Service Level Agreement (SLA) and Global QoS index for 3G networks

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ITU-BDT Regional Seminar on Fixed Mobile Convergence and Guidelines on the smooth transition of existing mobile networks to IMT-2000 for Developing Countries for Africa Region

Nairobi, Kenya, 9-12 May 2005

Outlook

1.1 Service Level Agreement

1.   Service Level Agreement (SLA) - formal agreement
      between two or more entities with the scope to

      –   assess service characteristics,

      –   responsibilities and

      –   priorities of every part.

2.   SLA may include compensations for an unreached
   level of quality as a economic issue of the contract.

1.2 Introduction on QoS and SLA studies

1. **ITU-T Rec. E.860 "Framework of a service level agreement" (2002) –**
   a framework for NGN interconnection studies

2. **ETSI Rec. ETR 138 (1997) – 9 QOS measures (incl. ISDN):**
   – Fault report for access line per year,
   – Unsuccessful call ratio,
   – Call set up time,
   – Supply time for initial network connection,
   – Percentage of orders completed on or before the date confirmed or contracted with the customer,
   – Response time for operator service,
   – Availability of card or coin operated public pay phones,
   – Fault repair time,
   – Service restoration.

3. **ETSI TIPHON project for IP telephony**. **"Gold-silver-bronze" approach:**
   voice packet loss: $< .5\%$ for class 1   = gold,
                              $.5\%$ to 1% for class 2 = silver,
                              1% to 2% for class 3 = bronze.

1.3 3GPP QoS Concept and Architecture (3GPP TS 23.107 V5.1.0)
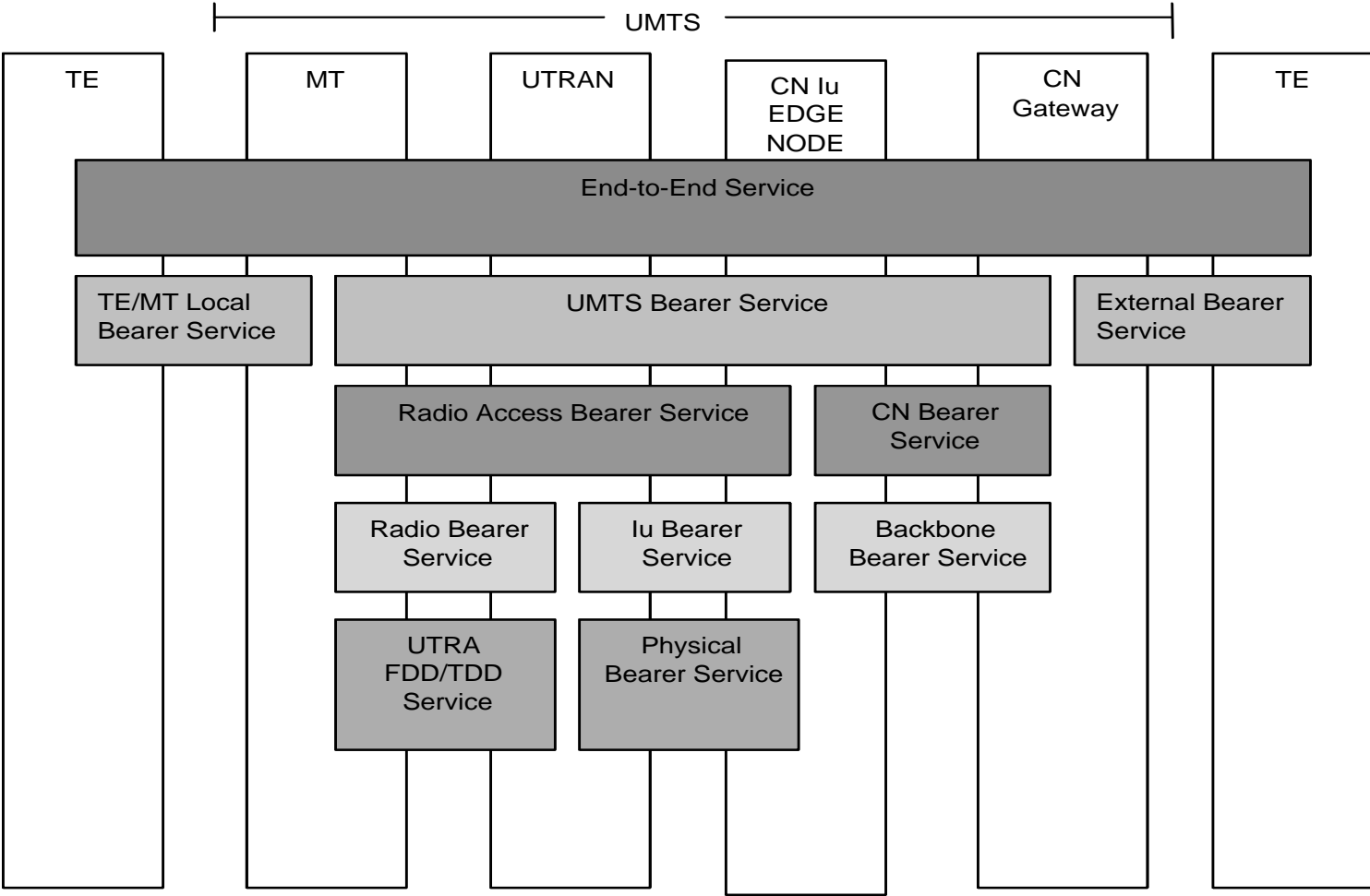
1.4 Multimedia Services

- **Real Time Communications**
- **Voice**
- **Text**
- **Video**
- **Non-Real Time Communications**
- **audio download;**
- **video download;**
- **audio streaming;**
- **video streaming;**
- **general data files;**
- **text messaging (e.g. SMS);**
- **emails;**
- **general web browsing;**
- **multi-media messaging**

