoS information meaningful to users
 - Key Quality Indicators (KQI)
 - Global Key Quality Indicator $Q_{criteria} = \sum_{i=1}^n w_i Scal_i(KQI)_i$
 - Scal (KQI): Relation QoR-QoO-QoD
 - QoS perceived by users $QoP = \alpha_1 Q_{net} + \alpha_2 Q_{avail} + \alpha_3 Q_{c_care} + \dots$
 - Users' satisfaction $S = f_1(QoP) + f_2(QoP - QoR)$

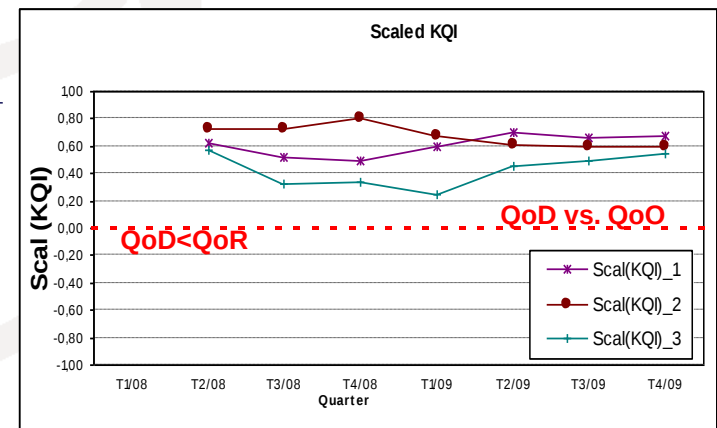


Scaled Key Quality Indicator

- Scaled KQI: $Scal_i(KQI_i)$
 - ➔ Scaled domains/units
 - ➔ Range $[-1,1]$
 - ➔ QoD/QoO Relation
- Objective QoS



$$Scal_i(KQI_i) = \begin{cases} \frac{(KQI_i) - (KQI_i)_{min}}{(KQI_i)_{max} - (KQI_i)_{min}} & \text{si } (KQI_i) \in KQI^+ \\ \frac{(KQI_i)_{max} - (KQI_i)}{(KQI_i)_{max} - (KQI_i)_{min}} & \text{si } (KQI_i) \in KQI^- \end{cases}$$



Global KQI and QoP

■ Global KQI ($Q_{criteria}$)

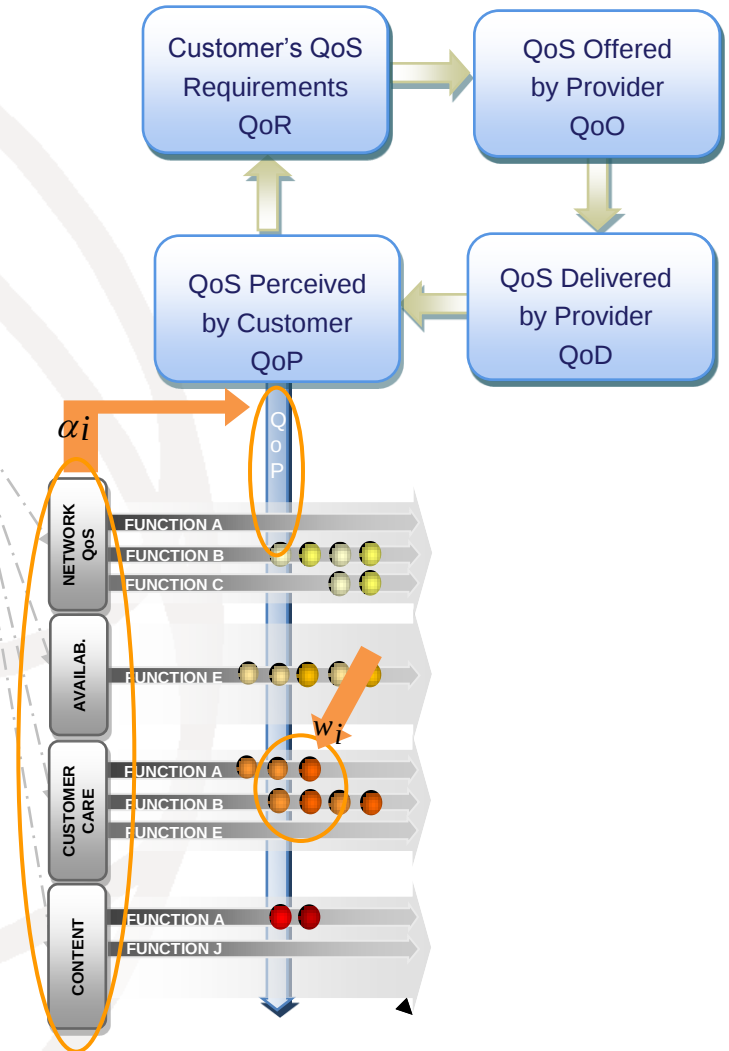
- Based on $Scal_i (KQI_i)$
- Weighted values (w_i)
- Different categories

