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COMMUNICATIONS
INDUSTRY FORUM



INDUSTRY CODE
ACIF C519:2004
END-TO-END NETWORK PERFORMANCE FOR THE
STANDARD TELEPHONE SERVICE

ACIF C519:2004 *End-To-End Network Performance for the Standard Telephone Service Industry Code*

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1 EXPLANATORY STATEMENT

Background Statement

- 1.1 Since 1st July 1997, the Australian telecommunications industry has been deregulated. This Code establishes an industry framework for Carriers and Carriage Service Providers (CSPs) to demonstrate compliance of their overall network performance to a set of parameter objectives. The objective of this Code is to specify minimum performance levels for end-to-end network performance together with a methodology for demonstrating compliance. The Code thus aims to ensure an acceptable overall level of performance for consumers in a multi-service deliverer, multi-network environment.
- 1.2 The Australian Communications Industry Forum (ACIF) Network Reference Panel Working Committee 16 (NRP/WC16) on End-To-End Network Performance developed this Code.

Current Regulatory Arrangements

- 1.3 The *Telecommunications (Transitional Provisions and Consequential Amendments) Act 1997*, Section 52, contains provisions for Australian Communications Authority (ACA) Technical Standard TS 027, End-to-End Network Performance, determined under the *Telecommunications Act 1991*, to continue as an Industry Standard under the *Telecommunications Act 1997* (the Act).
- 1.4 In accordance with Section 131 of the Act, an ACA technical standard may be revoked if a Code intended to replace the standard is registered with the ACA. The 1998 version of this Code (ACIF C519:1998) was intended to replace TS 027. The ACA registered ACIF C519:1998 and revoked TS 027 in January 1999.
- 1.5 ACIF C519:2002 replaced ACIF C519:1998. This version of the Code replaces ACIF C519:2002.
- 1.6 This Code may be submitted to the ACA for registration pursuant to section 117 of the Act.
- 1.7 Part 6 of the Act identifies the role of Industry Codes, which apply to participants in the industry in relation to their telecommunications activities as defined in section 109 of the Act. The Act defines requirements for the development of Codes and their registration by the ACA.
- 1.8 One of the matters which may be dealt with by an Industry Code identified in paragraph 113(3)(m) of the Act is "the quality of standard telephone services". Subsection 115(2)(a)(ii) allows for a Code that addresses the quality of the Standard Telephone Service (STS) by specifying performance requirements.

NOTE 1: The STS provides:

- (a) a carriage service for the purpose of voice telephony, or*
- (b) if voice telephony is impractical for a particular end-user with a disability (for example, because the user has a hearing impairment); a form of communication that is equivalent to voice telephony (for example, communication by means of a text telephone).*

NOTE 2: The STS is a carriage service which passes the following connectivity test. A service passes the connectivity test if an end-user supplied with the service is ordinarily able to communicate, by means of the service, with each other end-user who is supplied with the same service for the same purpose, whether or not the end-users are connected to the same telecommunications network.

Benefits to Customers

- 1.9 This Code aims to ensure that the STS, delivered over public circuit switched fixed and mobile networks meets an acceptable overall level of performance for consumers. Consumer benefits should flow from the adherence by Carriers and CSPs to a defined level of network performance. This Code also establishes an industry framework for Carriers and CSPs to demonstrate compliance of their overall network performance to a set of parameter objectives.
- 1.10 The primary aim of the Code is to specify the requirements for checking the overall end-to-end network performance of the multi-service deliverer, multi-network environment in Australia. It also aims to assure end users, Regulators and Government, that the switched networks operated by Carriers and CSPs provide an acceptable level of overall end-to-end network quality for a STS.
- 1.11 Registration of this Code by ACA will ensure that all Carriers and CSPs are bound by this Code. This uniformity will benefit customers who can be reasonably sure that the end-to-end network performance will meet industry standards.

Benefits to Industry

- 1.12 This Code also aims to assist industry by facilitating the interoperability and the interworking of Carriers' and CSPs' networks. It aims to assure that the network components used in establishing connections will enable a minimum level of overall end-to-end network quality for the STS to be provided to end users. Compliance with network design parameters should assist the industry to achieve effective interworking.
- 1.13 The development of performance standards should foster consumer confidence in relation to the quality of the STS provided by Carriers and CSPs.
- 1.14 Compliance with the Code should ensure that Carriers and CSPs operate on an equal footing in relation to end-to-end

network performance and quality of service, since the ACA can direct compliance with it.

Anticipated costs to industry

- 1.15 The compliance process defined within this Code has been developed in order to minimize the associated cost to Carriers and CSPs. It is acknowledged that the implementation of extensive and regular connectivity testing between Carriers and CSPs required in the 1998 version of this Code was likely to have involved substantial time and cost. Also the technical complexity of making routine transmission performance measurements effectively precludes the mandating of such measurements. Accordingly a regime of self-verification and declaration has been adopted to demonstrate compliance.

Applicability of the Code

- 1.16 This Code applies to all Carriers and CSPs providing a STS (e.g. local, long-distance or mobile) within Australia.