1.5 Value ranges for UMTS Bearer Service Attributes

Traffic class	Conversational class	Streaming class	Interactive class	Background class
Maximum bitrate (kbps)	< 2 048	< 2 048	< 2 048	< 2 048
Delivery order	Yes/No	Yes/No	Yes/No	Yes/No
Maximum SDU size (octets)	<=1 500 or 1 502	<=1 500 or 1 502	<=1 500 or 1 502	<=1 500 or 1 502
SDU format information	RCP protocol	RCP protocol		
Delivery of erroneous SDUs	Yes/No	Yes/No)	Yes/No	Yes/No
Residual BER	$5*10^{-2}$, 10^{-2}, $5*10^{-3}$, 10^{-3}, 10^{-4}, 10^{-6}	$5*10^{-2}$, 10^{-2}, $5*10^{-3}$, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}	$4*10^{-3}$, 10^{-5}, $6*10^{-8}$	$4*10^{-3}$, 10^{-5}, $6*10^{-8}$
SDU error ratio	10^{-2}, $7*10^{-3}$, 10^{-3}, 10^{-4}, 10^{-5}	10^{-1}, 10^{-2}, $7*10^{-3}$, 10^{-3}, 10^{-4}, 10^{-5}	10^{-3}, 10^{-4}, 10^{-6}	10^{-3}, 10^{-4}, 10^{-6}
Transfer delay (ms)	100 – maximum value	250 – maximum value		
Guaranteed bit rate (kbps)	< 2 048	< 2 04		
Traffic handling priority			1,2,3	
Allocation/Retention priority	1,2,3	1,2,3	1,2,3	1,2,3

1.6 IETF activities and 3GPP

Quality of Service Enablers

IETF Integrated Services (IntServ) and Resource Reservation Protocol (RSVP)

Differentiated Services (DiffServ)

Multiprotocol Label Switching (MPLS)

QoS Management Enablers

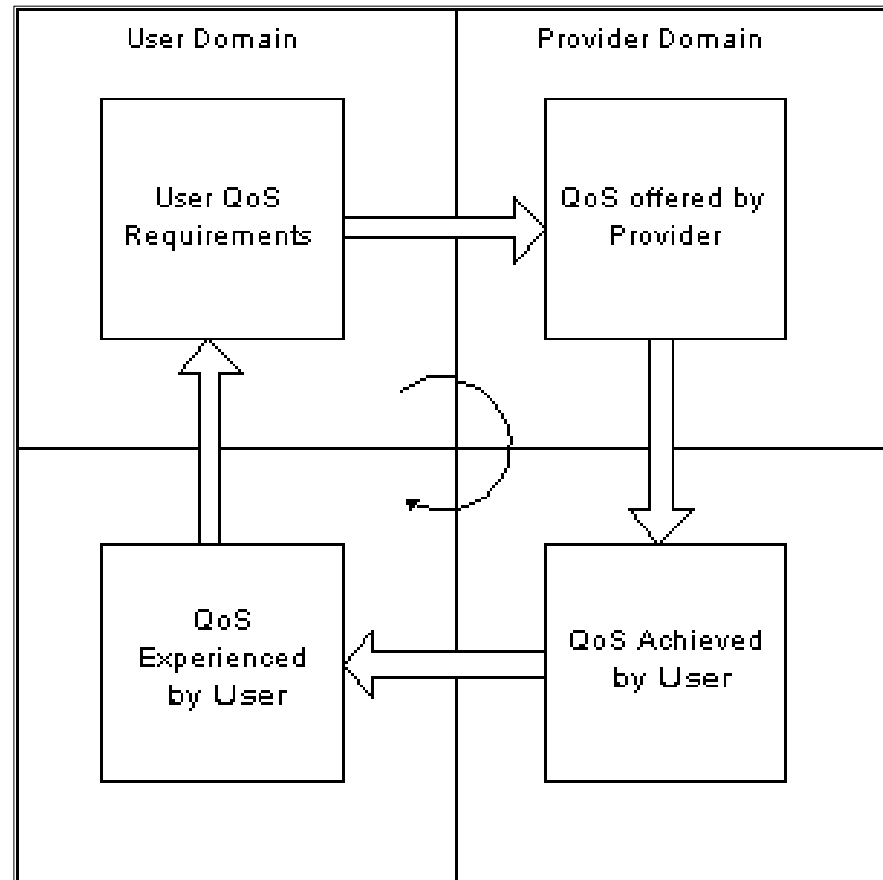**Service Level Agreements (SLAs)**

Common Open Policy Service (COPS) protocol

Simple Network Management Protocol (SNMPv3)

1.7 Quality of Service (QoS)

ITU-T: *The collective effort of service performance which determine the degree of satisfaction of a user of the service.*

- User Domain
  - Speed
  - Accuracy
  - Dependability
    - Reliability
    - Availability
  - …

- Provider Domain
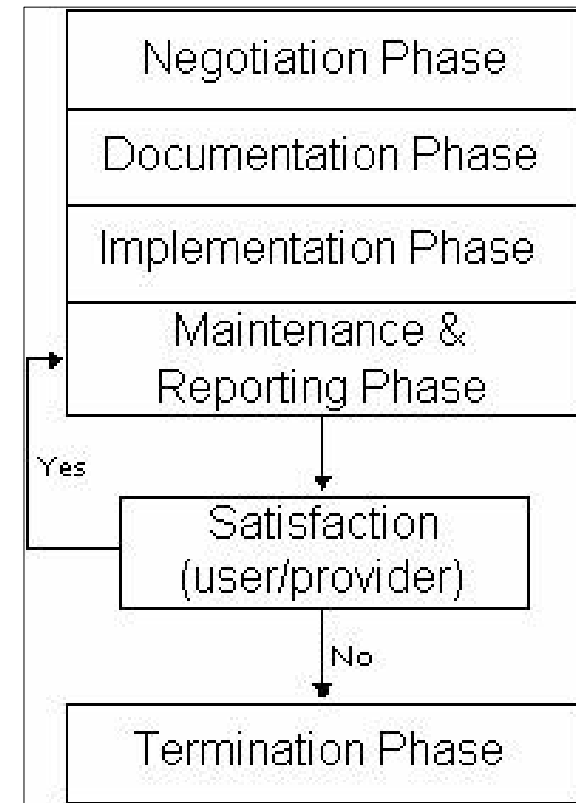 - Delay
  - Loss
  - Utilization
  - …

1.8 Service Level Agreement

SLA is a result of negotiation between two entities which shows

- **service development**
- **service access & delivery characteristics**
- **service monitoring and management and**
- **service economical perspective**

SLA Parts

- QoA – QoS Agreement
  - QoA Objectives or Service Level Specifications
- TCA Traffic – Conditioning Agreement
- Management and Monitoring
- Reporting and Backup

Negotiation Phase

Documentation Phase

Implementation Phase

Maintenance & Reporting Phase

Yes

Satisfaction (user/provider)

No

Termination Phase

QoS: ITU-T: The degree of conformance of the service delivered to a user by a provider with an agreement between them.