$$Q_{criteria} = \sum_{i=1}^n w_i Scal_i(KQI_i)$$

■ Perceived QoS (QoP)

- Based on $Q_{criteria}$
- Users' preferences
- Weighted values (α_i)

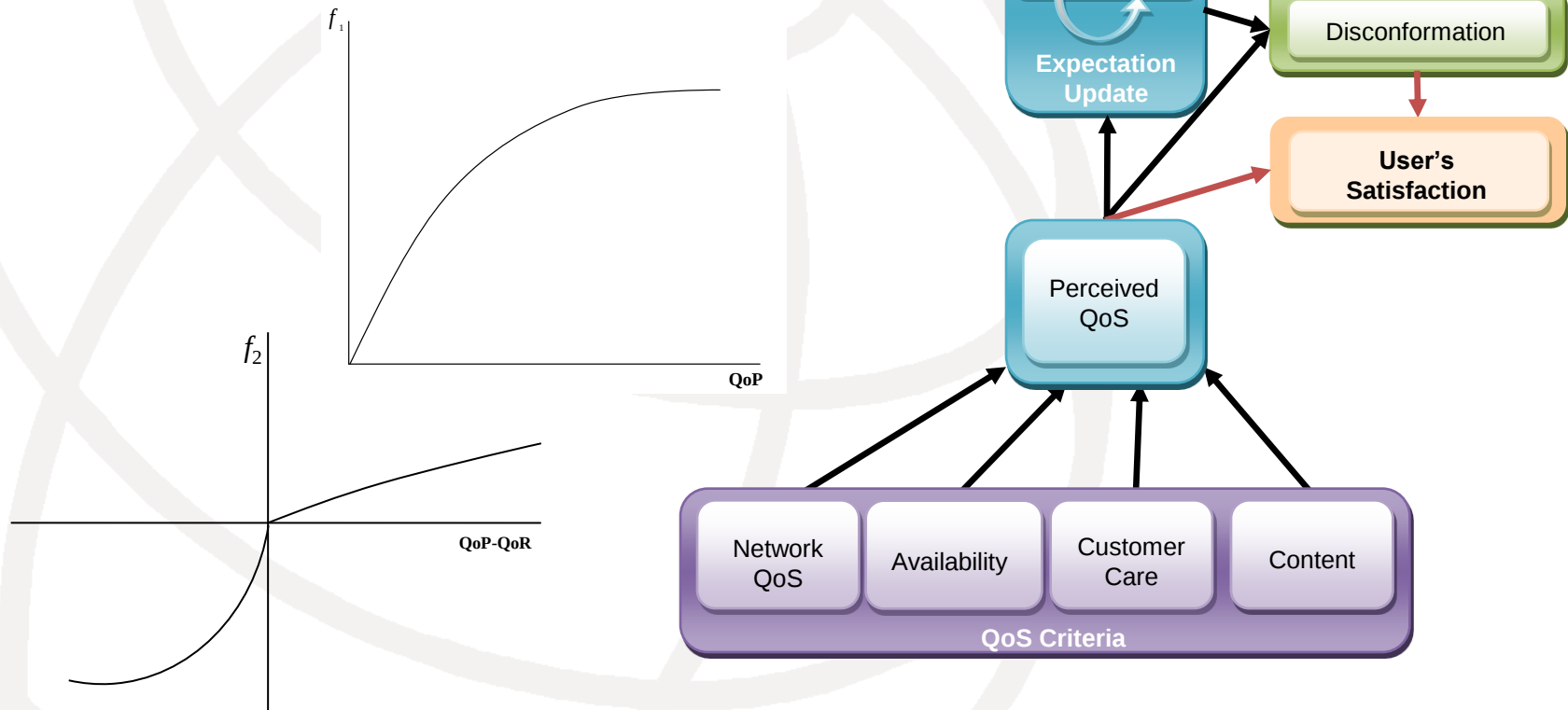
$$QoP = \alpha_1 Q_{net} + \alpha_2 Q_{avail} + \alpha_3 Q_{c_care} + \dots$$