How will the objectives of the code be achieved

- 1.17 The objectives of the Code will be achieved through:
- (a) setting of operational limits for key performance parameters;
 - (b) verification procedures;
 - (c) Carriers and CSPs responding to complaint patterns and trends;
 - (d) sanctions for non-compliance;
 - (e) the ACIF Code Administration and Compliance Scheme; and
 - (f) the promotion of Code awareness by ACIF to encourage sign up.

Overview of the Compliance Process

- 1.18 The method of demonstrating compliance is by self-verification and declaration. All Carriers and CSPs must demonstrate compliance to the performance levels specified in this Code. Network performance levels are defined for a set of connectivity and transmission performance parameters.
- 1.19 Signatories to this Code (Code Signatories) must verify (by whatever means they consider necessary) that their networks meet the defined performance levels.
- 1.20 Code Signatories must annually declare compliance by providing a statement (on the anniversary of signing up to the Code) that provides confirmation that their networks meet the end-to-end performance objectives specified by this Code.
- 1.21 Carriers and CSPs who are not signatories to the Code may be directed by the ACA to submit a compliance statement.

- 1.22 Carriers and CSPs should note that the Code does not specify a mandatory requirement to undertake routine or continual performance testing against which they report compliance.

NOTE: However, it is envisaged that as part of their normal operational procedures, Carriers or CSPs may wish to give consideration to undertaking in house testing in order to establish an audit trail.

- 1.23 In accordance with Section 121 of the Telecommunications Act, it should be noted that Carriers and CSPs may be directed by the ACA to comply with the Code.
- 1.24 If there is evidence of a systemic problem that raises doubts as to whether a Carrier or CSP is meeting the performance requirements of this Code, they may be directed to demonstrate compliance by the ACA. Where necessary the ACA may also require specific measurements to be undertaken as part of an investigation to resolve the problem. This may involve both directed operational measurement of end-to-end connectivity parameters and /or verification of the network design to show compliance for the transmission parameters. (See Section 8).

Code Administration, Compliance and Review

- 1.25 Under the ACIF Code Signatory arrangements, signatories are subject to ACIF G514 Code Administration and Compliance Scheme.

Related ACIF Technical Specifications

- 1.26 This Code is intended to address the industry approach to the self-regulation of end-to-end network performance. To assist in the design and planning of interconnected networks, ACIF has also produced ACIF G502 Specification - Australian Network Performance Plan. The Australian Network Performance Plan provides information on international standards appropriate for use in the design of fixed and mobile networks in Australia for the provision of voice telephony services. If there is any inconsistency between this Code and the Australian Network Performance Plan this Code shall take precedence.

2 PARTICIPANTS

The End-To-End Network Performance Working Committee that developed the current version of this Industry Code consisted of the following organisations and representatives:

Organisation	Representative
Australian Communications Authority (ACA)	Kevin Sutherland
Australian Communications Authority (ACA)	Natalie Lippey
Cisco Systems	Kim Yan
Engineers, Australia	Allan Sangster (Chair)
Hutchison Telecommunications (Australia) Limited	Glenn Fernandez
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Vodafone	Davorka Karacic

James Duck of ACIF supplied project management support.

3 OBJECTIVES AND SCOPE

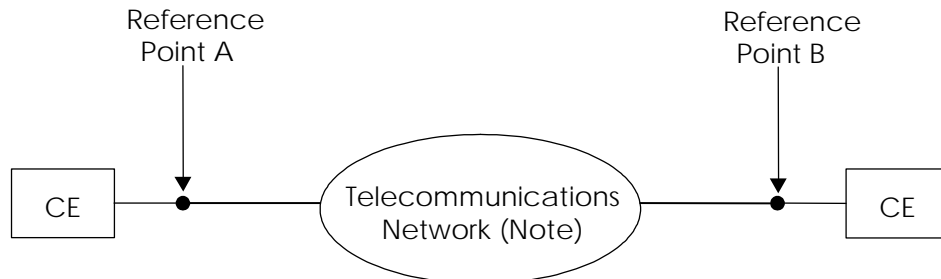
3.1 Objectives of the Code

- 3.1.1 This Code specifies minimum levels of performance for the end-to-end carriage of the STS over public telecommunication networks. The Code provides visible and specific criteria through which end-to-end network performance can be assessed. Compliance with this Code is demonstrated by self-attestation (i.e. self-verification and declaration) for both connectivity and transmission parameters.