1.9 Service Level Specifications

A SLS is a specific SLA and its SLO's to guarantee quality of
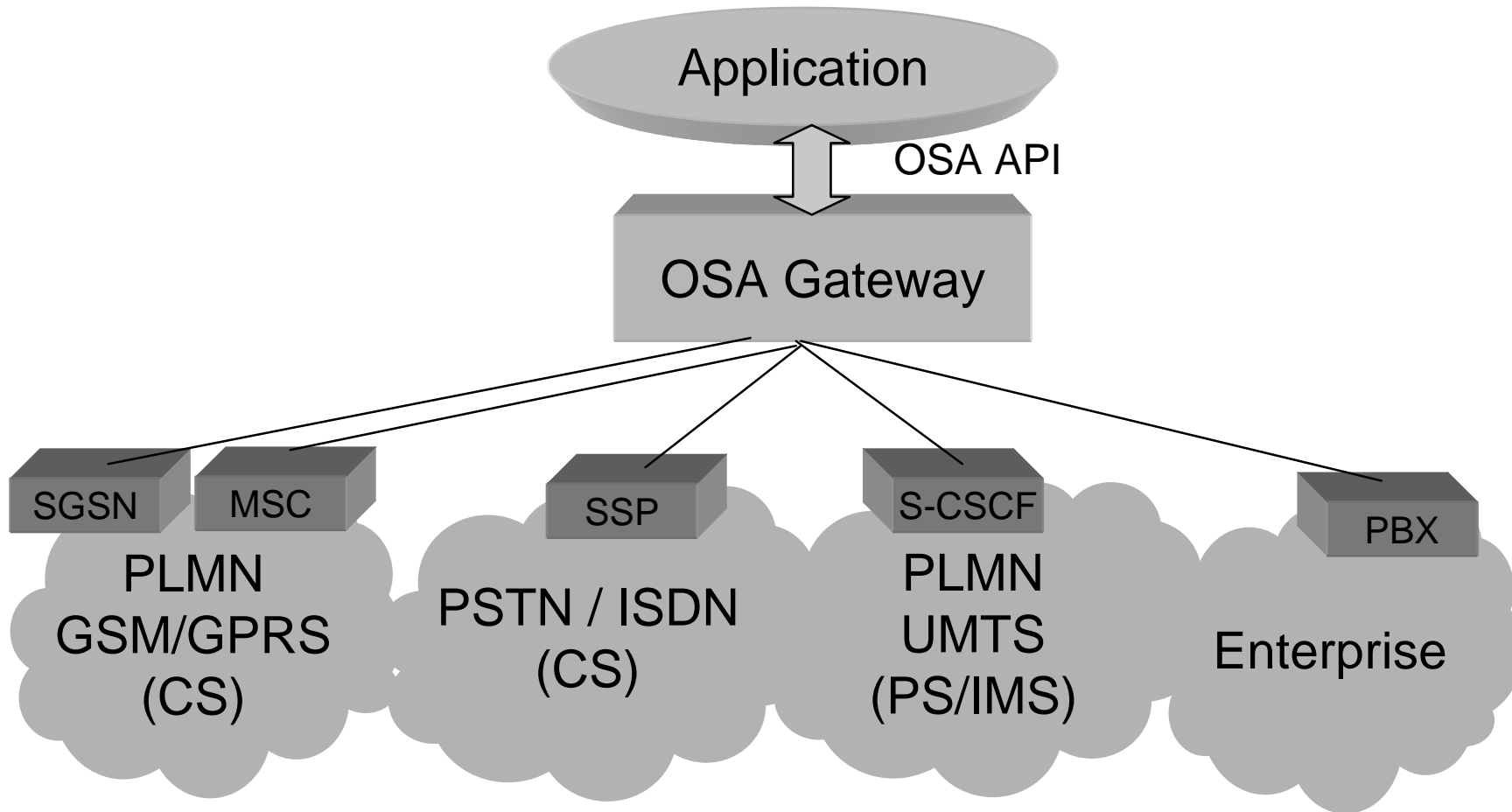service to the user

- SLS are dependent on network environment but are independent of underlying technology and protocols.