Users' Satisfaction

■ Final Satisfaction: $S = f_1(QoP) + f_2(QoP - QoR)$

- Perception function f_1
- Disconformation function f_2



Case Study:

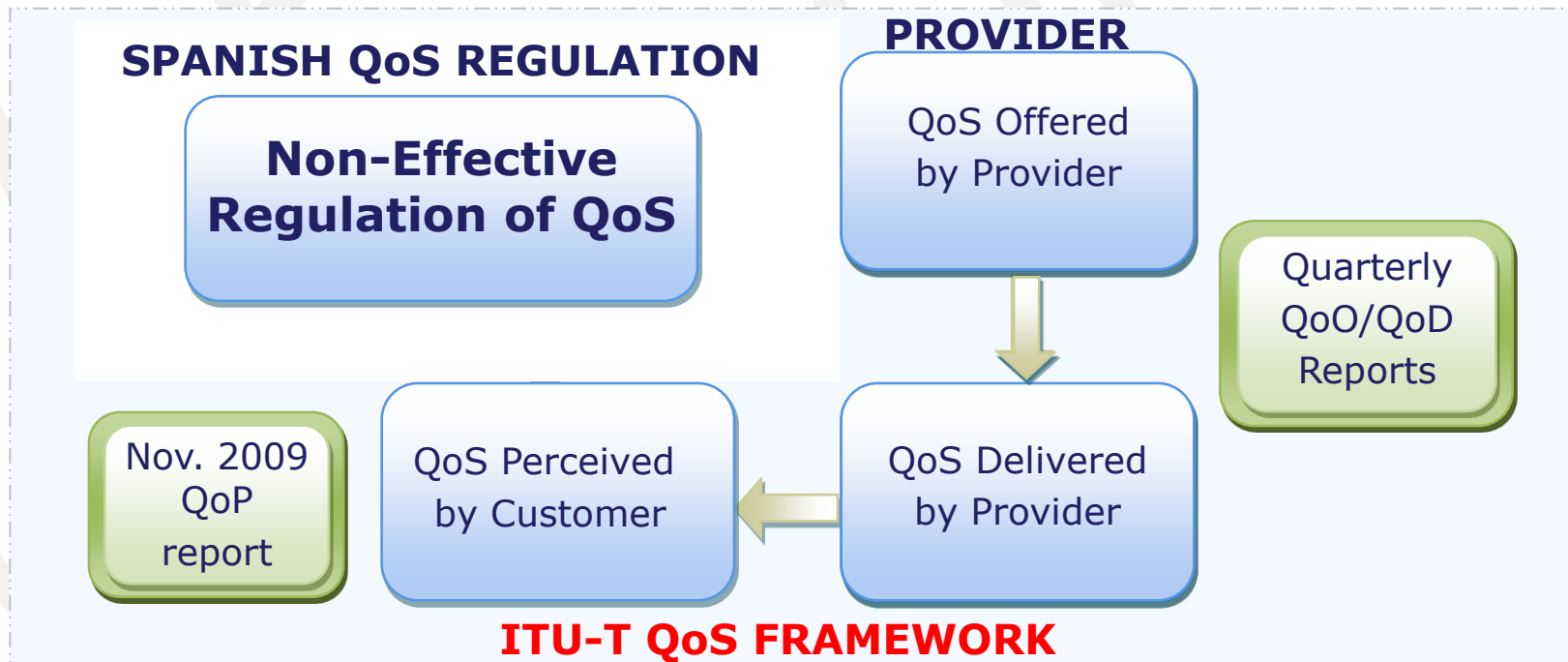
Spanish Internet QoS regulation

- Spanish Ministerial Order (MICyT)
 - “ITC/912/2006 of 29 March 2006”
 - Based on ITU-T QoS framework
- GT3 Working Group
 - Identification of Internet QoS parameters
 - Definition of measurement methodology
 - ITU-T QoS framework not completely fulfilled
 - Lack of users' point of view
- Meets basic criteria
- Do not comply the objective

Non-effective regulation!

