[File No.402-30/2001-FN]
Telecom Regulatory Authority of India

NOTIFICATION

New Delhi **15th November 2002**

In exercise of the powers conferred upon it under sub–clause (b) (v) of sub section (1) of section 11 of TRAI (Amendment) Act 2000 in regard to laying down the standards of quality of service to be provided by the service providers, the Telecom Regulatory Authority of India hereby makes the following Regulation:

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REGULATION ON QUALITY OF SERVICE FOR VOIP BASED INTERNATIONAL LONG DISTANCE SERVICE, 2002 (3 of 2002)

Section-I

Title, Extent and Commencement

Short title, extent and commencement

1. i) The title of this regulation shall be **'Regulation on Quality of Service for VOIP based International Long Distance Service, 2002'**

ii) This regulation shall be applicable to all the International long Distance Service Providers using VOIP based networks.

iii) This regulation shall come into effect from the date of its notification in the Official Gazette.

Section-II

Definitions

2 In this Regulation, unless the context otherwise requires:

i) '**Act**' means the Telecom Regulatory Authority of India Act, 1997, as amended by, TRAI (Amendment) Act, 2000 and as amended from time to time.

ii) **'Authority'** means the Telecom Regulatory Authority of India.

iii) **'MOS'** means Mean Opinion Score, a subjective measure of speech quality as defined in ITU-T Recommendation P.800, 'Methods for Subjective Determination of Transmission Quality, August 1996'

iv) '**Regulation'** means the Regulation on Quality of Service for VOIP based International Long Distance Service notified by the Authority under the 'Act'.

v) **'R-Value'** is the objective measure of speech quality denoted as the resultant value of the 'Transmission Rating Factor' as defined in ITU-T Recommendations G.107, 'E-Model, Computation Model for Use in Transmission Planning, August 2001' and G.108, 'Application of the E-Model, A Planning Guide, September 1999'.

vi) **'Service Provider'** in the context of this regulation means a legal entity holding an ILD licence.

vii) **'Quality of Service (QOS)'** means the indicator of performance of a network and of the degree to which the network conforms to the stipulated norms.

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viii) **'Voice over Internet Protocol (VOIP)** means a technology that enables the carriage of real time voice traffic over a packet network by using Internet Protocol (IP).

ix) **Acronyms & Abbreviations**

AP	Access Provider
BSO	Basic Service Operator
BHCA	Busy Hour Call Attempt
CCR	Call Completion Rate
CCS7	Common Channel Signalling system no. 7
DTMF	Dual Tone Multi Frequency
ILDO	International Long Distance Operator
IP	Internet Protocol
IPTD	IP Packet Transfer Delay
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunication Union – Telecommunication standardization sector
IUT	Implementation Under Test
IVR	Interactive Voice Response
MOS	Mean Opinion Score
ms	milli second
NLDO	National Long Distance Operator
PLMN	Public Land Mobile Network
PoP	Point of Presence
PSTN	Public Switched Telephone Network
QoS	Quality of Service
TEC	Telecom Engineering Centre
TRAI	Telecom Regulatory Authority of India
VoIP	Voice over Internet Protocol

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Section-III

Objective of laying down Quality of Service Benchmarks:

3 The objective of laying down Quality of Service benchmarks is to:

i) Ensure customer satisfaction by laying down standards of network performance, which the service provider is required to achieve by proper engineering of his network.

ii) Measure the Quality of Service from time to time and to compare that with the specified norms so as to monitor the level of performance, provided by various service providers' networks.

iii) Protect the interests of subscribers of the ILD services in regard to Quality of Service, particularly a minimum level of voice quality, which he expects, when he makes an ISD call and pays for it.