- On the other hand, SLO's depend on the underlying technology, protocols and implementation schemes.
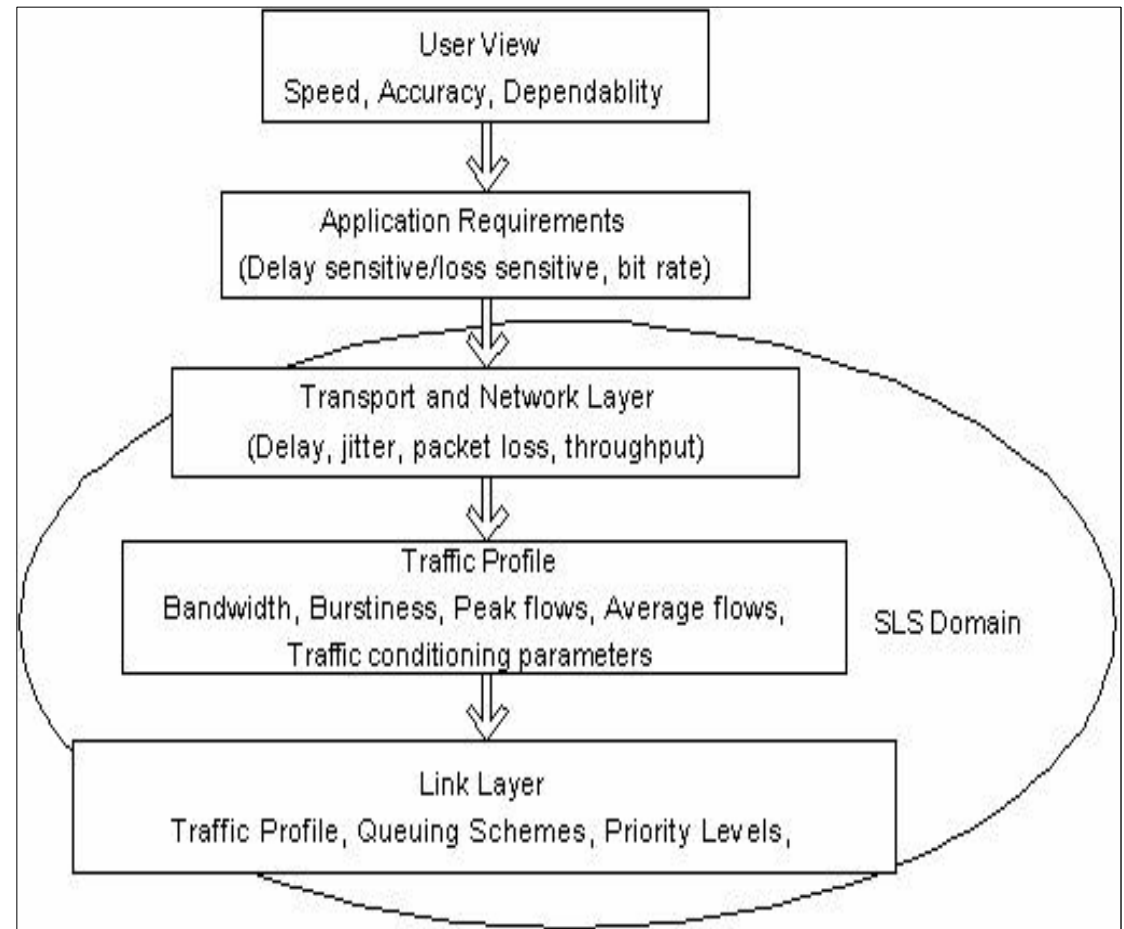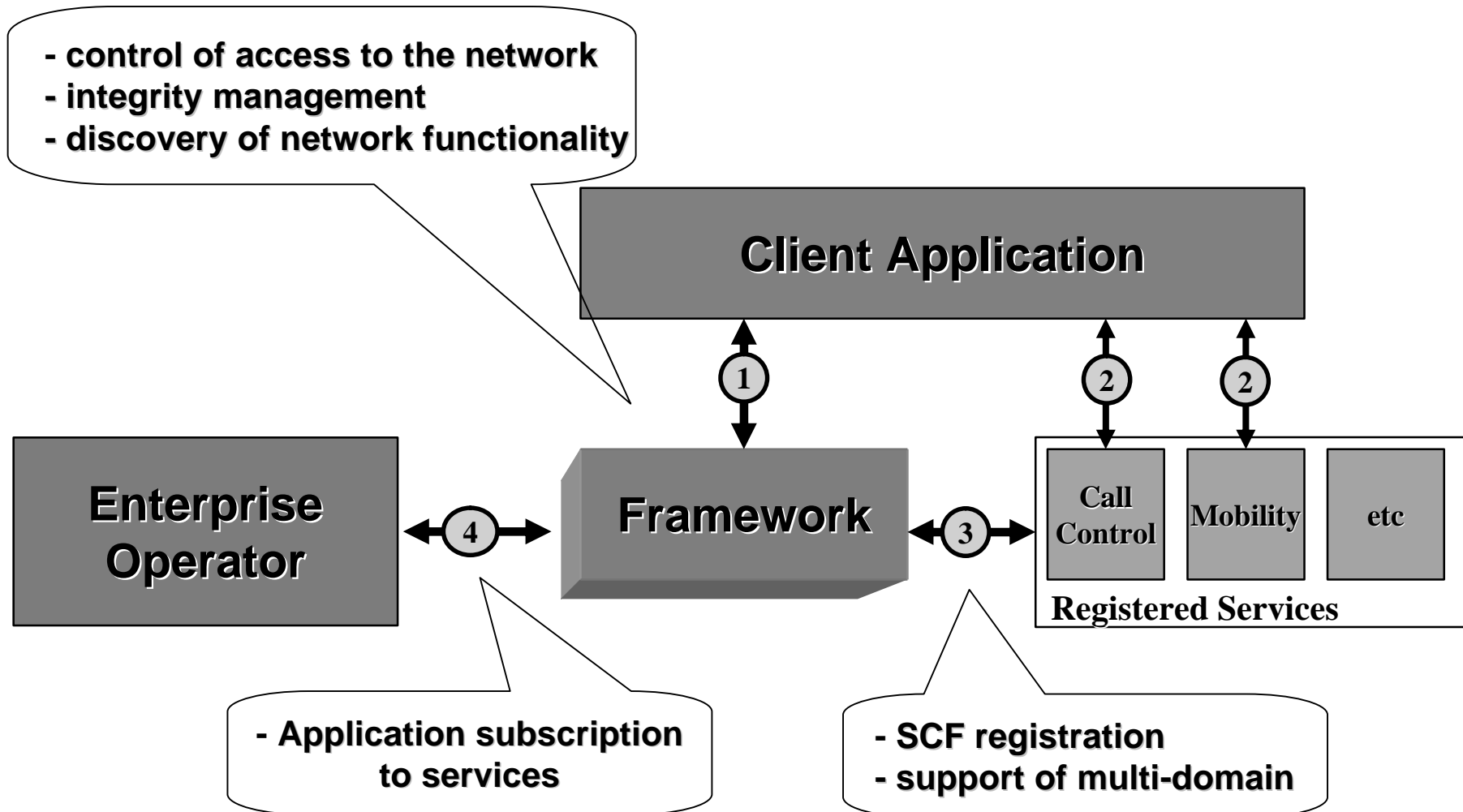
1.10 SLA and QoS for Wireless Environments