Results of Spanish QoS Regulation

- Since 2007 publication of QoS information
 - ➔ Only covers ISPs' point of view (QoO/QoD)
- Nov. 2009: a survey report about QoP
- Lack of analysis between QoO/QoD/QoP



New Regulation Approach

- Identification of KQI
- QoS offered: $(KQI_i)_{min}, (KQI_i)_{max}$
- QoS delivered: measurements
- Scal (KQI):

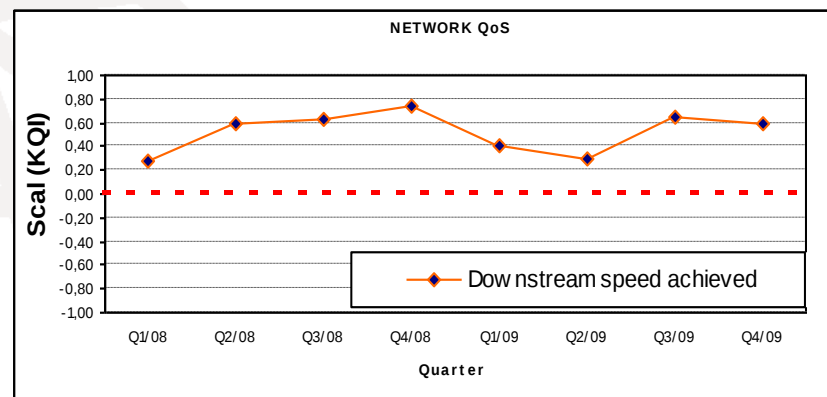
KQI	Scal (KQI)							
	2008				2009			
	Q 1	Q 2	Q3	Q 4	Q 1	Q 2	Q 3	Q 4
Downstream speed achieved	0,27	0,60	0,73	0,74	0,40**	0,30	0,65	0,60
Successful log-in ratio	0,75	0,93	0,90	0,98	0,98**	0,92	0,95	0,95
Unsuccessful data transmissions ratio	0,53	0,87	0,93	0,80	0,96**	0,96	0,96	0,88
Provisioning time for the Internet Access	0,38	0,38	0,50	0,88	0,88	0,88	0,88	0,75
Fault report rate per fixed access lines	0,57	0,71	0,63	0,63	0,39**	0,63	0,49	0,07
Fault repair time on access network	0,36	0,97	0,60	0,56	0,41	0,92	0,55	-0,11
Response time for admin/billing enquiries	0,20	0,31	0,37	0,65	0,97**	0,79	0,52	0,67
Rate of bill correctness complaints	-0,61	-0,53	-0,11	-0,11	-0,02*	0,57	0,55	0,25
Customer complaints resolution time	-1,00	-1,00	0,17	0,69	0,45	-0,15	0,42	0,68
Frequency of customer complaints	-0,93	-0,83	-0,36	-0,44	0,04*	0,55	0,54	0,24

Analysis of Results: Scal (KQI)