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Section-IV

4. Quality Of Service Benchmarks for ILD networks engineered by employing VoIP technology

4.1 Determination of QoS: -

4.1.1 End-to-End QoS Parameters

The ILD segment of the network will be engineered to meet the following end-to-end service quality parameters:

4.1.1.1 Toll Quality Networks:

- MOS ≥ 4 or R-value of 80 or higher
- One-way end-to-end delay ≤ 150 ms
- Packet loss not to exceed 0.1%
- Jitter should not exceed 5 ms
- Transparency to DTMF tones
- Services covered in addition of voice to include: G3 Fax ; voice-band modem @ 14.4 kbps or higher

4.1.1.2 Below Toll quality Networks:

- MOS ≥ 3 or R-value of 70 or higher
- One-way end-to-end delay ≤ 400ms
- Packet loss not to exceed 2%
- Jitter not to exceed 10 ms

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4.1.2 VoIP ILD Equipment Performance:

From the end-to-end performance parameters specified above, the contribution of the ILD segment of the end to end connection in regard to parameters specified in prepara shall be as indicated below:

4.1.2.1 Toll quality:

- MOS ≥ 4 or R-value of 80 or higher
- One-way IPTD (IP Packet Transfer Delay) ≤ 50 ms
- Transparency to DTMF tones
- Services covered in addition of voice to include: G3 Fax ; voice-band modem @ 14.4 kbps or higher

4.1.2.2 Below Toll quality:

- MOS ≥ 3 or R-value equal or greater than 70
- One-way IPTD (IP Packet Transfer Delay) ≤ 150 ms

In both cases, echo-cancellers complying with ITU-T G.168 shall be employed in the ILD segment at each end. The above parameters shall

be met for voice traffic even in the presence of other types of traffic such as data/ video.

4.2 *Test & Measurement Setup*

The measurement set up and methodology is described in the following paragraph.

Apropos the reference network configuration described in Figure-4.1, the measurements required at the maximum traffic handling capacity over various interface spans and the expected results are indicated in Table 4.2. The network configuration should be similar to the actual network deployed by the ILDO in terms of the number of nodes and transmission links. Figure 4.2 depicts the test setup along with the measurements to be made. The national PSTN sections can be realized by using real telephone switches deployed in the network of BSO and NLDO. For International section, the two mated setup's offered by the ILDO can be connected via looped back transmission links over the actual physical facility - whether fiber or satellite – or via simulated-delay links. In the case of end-to-end measurements, the test equipment is to be connected to reference points X_1 and X_4 while in the case of VoIP section; measurements could be with reference points X_2 and X_3 (see figure 4.2). In both the cases, the International transmission link has to be looped back.

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Two-stage testing is prescribed – lab tests and pre-commissioning (*in situ*) tests. All the measurements as given in the following Table shall be conducted in each testing stage. In the first stage, i.e. lab testing stage, the tests and measurements shall be conducted only on the VoIP set up offered by the ILDO in the lab or at ILDO's actual VoIP installation but the equipment shall not be connected to the PSTN/ISDN/PLMN. In contrast, the pre-commissioning test shall be conducted *in situ* over the VoIP section as well as the entire International connection in the actual inter-connection scenario. It may be noted that the second stage of testing may not be taken up if the equipment does not pass the lab tests and measurements.

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Table 4.2: Measurements Required

Span	Description	Parameter	Value For Toll Quality Service	Value for Below Toll Quality Service	Method
X_2 - X_3	ILD segment employing VOIP techniques * (excluding transmission delay)	Packet Delay	≤ 50 ms	≤ 150 ms	Individual parameters measured by using IP analyzer plus the Aggregate measure (MOS or R-value)
		Jitter	≤ 5 ms	≤ 10 ms	
		Packet Loss	≤ 0.1%	≤ 2%	
		R- value	≥ 80	≥ 70	
		MOS	≥ 4	≥ 3	
X_1 - X_4	End to End International Connection of which ILD segment is a subset*	Delay	≤ 150 ms	≤ 400 ms	Aggregate measure (MOS or R-value)
		R-value	≥ 80	≥ 70	
		MOS	≥ 4	≥ 3	
		Jitter	≤ 5 ms	≤ 10 ms	
		Packet Loss	≤ 0.1%	≤ 2%	
		CCS7 Signalling Delay	As per Q.709.	Same as for Toll quality.	CCS7 Signalling Analyzer

* The terminating PSTN and VoIP Sections in another country are outside the purview of our national administration and as such have to be simulated.

For the complete end to end international connection and the ILD segment, commercially available voice quality monitoring tools are recommended for dynamic measurement of the R-value or MOS at the end of each call. PSTN/ISDN/PLMN call samples are automatically collected by these tools and the R-value or MOS are computed in each case. It would be necessary to make sure that during these measurements, the VoIP equipment is loaded up to its rated BHCA with the help of a telephony traffic simulator. In the case of end-to-end tests, the actual interconnection path offered by the service provider should be used and measurements made during the peak and off-peak hours.