3.2 Scope and Application

- 3.2.1 This Code applies to all Carriers and CSPs that supply a STS across:
- (a) public fixed Telecommunications Networks; or
 - (b) public digital mobile Telecommunications Networks.
- 3.2.2 This Code only applies to calls made between end users in Australia.
- 3.2.3 This Code defines the parameters for the statistical evaluation of the overall end-to-end network performance only for the following call cases:
- (a) calls from Public Fixed Telecommunications Network Geographic Numbers to Public Fixed Telecommunications Network Geographic Numbers;
 - (b) calls between Public Fixed Telecommunications Network Geographic Numbers and Public Digital Mobile Telecommunications Network Numbers; and
 - (c) calls from Public Digital Mobile Telecommunications Network Numbers to Public Digital Mobile Telecommunications Network Numbers.
- 3.2.4 This Code does not apply to calls:
- (a) using an international roaming service;
 - (b) made to Non-Geographic Service Numbers; or
 - (c) that are diverted by a called party (e.g. called party busy, called party not reachable, unconditional diversion).
- 3.2.5 The Code defines the parameters applicable to the overall end-to-end network performance i.e. the performance between Reference point A and Reference point B as illustrated in the reference telecommunications network in Figure 3-1. For fixed and mobile networks the Reference Point is the Network Boundary.
- 3.2.6 The Code specifies the minimum performance of a statistical sample of calls during the normal operation of public fixed Telecommunications Networks and public digital mobile Telecommunications Networks. The Code does not apply to the performance of an individual telecommunications service

or call. The Code does not apply to call cases when the public networks are experiencing major faults (e.g. fibre cuts) or events causing abnormal network traffic conditions that require the use of protection switching or alternative / standby circuits to maintain network connectivity.



Note: The "Telecommunications Network" includes Carrier network making up the connection between the two CEs.

CE: Customer Equipment (e.g. Telephone, Mobile Handset, PABX, or Text Telephone).

Figure 3-1

Reference Telecommunications Network

- 3.2.7 This Code does not apply to calls within Private Networks. In the case where a call is being made to or from a Private Network, the Code applies to that part of the connection established across the public network.

NOTE: Guidelines for Private Networks are provided in the Australian Network Performance Plan ACIF G502.

- 3.2.8 This Code does not apply to call cases where Carriers and CSPs use Internet Protocol (IP) technology within or across interconnecting public telecommunication networks in order to provide a STS. The performance levels defined in this Code have been developed in the context of Circuit Switched Network technology. The performance levels (where applicable), defined in this Code are only provisional for such IP-based call cases. It is recommended that Carriers and CSPs use them as a reference for indicative target objectives for such IP-based call cases until standards mature.
- 3.2.9 At the time of publication, International performance standards applying to the deployment of networks based on IP for the provision of voice telephony and Real-time Text Telephony services across the Public Telecommunications network were still being finalised. Until standards mature and can be verified by operational experience, clause 3.2.8 above applies. It should be noted that in the case where IP technology is used, the end-to-end performance quality will be impacted by packet loss, packet transfer delay and packet delay jitter.

4 REFERENCED STANDARDS AND PUBLICATIONS

This Code refers to the standards and publications listed in Tables 4-1 and 4-2.

TABLE 4-1

ITU-T Recommendations & International Specifications / Publications

Publication	Title
IETF RFC 791 September 1981	Internet Protocol DARPA Internet Program Protocol Specification
ITU-T Rec F.700 (11/00)	Framework Recommendation for multimedia services
ITU-T Rec E.721 (05/99)	Network grade of service parameters & target values for circuit-switched services in the evolving ISDN.
ITU-T Rec E.771 (10/96)	Network grade of service parameters and target values for circuit-switched public land mobile services.
ITU-T Rec G.100 (02/01)	Definitions used in Recommendations on general characteristics of international telephone connections and circuits.
ITU-T Rec G.100.1 (11/01)	The use of the decibel and of relative levels in speechband telecommunication
ITU-T Rec G.101 (08/96)	The transmission plan
ITU-T Rec G.102 (11/88)	Transmission performance objectives and Recommendations
ITU-T Rec G.111 (03/93)	Loudness ratings (LRs) in an international connection
ITU-T Rec G.113 (02/01)	Transmission impairments due to speech processing
ITU-T Rec G.114 (05/03)	One-way transmission time
ITU-T Rec G.121 (03/93)	Loudness Ratings (LRs) of National Systems
ITU-T Rec G.131 (08/96)	Control of talker echo
ITU-T Rec G.165 (03/93)	Echo cancellers
ITU-T Rec G.168 (04/00)	Digital network echo cancellers
ITU-T Rec G.712 (11/01)	Transmission performance characteristics of pulse code modulation channels

Publication	Title
ITU-T Rec G.822 (11/88) [Blue Book Fascicle III.5]	Controlled slip rate objectives on an international digital connection.
ITU-T Rec P.79 (09/99)	Calculation of loudness ratings for telephone sets.
ITU-T Rec T.140 (02/98) + Addendum 1 (02/00)	Protocol for multimedia application text conversation
ITU-T Rec Q.552 (11/01)	Transmission characteristics at 2-wire analogue interfaces of digital exchange
ITU-T Rec V.18 (11/00) + Amendment 1 (11/02)	Operational and interworking requirements for DCEs operating in the text telephone mode