- QoS Support in the 2.5 and 3rd Generation Networks

- QoS Criteria particular to wireless and mobility
  - Accessibility
  - Reliability
  - Connection time
  - Service interruptions or dropout due to scarce network resources
  - Network coverage
  - Roaming and Hand-Over performance
  - Speech quality
  - Data transfer rate
  - Inter-operability between different domains
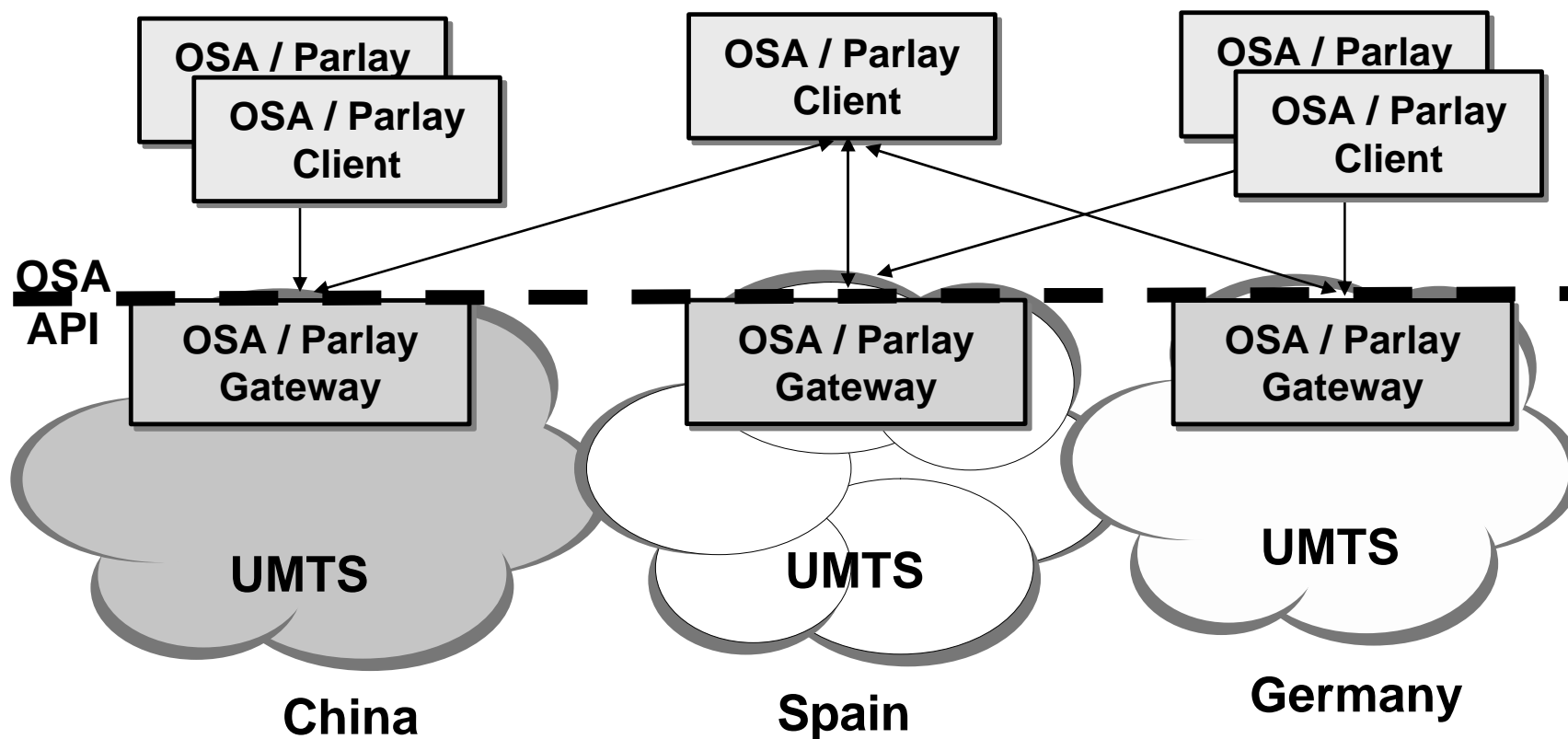
2.1 The Parlay/OSA API

Application

OSA API

OSA Gateway

SGSN   MSC

SSP

S-CSCF

PBX

PLMN
GSM/GPRS
(CS)

PSTN / ISDN
(CS)

PLMN
UMTS
(PS/IMS)

Enterprise

2.2 The Parlay/OSA Framework

2.3 OPIUM Project as UMTS QoS Testbed ?

3.1. How to built the global SLA index

1)   We use a **linear discriminant function LDF**, in other words, a scalar product of vectors and :

$$Q = W_1X_1 + W_2X_2 + \ldots + W_nX_n$$

where $W_1, \ldots, W_n$ are unknown constants, and choose some threshold value a that the decision rule is as follows

    decision **D_1 if $Q < a$**
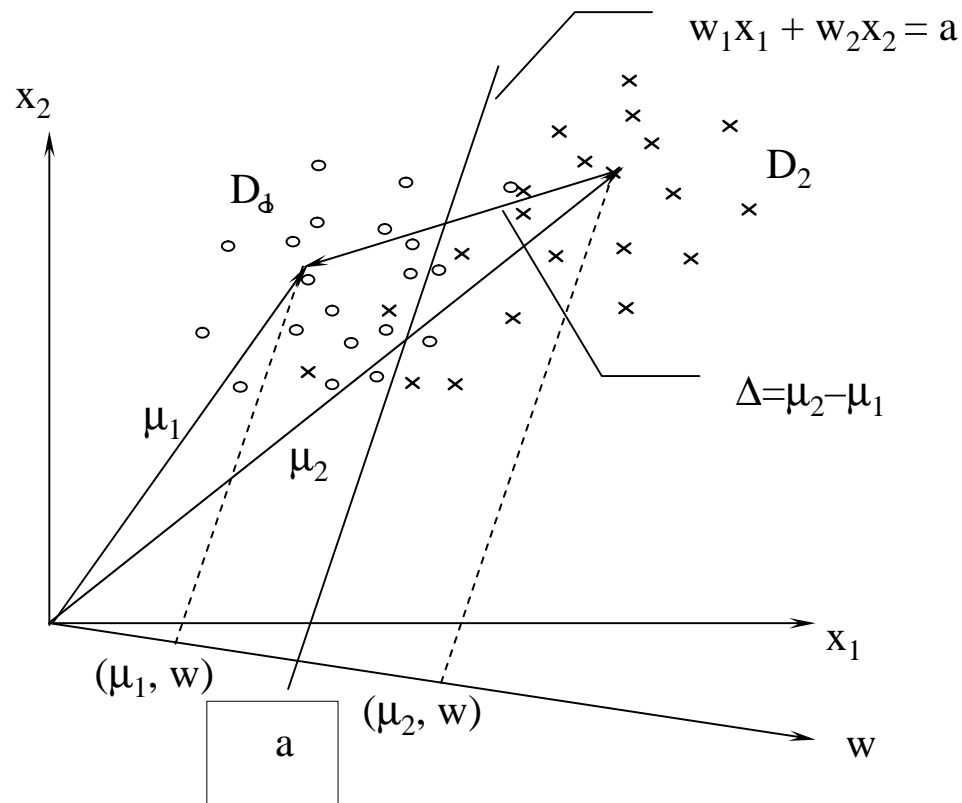
    decision **D_2 if $Q > a$**