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In addition to the above, for Toll Quality service end to end through tests are to be conducted by making International telephone calls, sending fax messages, sending DTMF tones to an IVR system and by sending data via voice band modems over the complete end to end International connection described above.

The end-to-end CCS7 signalling delays can be measured using a CCS7 protocol monitor and noting the message time stamp at the first and the last PSTN/ISDN/PLMN node. The values should be within the values mandated in Q.767[1] and Q.709[2] and calls should be successful.

[1] ITU-T Recommendation Q.767, Application of the ISDN user part of CCS-7 for International ISDN connections, Feb-1991.
[2] ITU-T Recommendation Q.709, Hypothetical Signalling Reference Connection, March 1993.

The individual parameter measurements on the VoIP section should be made with a suitable Internet Protocol analyzer. The traffic up to the maximum traffic handling capacity of the VoIP equipment can be generated with a telephony traffic simulator. The Call Completion Rate (CCR) should be as mandated under Clause 4 (i) (7) of Section IV of the TRAI Regulation on Quality of Service of Basic and Cellular Mobile Telephone Services, (2 of 2000) dated 5th July 2000, as modified from time to time. The packet size and the payload-to-header ratio should be varied by employing various speech codecs offered by the Implementation Under Test (IUT) in the gateway.

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4.3 Testing Agency

The testing agency shall be the Telecommunication Engineering Centre of Ministry of Communication.

Section-V

5. Review:

i) The QOS parameters given in Section IV may be reviewed by the Authority from time to time.

ii) The Authority, on reference from any affected party, and for good and sufficient reasons, may review and modify this Regulation.

Section-VI

Residuary Clauses

6. Over-riding Effect:

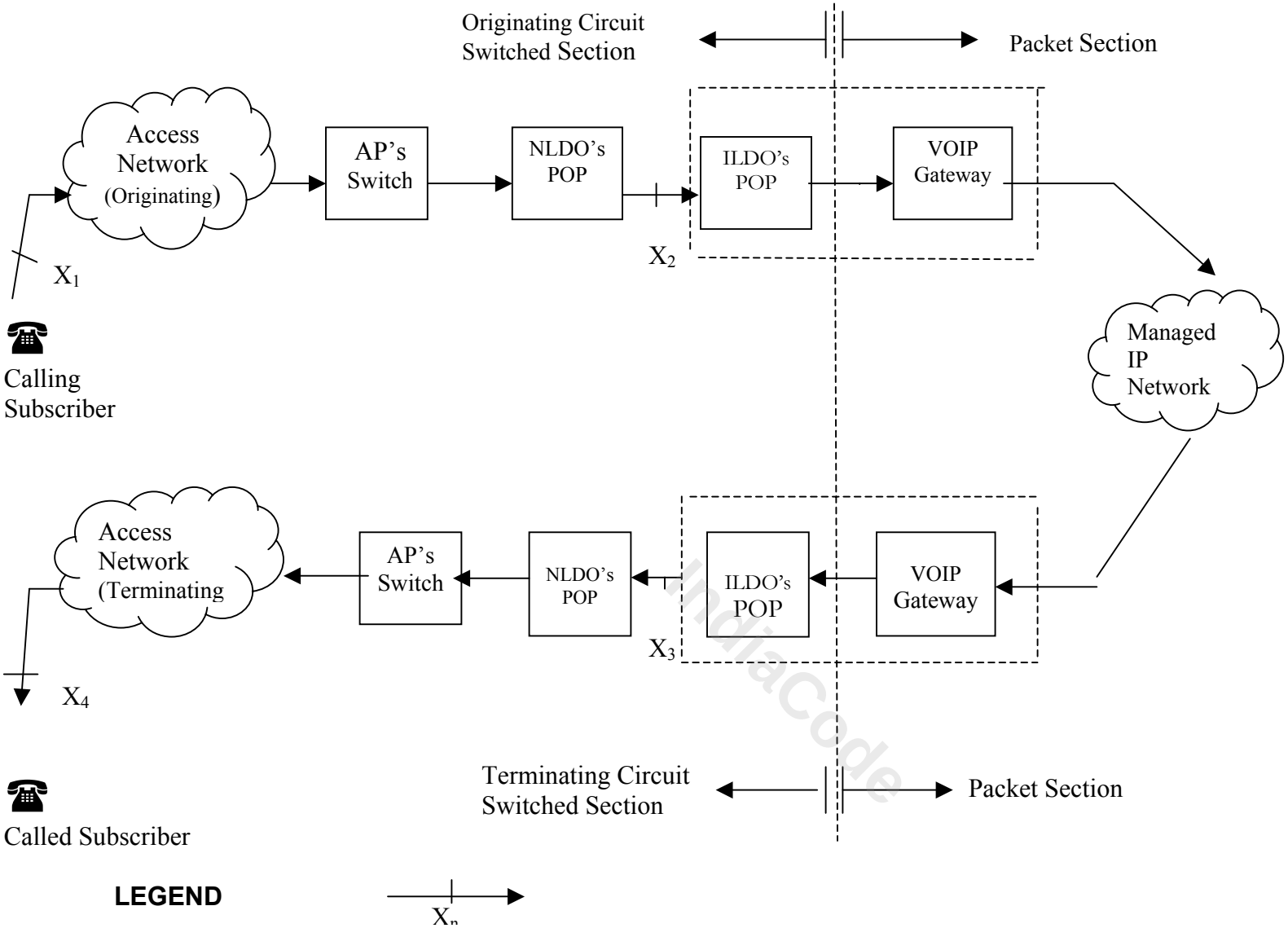
Wherever higher quality parameter has been stipulated as a condition of license, the QOS as required by the license will over-ride the parameters given herein.