TABLE 4-2

Australian Publications

Description	Title
	Australia - <i>Telecommunications Act 1991</i> (No.98 1991)
	Australia - <i>Telecommunications Act 1997</i> (No.47 1997)
	Australia - <i>Telecommunications (Transitional Provisions and Consequential Amendments) Act 1997</i> (No.59 1997)
	Australia - <i>Telecommunications (Consumer Protection and Service Standards) Act 1999</i>
	Australia - <i>Telecommunications (Equipment for the Disabled Regulations) 1998 plus amendments</i>
	Australia - <i>Telecommunications Numbering Plan 1997</i> and Amendments as made under Section 455 of the <i>Telecommunications Act 1997</i>
AS/ACIF S 004:2001	Voice Frequency Performance Requirements for Customer Equipment
AS/ACIF S 016:2001	Requirements for Customer Equipment for Connection to Hierarchical Digital Interfaces
ACIF G502:1998	Australian Network Performance Plan
AS/ACIF S009:2001	Installation Requirements for Customer Cabling (Wiring Rules)
ACIF G514:2003	Code Administration and Compliance Scheme
ACIF C519:1998	End-to-End Network Performance
ACIF C519:2002	End-to-End Network Performance

5 ABBREVIATIONS AND DEFINITIONS

5.1 Abbreviations

ACA	Australian Communications Authority
ACIF	Australian Communications Industry Forum
AN	Access Network
AS	Australian Standard
CE	Customer Equipment
CSP	Carriage Service Provider
HFC	Hybrid Fibre Coaxial
IETF	Internet Engineering Task Force
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunication Union - Telecommunication-Standardization Sector
NB	Network Boundary
PCM	Pulse Code Modulation
POI	Point of Interconnection
RFC	Request For Comment
STS	Standard Telephone Service
TS	Technical Standard

5.2 Definitions

The definitions used within this Code are consistent with those of ITU-T Recommendation G.100, unless otherwise stated.

Access Network

is the part of a Carrier's or CSP's telecommunications network that connects a customer from the network boundary to the first switch in the network.

Access Path Attenuation Asymmetry

is the difference between the attenuation in the receive path and the attenuation in the send path between the 0 dBr point (POI) and the NB measured at 1020 Hz.

Carriage Service Provider (CSP)

has the same meaning as under Section 87 of the *Telecommunications Act 1997*.

Carrier

has the same meaning as under Section 7 of the *Telecommunications Act 1997*.

Character Corruption Ratio

for text telephony transmission is the ratio of the number of characters received in error divided by the total number of characters transmitted expressed as a percentage. The characters received in error is the sum of the deleted characters, inserted characters and replaced characters.

Circuit Noise

is the short-term average noise power on an idle channel or connection, i.e. a channel with a termination and no signal at the transmitting end.

Circuit Switched Network (CSN)

means a network in which a fixed bandwidth channel is established for, and dedicated to the duration of a communication session. In general Circuit Switched Networks use time division multiplexing transmission techniques to establish a dedicated bearer channel (circuit) for end-to-end communication.

Code Signatory

has the same meaning as under ACIF G514.

Customer Equipment

has the same meaning as under Section 21 of the *Telecommunications Act 1997*.

Delay

(Mean One-way Propagation Time) in a connection is the mean of the propagation times in the two directions of transmission.

Echo

is the unwanted signal delayed to such a degree that it is perceived by the end user as distinct from the wanted signal (i.e. the signal directly transmitted).

End-to-End Connection Setup Failure Rate

is the ratio (expressed as a percentage) of the number of unsuccessful connection setup attempts to the total number of valid connection setup attempts, calculated for period of thirty consecutive days.

A connection setup attempt is considered valid only if a valid network address is dialled, and a start dial signal, if it is a feature of the service, is present before dialling commences.

A connection setup failure will occur for any of the following conditions:

- (a) No ring and no answer;
- (b) All circuits busy signal or equivalent recorded voice announcement;
- (c) Connection to the wrong number (misrouting); or
- (d) Start dial signal (e.g. dial tone) is present after dialling completed.

End-to-End Network Performance

is the performance across interconnecting public networks, from the Network Boundary of a fixed or a mobile STS to the Network Boundary of another fixed or mobile STS.

NOTE: In the case of Overall Loudness Rating, End-To-End Network Performance includes the performance of Customer Equipment. At the time of publication the specification for Customer Equipment was AS/ACIF S004.

Internet Protocol (IP)

is the protocol specified in the Internet Engineering Task Force (IETF) Request For Comment (RFC) 791. The Internet Protocol enables the transmission of blocks of data (called datagrams) from sources to destinations, utilizing packet switching techniques.

Loudness Rating

is a measure expressed in decibels, for characterising the loudness performance of complete telephone connections or parts thereof such as sending system, line, receiving system. It is the amount of frequency-independent gain that must be inserted into a system under test so that speech sounds from the system under test and a reference system are equal in loudness.

Network Boundary (NB)

has the same meaning as the "boundary of a telecommunications network" under Section 22 of the *Telecommunications Act 1997*. For the purpose of this Code, a Carrier's or CSP's performance responsibilities terminate at the Network Boundary.

Network Design Verification

is technical verification of network design carried out by a person who is a certified practitioner (or eligible for membership) of a professional organisation relevant to the telecommunications industry (for example Engineers, Australia).

Non-Geographic Service Number

is one that is not a mobile number, and where the location of the called party cannot be deduced by the caller from the number dialled. Examples of a call to a Non-Geographic Service Number include calls to 1800 services and 13 services.

Overall Loudness Rating

is the loudness loss from the talker's mouth to the listener's ear via a connection.