2)   For **"gold-silver-bronze" standard** - any service/network provider can be correlated to one of three classes:

Gold level   ("Really Great" – expensive)   if $Q < Q1$,

Silver level   ("Darn Good" – not so expensive)   if $Q1 < Q < Q2$,

Bronze level ("Best Effort" – inexpensive)   if $Q2 < Q$.

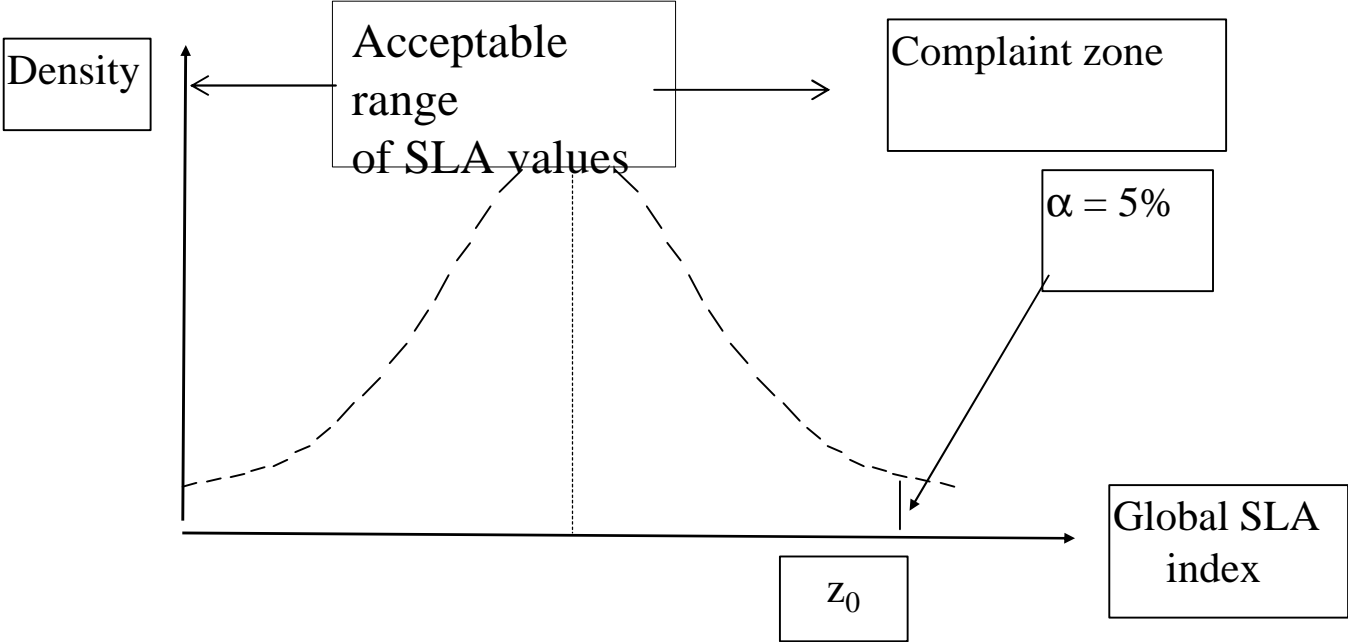# 3.2 Geometrical interpretation of classification for two-dimensional case

Mahalanobis distance

$$M^2 = \left(\boldsymbol{m}_2 - \boldsymbol{m}_1 \right)^T \sum \left(\boldsymbol{m}_2 - \boldsymbol{m}_1 \right)$$

3.3 Scheme for SLA conflict resolution

4.1 Quality optimisation scheme:

a) basic idea, b) penalty scheme

A+B=
Total
Expenditure

Expenditure

A=Cost of
service
improvement

B=Penalties

Objective
level q

Global SLA
index

a)