7. Interpretation:

In case of disputes regarding interpretation of any of the provisions of this Regulation, the decision of the Authority shall be final and binding.

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(Harsha Vardhana Singh)
Secretary cum Principal Advisor



AP – Access Provider
NLDO – National long Distance Operator
ILDO – International long Distance Operator

Note : Interfaces X_2 and X_3 are at the boundaries of circuit switched and packed switched network segments.

Figure 4.1: Reference Network Configuration

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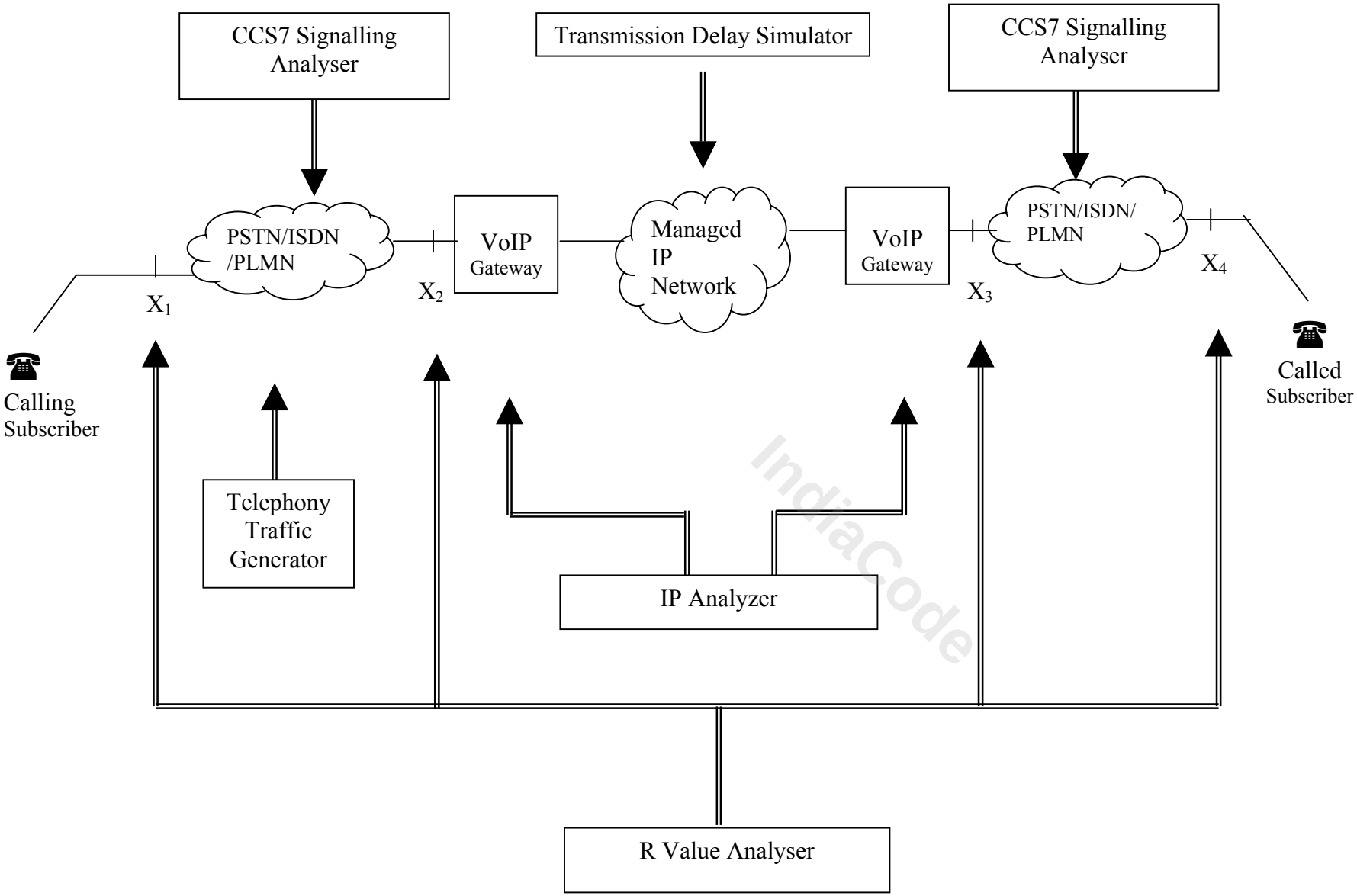