NOTE: For the Overall Loudness Rating parameter, End-To-End Network Performance includes the performance of Customer Equipment. At the time of publication the specification for Customer Equipment was AS/ACIF S004.

Point of Interconnection (POI)

is the point at which a Carrier's or CSP's network interconnects with another Carrier's or CSP's Network or connects to a Transit Network.

Post Dialling Delay

is the time interval between the end of user or originating customer equipment dialling and the reception of an appropriate network response. Appropriate network response includes: ring tone, busy tone, congestion tone and recorded voice announcement.

Prime Service Deliverer

is the service deliverer contracted by a customer to provide a telecommunications service.

Private Network

is a network which provides switching functions and other features to a single customer or group of customers and which is not available to the general public.

Public Fixed Telecommunications Network Geographic Number

is a number that is used to identify a service on the fixed network and that has geographic significance, in accordance with the *Telecommunications Numbering Plan 1997*.

Public Digital Mobile Telecommunications Network Number

is a number used to identify a service on a digital mobile network in accordance with the *Telecommunications Numbering Plan 1997*.

Real-time Text Telephony

(see Text Telephony).

Receive Loudness Rating

is a measure of the electro-acoustic characteristic of Customer Equipment with respect to the reception of speech signals from a telecommunications network. In accordance with ITU-T Recommendation G.100, the Receive Loudness Rating is the loudness loss between an electrical interface in the network and the listening subscriber's ear. The loudness loss is defined as the weighted (dB) average of driving electro motive force (e.m.f.) to measured sound pressure.

Send Loudness Rating

is a measure of the electro-acoustic characteristic of Customer Equipment with respect to the transmission of speech signals to a telecommunications network. In accordance with ITU-T Recommendation G.100, the Send Loudness Rating is the loudness loss between the speaking subscriber's mouth and an electrical interface in the network. The loudness loss is defined as the weighted (dB) average of driving sound pressure to measured voltage.

Slip

is the repetition or deletion of a block of bits in a synchronous or plesiochronous bit stream due to a discrepancy in the read and write rates at a buffer.

Standard Telephone Service

has the same meaning given by section 6 of the *Telecommunications (Consumer Protection and Service Standards) Act 1999*.

Synchronisation

is the process of keeping all digital elements of a network operating at the same frequency, so that no information is lost.

Telecommunications Network

has the same meaning as under Section 7 of the *Telecommunications Act 1997*.

Text Telephone

is Customer Equipment which incorporates Text Telephony functions to enable real-time text conversation.

Text Telephony

is a telecommunications capability which supports real-time text conversation over communication networks. Real time text telephony is a form of communication that is used in those cases where standard voice telephony is not practical for a particular end user because, for example, the user has a hearing or speech impairment.

Transit Network

is that part of the network which connects two POIs and may connect to an Access Network or another Transit Network.

Transmission Loss

(also called ***Composite Loss*** in ITU-T Recommendation G.100) is a voltage loss from the generator to the load with respect to the actual source and terminating impedances being used in service.

The Transmission Loss of a connection inserted between two impedances, Z_g (of the generator) and Z_l (of the load), is the expression in dB of the ratio P_g/P_l at the reference frequency f_0 where P_g is the apparent power that a generator would furnish through impedance Z_g to a load of impedance Z_g (i.e. maximum power transfer), and P_l is the apparent power that the same generator furnishes via the connection to a load of impedance Z_l .

At frequencies other than the reference frequency, the impedance terms are held to their reference frequency values, so that transmission loss indicates voltage loss only.

$$\text{Transmission loss} = 10 \log_{10} \left[\left(\frac{V_g}{2V_l(f)} \right)^2 \frac{|Z_l(f_0)|}{|Z_g(f_0)|} \right]$$

where V_g is the r.m.s. generator voltage (frequency independent);

$V_l(f)$ is the r.m.s. load voltage at the frequency of interest; and

$Z_l(f_0)$ and $Z_g(f_0)$ are the impedances at a reference frequency f_0 , e.g. 1020 Hz.

Voice Telephony

is real time two-way voice communication within the frequency range 300 Hz to 3400 Hz using one or more telecommunications networks.

6 PERFORMANCE LEVELS

The specified performance levels in this Code are for the End-To-End Network Performance of STSs across interconnecting public networks within Australia. The end-points are defined in the generic network reference model for voice telephony and Real-time Text Telephony as shown in Figure 6-1.

NOTE: The reference model shown in Figure 6-1 does not preclude the use of various access technologies such as Wireless Local Loop, Satellite, Hybrid Fibre Coaxial (HFC) Cable in order to provide a connection to the fixed network.