Expenditure

A+B

A

B=Penalties

z_0

q

Global SLA
index

b)
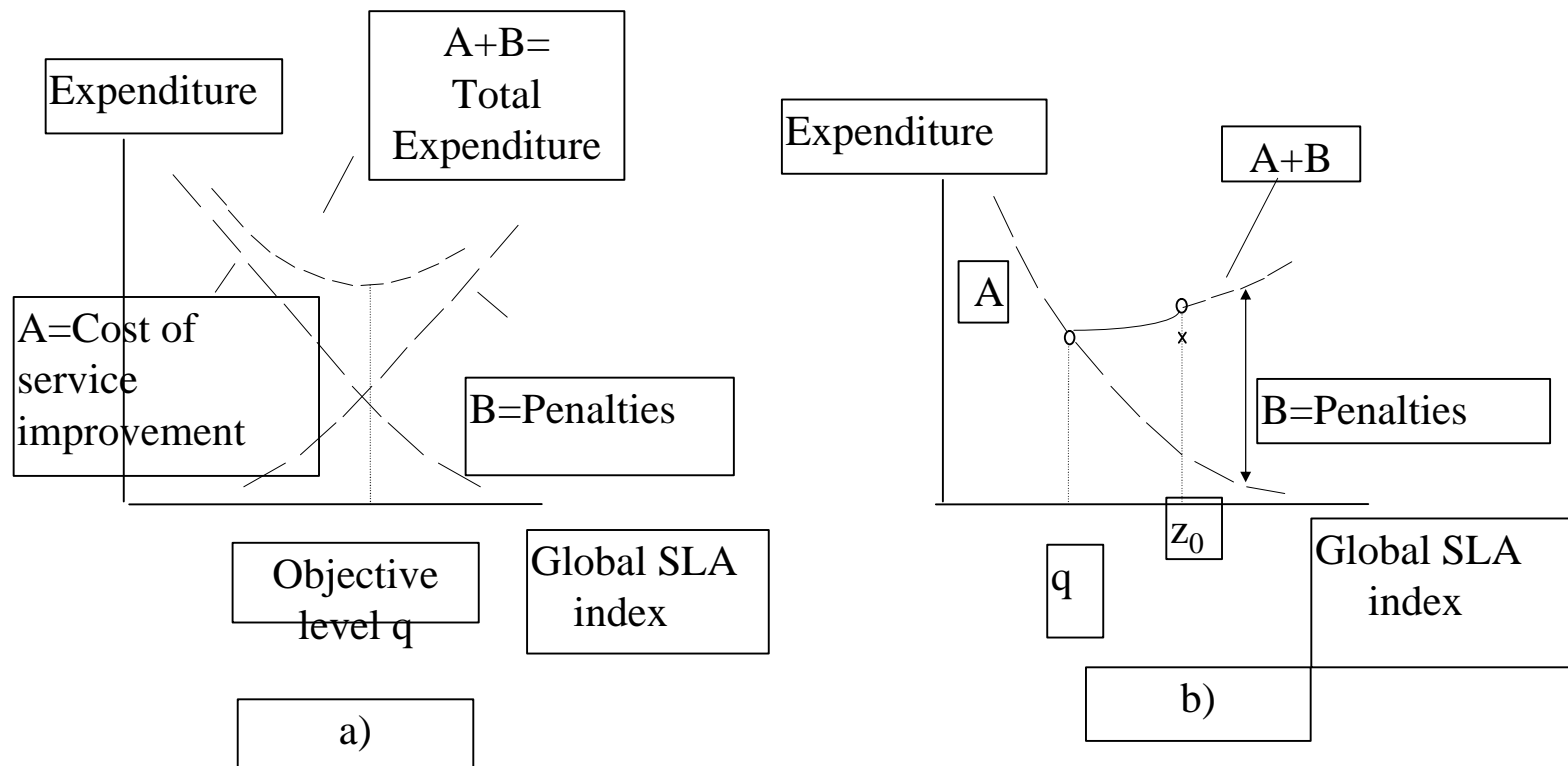
4.2 "Gold-silver-bronze" penalty scheme

Expen-
diture

? ?st of service improvement

Silver penalties/at gold agreed

Gold-missed penalties

Bronze penalties/ at gold agreed

Silver-missed penalties

Global SLA index Q

Gold zone

Silver zone

Bronze zone

Q1

Q2
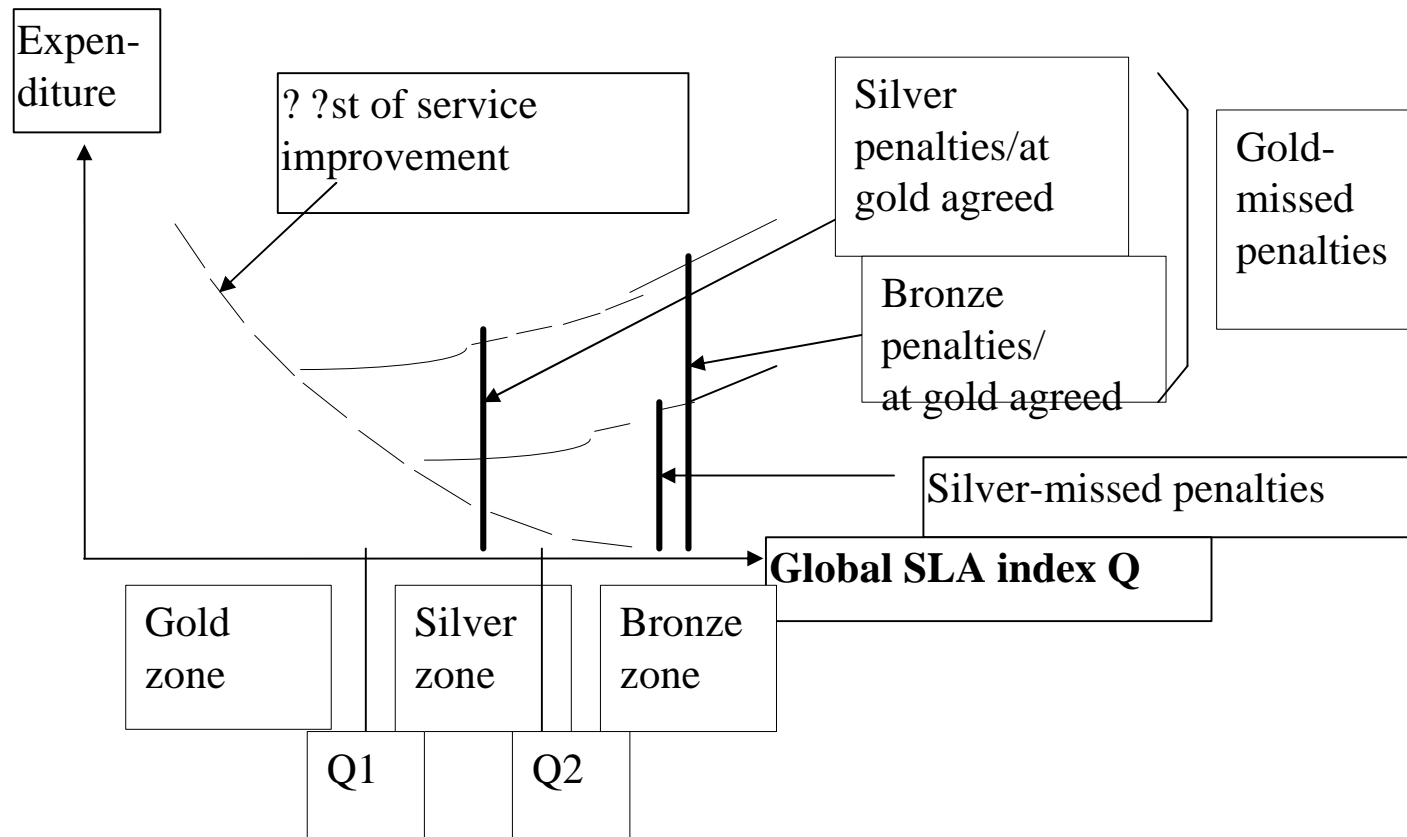
5.1 Best Practice: "New York Telephone" Service Standards