Current Regulation

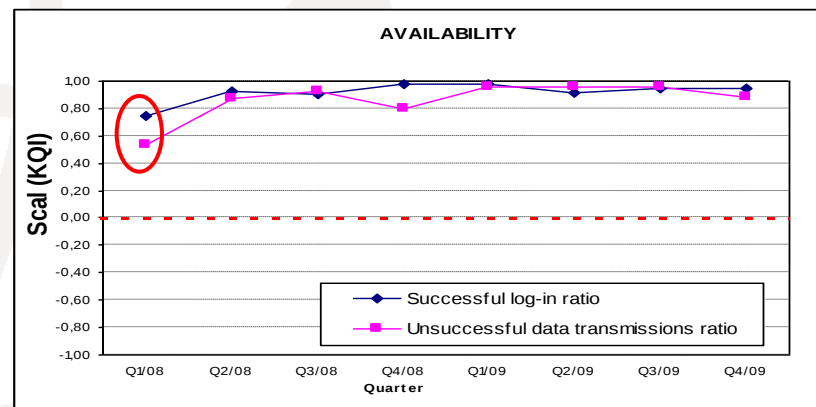
INTERNET ACCESS SERVICE: ADSL 3MB								
PARAMETERS (ETSIEG 202 057-4)	MEASURE- MENTS	QoS OFFERED		QoS ACHIEVED				
		VALUE	VALID SINCE	T3 2007	T4 2007	T1 2008	T2 2008	T3 2008
SUCCESSFUL LOG-IN RATIO (%)		98	Jan. 2008			99.95	99.86	99.80
UNSUCCESSFUL DATA TRANSMISSIONS RATIO (%)		0.3	Jan. 2008			0.14	0.04	0.02
DOWNSTREAM SPEED ACHIEVED (kbps)	MEDIUM SPEED	2430	Jan. 2008			2446	2504	2522
	MAXIMUM SPEED (Percentile 95)	2460	Jan. 2008			2489	2553	2556
	MINIMUM SPEED (Percentile 05)	2330	Jan. 2008			2352	2445	2485

New Approach



► Increase of QoS offered in 2009

INTERNET ACCESS SERVICE: ADSL 3MB								
PARAMETERS (ETSIEG 202 057-4)	MEASURE- MENTS	QoS OFFERED		QoS ACHIEVED				
		VALUE	VALID SINCE	T4 2008	T1 2009	T2 2009	T3 2009	T4 2009
SUCCESSFUL LOG-IN RATIO (%)		99.2	Jan. 2009	99.96	99.98	99.94	99.96	99.96
UNSUCCESSFUL DATA TRANSMISSIONS RATIO (%)		0.25	Jan. 2009	0.06	0.01	0.01	0.01	0.03
DOWNSTREAM SPEED ACHIEVED (kbps)	MEDIUM SPEED	2440	Jan. 2009	2507	2485	2475	2515	2510
	MAXIMUM SPEED (Percentile 95)	2500	Jan. 2009	2555	2553	2555	2556	2556
	MINIMUM SPEED (Percentile 05)	2350	Jan. 2009	2451	2429	2380	2485	2461



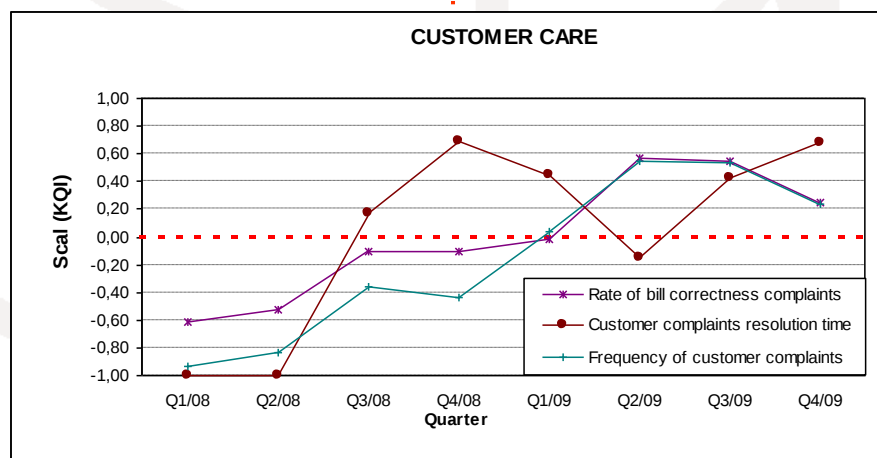
Analysis of Results: Scal (KQI)

■ Current Regulation (customer care)

PARAMETER S (ETSI EG 202 057-1)	MEASURE- MENTS	CUSTOMER CARE							CUSTOMER CARE						
		QoS OFFERED		QoS ACHIEVED					QoS OFFERED		QoS ACHIEVED				
		VALUE	VALID SINCE	T3 2007	T4 2007	T1 2008	T2 2008	T3 2008	VALUE	VALID SINCE	T4 2008	T1 2009	T2 2009	T3 2009	T4 2009
FREQUENCY OF CUSTOMER COMPLAINTS (%)		1.6	July 2006	1.88	2.44	3.08	2.92	2.18	3	January 2009	2.30	2.87	1.35	1.39	2.28
CUSTOMER COMPLAINTS RESOLUTION TIME (Percentile 95 in days)		25	July 2006	25.62	22.91	49.95	55.49	20.78	25	July 2006	7.84	13.69	28.78	14.60	8.00
RATE OF BILL CORRECTNESS COMPLAINTS (%)		0.75	January 2007	0.73	0.93	1.21	1.15	0.83	1	January 2009	0.83	1.02	0.43	0.45	0.75