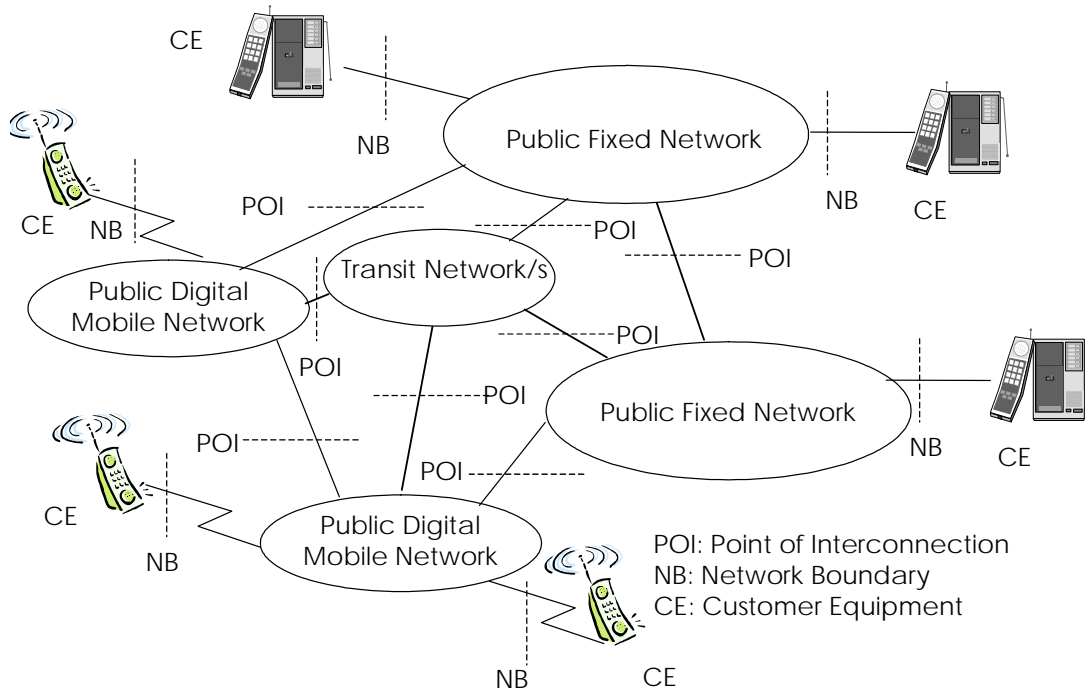


FIGURE 6-1

Generic network reference model for voice telephony and Real-time Text Telephony

6.1 Network Performance Parameters

6.1.1 The network performance parameters covered by this Code are listed in Table 6-1. The parameters fall into two groups: connectivity network performance parameters (End-to-End Connection Setup Failure Rate and Post Dialling Delay) and transmission network performance parameters (Transmission Loss, Overall Loudness Rating, Circuit Noise, Access Path Attenuation Asymmetry, Transmission Delay, Echo Control, Synchronisation and Slip and Real-Time Text Telephony Character Corruption Ratio).

6.2 Network Performance Requirements

6.2.1 This section specifies the end-to-end performance levels for each parameter. Carriers and Carriage Service Providers must

meet the defined Performance Requirements for each applicable parameter as indicated in Table 6-1.

- 6.2.2 Where applicable the performance levels are consistent with the principles and objectives defined in ITU-T Recommendations E.721, E.771, F.700, G.100, G.101, G.102, G.111, G.113, G.114, G.121, G.131, G.165, G.168, G.712, G.822, P.79 and Q.552 (Refer to Appendix B for a cross referencing of performance parameters / capabilities with the DR ACIF C519:2004 sections and relevant international specifications and/or ITU-T Recommendations).
- 6.2.3 Carriers and CSPs must demonstrate compliance with the specified network Performance Requirements utilizing the method described in Section 7.

Parameter	Network Applicability		Explanatory Notes	Performance Requirement Section Reference(s)
	Fixed Network	Mobile Network		
End-to-End Connection Setup Failure Rate	✓	✓		6.2.4
Post Dialling Delay	✓	✓		6.2.5
Transmission Loss	✓	X	Note 1	6.2.6, 6.2.7
Overall Loudness Rating	✓	X	Note 2	6.2.8,
Circuit Noise	✓	X	Note 1	6.2.9
Access Path Attenuation Asymmetry	✓	X	Note 1	6.2.10
Transmission Delay	✓	✓		6.2.11
Echo Control	✓	✓		6.2.12, 6.2.13
Synchronisation and Slip	✓	✓		6.2.14
Real-time Text Telephony - Character Corruption Ratio	✓	X	Note 3	6.2.15, 6.2.16

TABLE 6-1

Requirements on End-To-End Network Performance Parameters

NOTE 1: Transmission Loss, Circuit Noise and Access Path Attenuation Asymmetry, are fixed network performance parameters, and are not applicable to public digital mobile networks.

NOTE 2: Overall Loudness Rating is not applicable to public digital mobile networks since they are fully digital. For mobile networks, all loudness loss is incurred in the mobile handsets.

NOTE 3: The provision of a Real-time Text Telephony service is dependent on the commercial availability of customer equipment that meets Australian regulatory requirements. International specifications now exist to interface text telephony equipment to digital mobile networks in order to support real-time text communication. At the time of publication, actual units were being tested to determine their capabilities for use with existing networks.