Figure 4.2 : Test & Measurement Setup

[File No.402-30/2001-FN (pt)]
Telecom Regulatory Authority of India

NOTIFICATION

New Delhi **20th January 2004**

In exercise of the powers conferred upon it under clause (v) of section (1)(b) of section 11 of Telecom Regulatory Authority of India Act, 1997, as amended by, TRAI (Amendment) Act, 2000 in regard to laying down the standards of quality of service to be provided by the service providers, the Telecom Regulatory Authority of India hereby makes the following Regulation:

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REGULATION ON QUALITY OF SERVICE FOR VOIP BASED INTERNATIONAL LONG DISTANCE SERVICE(FIRST AMENDMENT), 2004
(1 of 2004)

Section-I

Title, Extent and Commencement

Short title, extent and commencement

1. i) The title of this regulation shall be called **'Regulation on Quality of Service for VOIP based International Long Distance Service (First amendment), 2004'**

ii) This regulation shall come into effect from the date of its notification in the Official Gazette.

Section-II

2. **Definitions**

The following shall be added in Clause 2 under Section II of "Regulation on Quality of Service for VOIP based International Long Distance Service, 2002 (3 of 2002)" dated 15th November 2002 (Principle Regulation).

x) **The Advantage Factor** : The E-Model provides for advantage factor allowing downward adjustment in the R-value required in situations where the user is being provided a certain "advantage"; or some specific transmission media is used for instance international connection with satellite link.

Example:- When VOIP technology is used in an international connection with satellite link, service may be considered Toll Quality even if the end-to-end delay exceeds 150 ms, but is below 400 ms due to the Advantage Factor of 10 points in R-value.

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Section-III

3.0 Determination of QOS

3.1 Clause 4.1.1 Section IV of Principal Regulation shall be substituted to read as under:

"The ILD segment of the network will be engineered to meet the following end-to-end service quality parameters;

4.1.1.1 Toll Quality Networks:

- MOS > 4 or R-value of 80 or higher (with advantage factor in case of international satellite link involved in which case MOS > 3.5 or R- value > 70 shall be acceptable).
- One-way end-to-end delay < 150ms without satellite link and < 400 ms with satellite link.

- Packet loss not to exceed 0.1%
- Jitter should not exceed 5 ms
- Transparency to DTMF tones
- Services covered in addition of voice to include : G3 Fax; voice band modem @ 14.4 kbps or higher."

3.2 Clauses 4.1.1.2, 4.1.2.2 Section IV of Regulation on Quality of Service for VOIP based International Long Distance Service, 2002 shall be deleted.

Section-IV

This Regulation contains at Annex A, an explanatory memorandum to provide clarity and transparency to matters covered under this Regulation.