■ New Approach

Reduction in QoS offered in 2009



Analysis of Results: Global KQI

Global KQI: Users' preferences

$\omega_1 = 0,34$ (Network QoS)

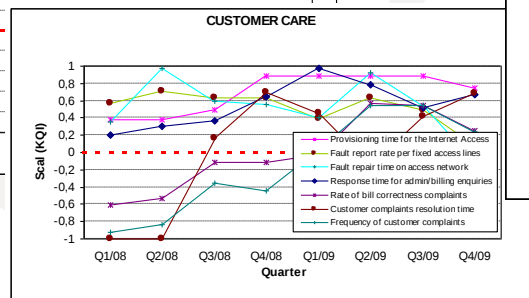
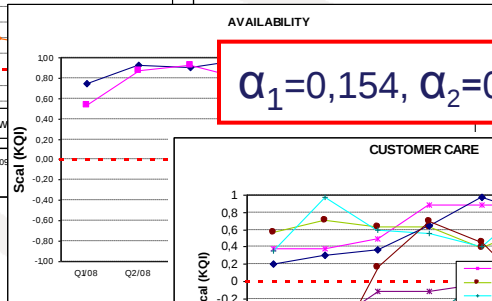
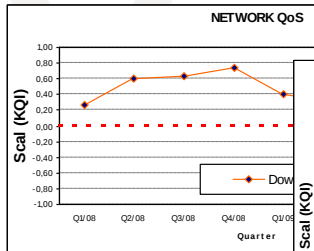
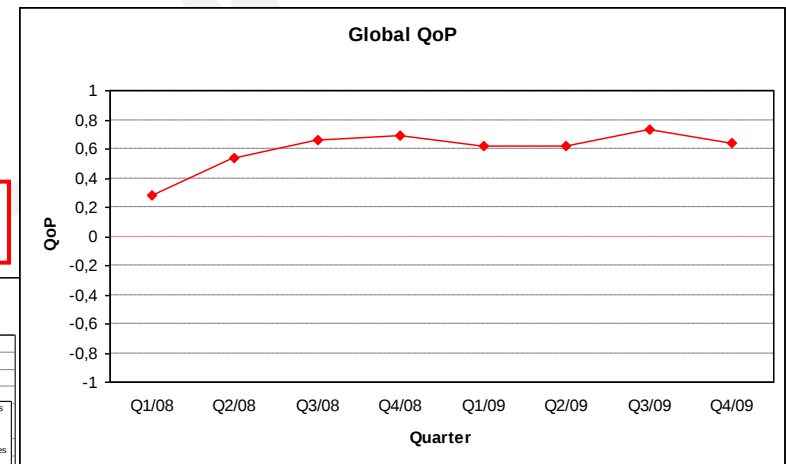
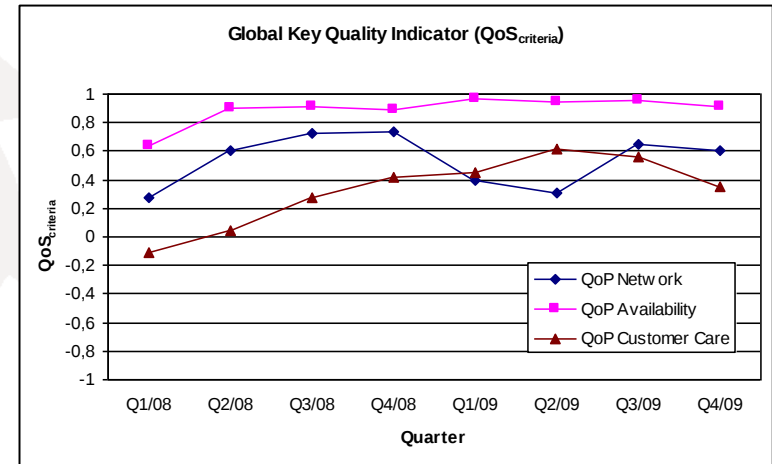
$\omega_2 = 0,35$ (Availability)