The Telephone Service Standards of New York Telephone Company (Verizon NY now) were adopted by the New York State Public Service Commission in 1973 and revised in 1989 and 1991.
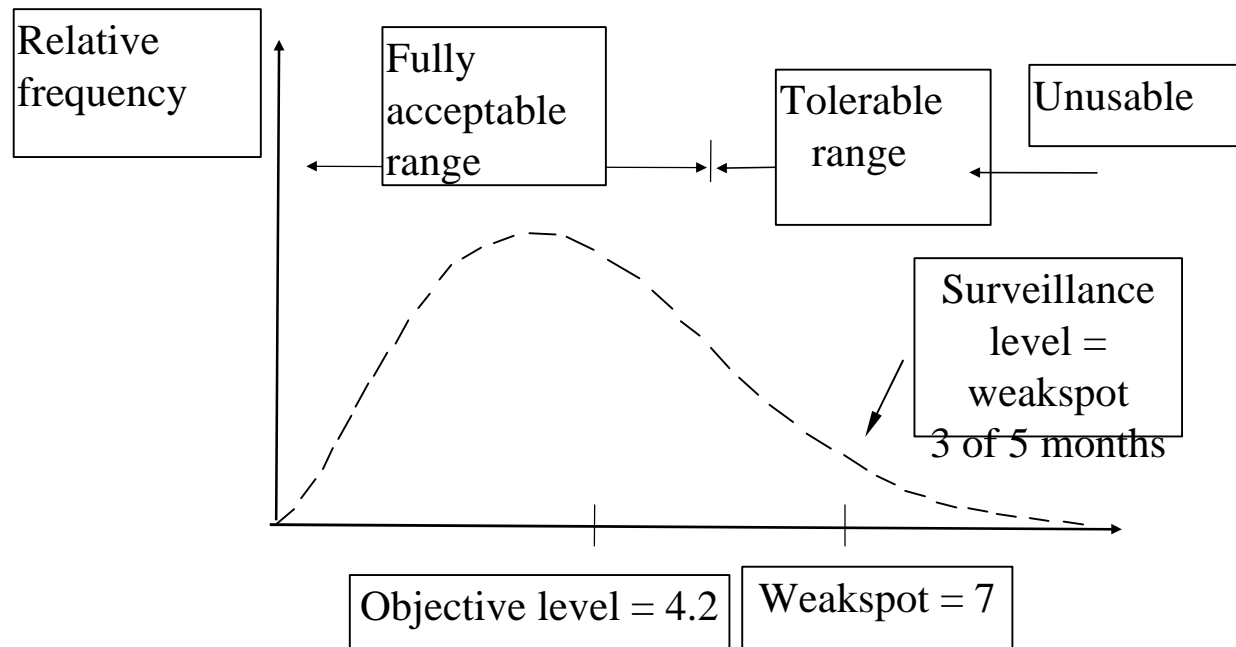
Measurement of service quality in four separate categories:

1) Maintenance Service,

2) Dial-Line Service,

3) Answer Time Performance, and

4) Installation Service.

These measurements are categorised into three levels:

1) **Objective levels** - the level of service that represents good quality service to consumers.

2) **Weakspot levels** to denote a level of service below which immediate analysis and corrective action may be required.

3) Three or more of five consecutive months of weakspot results are usually considered as **a surveillance level failure**

5.2 Illustration to customer trouble report rate CTRR

Relative frequency

Fully acceptable range

Tolerable range

Unusable

Surveillance level = weakspot
3 of 5 months

Objective level = 4.2

Weakspot = 7

5.3 NYT service standards

Service element	Objective level	Weakspot level
Maintenance service CTRR per 100 access lines Missed repair appointments (%) Out-of-service over 24 hours	 0.0 - 4.2 0.0 - 10.0 0.0 - 20.0	 Over 7 Over 15 Over 30
Installation performance Installations within 5 days (%) Installation appointments	 85 - 100 0.0 - 3.0	 Below 70 Over 10
Answering time performance (%) Business office - within 20 sec " ------- " - all positions busy Repair service - within 20 sec " ------- " - all positions busy	 90.0 - 100.0 0.0 - 10.0 90.0 100.0 12.0 - 16.0	 Below 85 Over 15 Below 85 Over 27

5.4 Rebates to all Manhattan customers relating CTRR

	Range of offices without penalties, %			
Target level	79%	81%	83%	85%
Rebate (Mill)	1995	1997	1999	2001
$5.0	78%	80	82	84%
$6.0	77	79	81	83
$7.0	76	78	80	82
$8.0	75	77	79	81
$10.0	74	76	78	80
$12.0	73	75	77	79
$15.0	72	74	76	78
$25.0	<72	<74	<76	<78

6 Best Practice: LRAIC approach for penalty scheme

Long Run Average Incremental Costs (LRAIC) approach:

1.   The interconnection charges reflect the actual production costs (new entrant operators should not pay for inefficiency, mis-investments, etc.)

2.   New entrant operators will be stimulated to invest in alternative networks.

3.   To create consensus on the cost level among telecom operators.

The SLA as the common target for LRAIC analysis - the border point between bottom-up (new entrant estimate) and top-down (incumbent estimate): **the higher LRAIC estimates the higher penalties.**

7 Conclusion

1.   UMTS QoS issues - a challenge for ITC

2.   Parlay for SLA control

3.   Revisited OPIUM Project as UMTS QoS and SLA Testbed

4.   Global QoS index and "Gold-silver-bronze" standard

5.   To develop LRAIC approach for penalties