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BY ORDER

S.N.GUPTA
ADVISOR (Converged Networks)

Annexure A

EXPLANATORY MEMORANDUM

1. The Authority specified benchmarks for ILD networks engineered by employing VOIP technology vide Regulation on Quality of Service for VOIP based International Long Distance Service, 2002 (3 of 2002) dated 15th November 2002.

2. As, at that time VOIP technology was not considered to be matured enough and so Authority specified two classes of QOS for this namely Toll Quality and Below Toll Quality. It was and also stated that Authority may review and modify the regulation on reference from any effected party, and for good and sufficient reasons.

3. The Authority is in receipt of some representations from ILD operators and also from Licensor, indicating difficulties in implementing the benchmarks of the above regulation particularly when satellite link is involved.

4. The Authority has noted that the boundary between "Toll quality" and "below Toll quality" is getting blurred because of advancement of technology for VOIP, making it easier now to deliver toll quality using VOIP network.

5. Authority has also noted that none of the ILDOs including incumbent are offering "below Toll quality" service and therefore decided not to specify any benchmarks for "below Toll quality" service / network.

6. Therefore, Authority has modified the QOS benchmarks to merge both the classes of QOS into one and by applying the concept of advantage factor to provide some downward adjustment in QOS benchmarks in case international satellite link is involved in the network.

Telecom Regulatory Authority of India
Notification
New Delhi, the 16th April,2004

F.No. 402-30/2001-FN(Pt.) – In exercise of the powers conferred upon it under clause (v) of Sub-section (1)(b) of Section 11 of Telecom Regulatory Authority of India Act, 1997 as amended by, TRAI (Amendment) Act,2000, in regard to laying down the standards of quality of service to be provided by the service providers, the Telecom Regulatory Authority of India hereby makes the following Regulation :

REGULATION ON QUALITY OF SERVICE FOR VOIP BASED INTERNATIONAL LONG DISTANCE SERVICE (THIRD AMENDMENT), 2004 (6 OF 2004)

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Section –I

Title, Extent and Commencement

Short title, extent and commencement

1.

i) The title of this regulation shall be called **'Regulation On Quality of Service For VOIP Based International Long Distance Service (Third Amendment), 2004'**

ii) This regulation shall come into effect from the date of its notification in the Official Gazette.

Section – II

1. The clause 1 under Section II of "The Regulation On Quality Of Service For VOIP Based International Long Distance Service (Second Amendment), 2004 (5 of 2004)" shall be substituted by the following:

   "Regulation On Quality Of Service For VOIP Based International Long Distance Service (First Amendment), 2004 (1 of 2004)" shall be read as "Regulation On Quality of Service For VOIP Based International Long Distance Service (First Amendment), 2004 (3 of 2004)".

2. The Table 4.2 captioned "Measurement Required" under Section IV of the "The Regulation On Quality of Service For VOIP Based International Long Distance Service, 2002 (3 of 2002)" shall be substituted to read as under:

Table 4.2: Measurements Required

Span	Description	Parameter	Value for QOS parameters when international satellite link is not involved	Value for QOS parameters when international satellite link is involved	Method
X2 - X3	ILD segment employing VOIP techniques* (excluding transmission delay)	Packet Delay	≤ 50 ms	≤ 50 ms	Individual parameters measured by using IP analyzer plus the aggregate measure (MOS or R-Value)
		Jitter	≤ 5 ms	≤ 5 ms	
		Packet Loss	≤ 0.1%	≤ 0.1%	
		R-value	≥ 80	≥ 80	
		MOS	≥ 4	≥ 4	
X1 - X4	End to End International Connection of which ILD segment is a subset*	Delay	≤ 150 ms	≤ 400 ms	Aggregate measure (MOS or R-value)
		R-Value	≥ 80	≥ 70	
		MOS	≥ 4	≥ 3.5	
		Jitter	≤ 5 ms	≤ 5 ms	
		Packet Loss	≤ 0.1%	≤ 0.1%	
		CCS7 signalling Delay	As per Q.709	As per Q.709	CCS7 Signalling Analyzer

* The terminating PSTN and VoIP Sections in another country are outside the purview of our national administration and as such have to be simulated.

By Order

S.N.GUPTA, Advisor (Converged Networks)

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