End-to-End Connection Setup Failure Rate

6.2.4 The End-to-End Connection Setup Failure Rate must meet the performance requirements in Table 6-2.

Connection Service Type	End to End Connection Setup Failure Rate
Fixed-Fixed (Local)	≤ 3%
Fixed-Fixed (Long Distance)	≤ 4.5%
Fixed-Mobile	≤ 8%
Mobile-Fixed	≤ 8%
Mobile-Mobile	≤ 10%

TABLE 6-2

Network performance requirements for End-to-End Connection Setup Failure Rate

Post Dialling Delay

6.2.5 The Post Dialling Delay must meet the performance requirements in Table 6-3.

NOTE: Calls requiring database lookup may require additional processing. Network designers should take this into account when designing networks.

Connection Service Type	Mean Value (Seconds)	95th Percentile (Seconds)
Fixed-Fixed (Local)	≤ 6	≤ 9
Fixed-Fixed (Long Distance)	≤ 9	≤ 12
Fixed-Mobile	≤ 15	≤ 20
Mobile-Fixed	≤ 10	≤ 15
Mobile-Mobile	≤ 19	≤ 25

TABLE 6-3

Network performance requirements for Post Dialling Delay

Transmission Loss

- 6.2.6 The maximum end-to-end Transmission Loss of Carrier and CSP networks must not be more than 28 dB at 1020 Hz using nominal design values for all network components (e.g. cables, PCM codecs).

NOTE: Requirements 6.2.6 and 6.2.7 assure appropriate relative levels in networks when satisfied together with the defined objective for Access Path Attenuation Asymmetry.

- 6.2.7 The Transmission Loss at 1020 Hz in the send path between the 0 dBr point (POI) and the NB must be greater than or equal to 0 dB.

NOTE: Figure 6-2 and Figure 6-3 illustrate a nominal attenuation of 3 dB in the send path which is normally associated with the transmission loss in the Access Network.

Overall Loudness Rating

- 6.2.8 The Overall Loudness Rating must not exceed 29.5 dB.

This assumes the following:

- (a) use of nominal design values for Customer Equipment Send Loudness Rating and Receive Loudness Rating as specified in AS/ACIF S004;
- (b) use of nominal design Loudness Ratings of network components, e.g. cables, PCM codecs;
- (c) weighting factors to calculate Loudness Ratings are in accordance to Table 1 of ITU-T Recommendation P.79 when the frequency band 200 Hz - 4000 Hz is used, or in accordance with Table A.2 of ITU-T Recommendation P.79 when the frequency band 100 Hz - 8000 Hz is used; and
- (d) Transmission Loss must be used in the calculation of Loudness Ratings.

Circuit Noise

6.2.9 The end-to-end design limit for Circuit Noise must not be more than -41 dBm_{0p}. The received relative level at the NB is assumed to be a -9 dBr point.

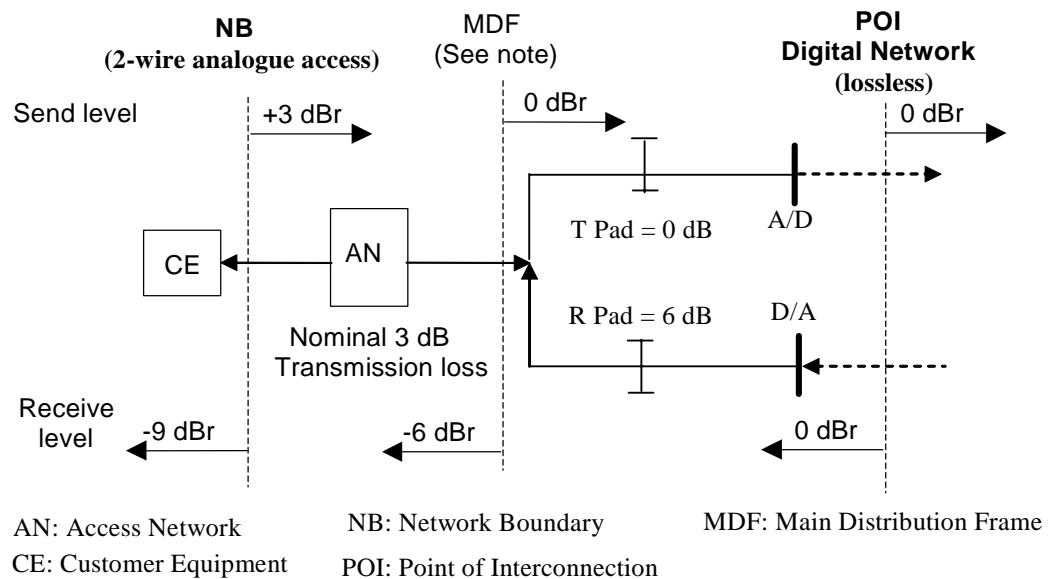
Access Path Attenuation Asymmetry

6.2.10 The Access Path Attenuation Asymmetry at 1020 Hz for each half-connection as illustrated in Figure 6-2 must be 6 ± 1 dB.

NOTE 1: This requirement is in accordance with principles defined in ITU-T Recommendation G.121 and assures appropriate send / receive levels when satisfied together with the defined objectives for end-to-end Transmission Loss and Overall Loudness Rating.