$\omega_3 = 0,31$ (Customer Care)

$\alpha_1 = 1$

$\alpha_1 = 0,502, \alpha_2 = 0,498$

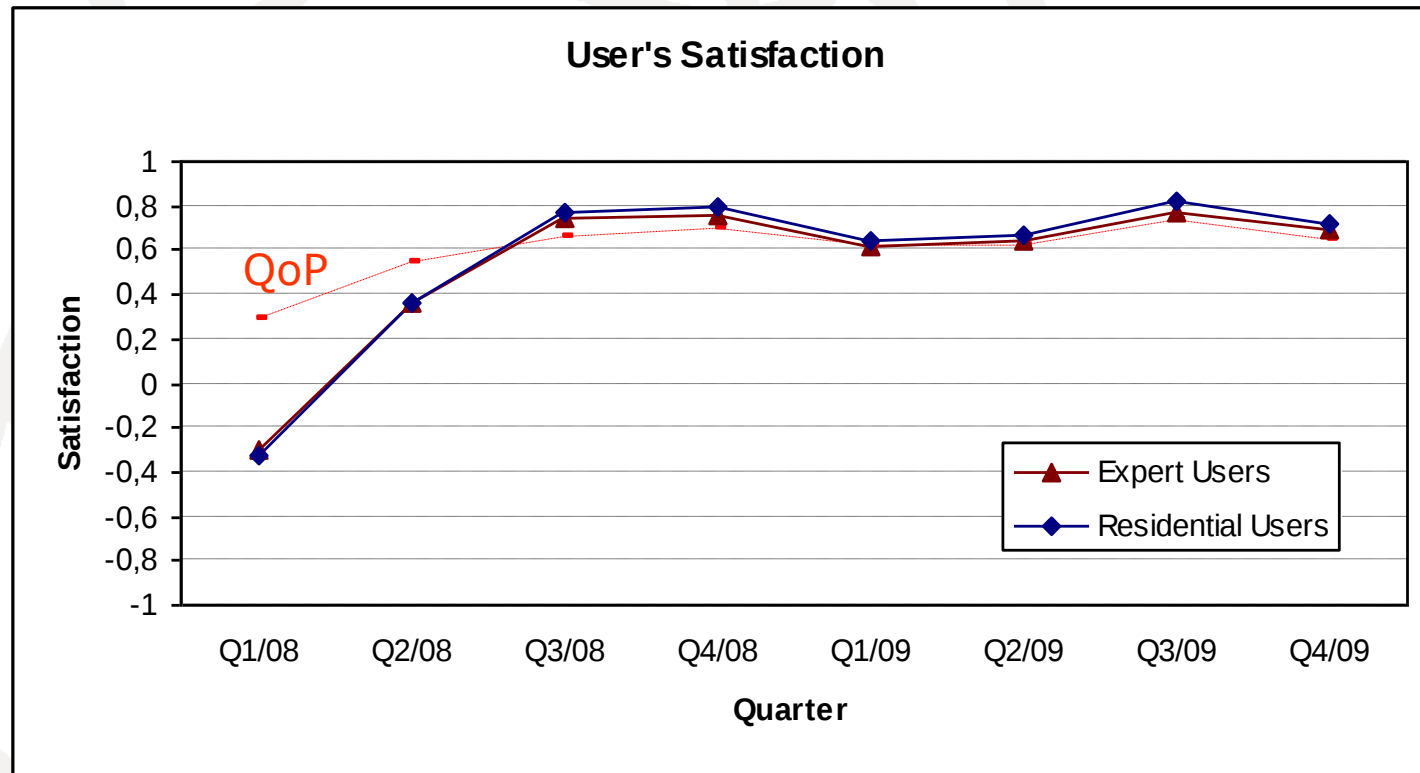
$\alpha_1 = 0,154, \alpha_2 = 0,154...$



Analysis of Results: Satisfaction

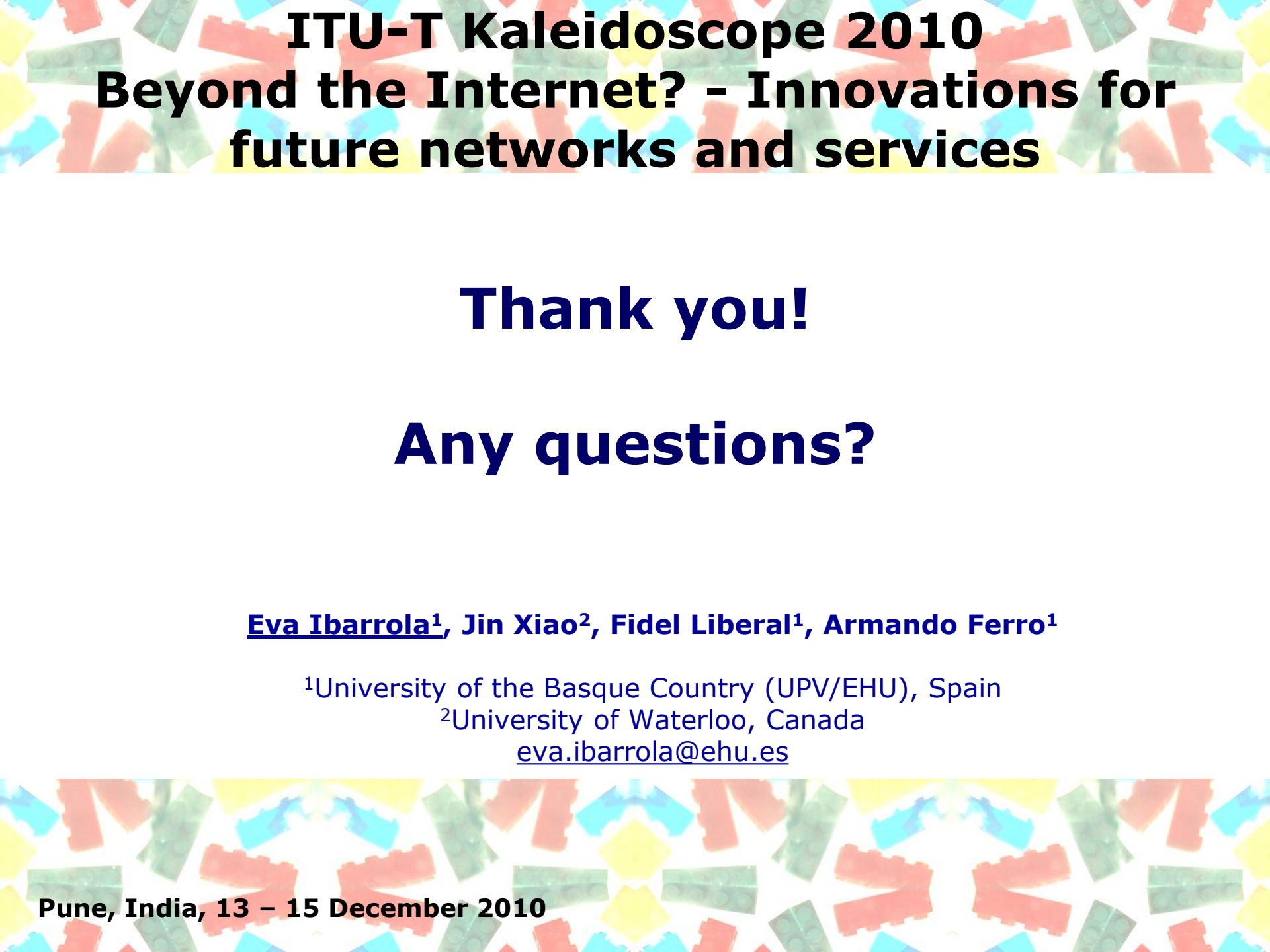
■ Satisfaction: $S = f_1(QoP) + f_2(QoP - QoR)$

- Perception and disconfirmation function
- Users' Satisfaction



Conclusions

- The new QoS regulation approach provides simple and useful QoS information for users, regulators and providers
- Based on ITU-T QoS framework, the user-centric regulation approach considers the QoS aspects that are relevant for users
- A new wider perspective is presented, offering new QoS subjective information that are technology-neutral as required in future networks



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Thank you!

Any questions?

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