NOTE 2: Figure 6-2 illustrates the Relative Levels at the Network Boundary and the Point of Interconnection for a traditional copper pair access network with asymmetrical loss in the access path. Figure 6-3 illustrates the Relative Levels for an end-to-end fixed network reference connection. (Figures 6-2 and 6-3 assume a 3dB transmission loss in the Access Network).

NOTE 3: Technologies other than copper pair may be deployed in the fixed network.



Note: The level at the MDF is shown for information only

FIGURE 6-2

Relative levels in a fixed (traditional copper) access network

NOTE 4: Use of low bit rate voice encoding may add between 150 ms and 250 ms of buffering and encoding delay.

Network Portion	Specific Conditions	One-way Propagation Time (non-satellite connections)	One-way Propagation Time (including one satellite hop)
Fixed-Fixed		≤ 150 ms	≤ 410 ms
Fixed-Mobile or Mobile-Fixed	Mobile handset delay is not included	≤ 150 ms	≤ 410 ms
Mobile-Mobile	Fixed network portion delay and mobile handset delay are not included.	≤ 150 ms	≤ 410 ms

TABLE 6-4

One-Way Transmission Delays

Echo Control

- 6.2.12 Echo cancellers must be employed when the round trip delay exceeds 34 ms.

NOTE: This requirement does not apply to calls made to Non-Geographic Service Numbers and to calls, which are diverted.

- 6.2.13 Carriers or CSPs who operate a public digital mobile network must provide echo cancellers within their networks for both call directions.

Synchronisation and Slip

- 6.2.14 The Slip performance of a 64 kbit/s connection must meet the requirements specified in Table 6-5.

Performance Category	Mean Slip Rate (Note 1)	Proportion of time (Total time ≥1 year)
A	≤ 5 slips in 24 hours	> 98.9%
B	> 5 slips in 24 hours and ≤ 30 slips in 1 hour	< 1.0%
C	> 30 slips in 1 hour	< 0.1%

TABLE 6-5

Controlled slip performance on a 64 kbit/s connection

NOTE: The nominal Slip performance due to plesiochronous operation alone is not expected to exceed 1 slip in 5.8 days.

Real-time Text Telephony – Character Corruption Ratio

6.2.15 The STS includes both a carriage service for the purpose of Voice Telephony and services alternative to Voice Telephony for end users with a disability. Real-time Text Telephony is a recognised viable alternate service to Voice Telephony for end users with a disability.

6.2.16 Where Real-time Text Telephony is utilised as an alternative service to Voice Telephony, the Character Corruption Ratio of a Real-time Text Telephony connection must be less than or equal to 1%. For Network Design Verification purposes (refer to section 7.2), a Carrier's or CSP's network which meets the network performance requirements for all the other parameters specified in Table 6-1 is deemed to comply with the Real-time Text Telephony- Character Corruption Ratio performance requirement.

NOTE: The performance requirement for Character Corruption Ratio is in accordance with ITU-T F.700 Annex A.3.

7 COMPLIANCE PROCESS

This section defines the process for demonstrating compliance with the performance levels specified in this Code.

7.1 Overview

7.1.1 The process for a Code Signatory to demonstrate compliance with the defined performance levels is by self-verification followed by submission of a statement to ACIF declaring that based on an assessment of the design principles and practices used, its network complies with the Code.

- 7.1.2 The process for demonstrating compliance consists of:
- (a) initial compliance verification and declaration by:
 - (i) self-verification for performance of connectivity and transmission parameters; and
 - (ii) submission of a compliance statement to ACIF; and
 - (b) annual compliance verification and declaration by:
 - (i) self-verification for performance of connectivity and transmission parameters; and
 - (ii) submission of a compliance statement to ACIF.

7.2 Network Design Verification

- 7.2.1 Prior to submission of the declaration statement, Carriers and CSPs must undertake Network Design Verification to ensure that the design of their network meets the End-To-End Network Performance requirements specified by this Code.
- 7.2.2 Based on a self-assessment of network design practices and principle or in-house testing, Carriers or CSPs must conclude that the design of their network is such that they comply with the End-To-End Network Performance objectives for the specified connectivity and transmission parameters.
- 7.2.3 The actual methodology by which Carriers and CSPs reach such a conclusion is not specified by this Code. However this may require measurement (for connectivity parameters) and assessments of individual network performance contributions (for transmission parameters) to ensure the specified objectives are met. Carriers and CSPs must maintain adequate levels of documentation to substantiate their compliance claims.
- 7.2.4 While some Carriers and CSPs may opt to conduct network testing (e.g. the connectivity parameters) to facilitate internal verification that their networks comply with the defined performance levels, this is not a mandatory requirement of this Code.

7.3 Compliance Declaration

- 7.3.1 Carriers and CSPs must declare that their network complies with the specified performance objectives:
- (a) on becoming a signatory to this Code;
 - (b) annually (on the anniversary of becoming a signatory to this Code), or
 - (c) on being directed by the ACA to comply with this Code.

Initial Compliance Declaration

- 7.3.2 On becoming a Code Signatory, Carriers and CSPs must submit a statement declaring compliance to the End-To-End Network Performance levels for the specified connectivity and transmission parameters.

Annual Compliance Declaration

- 7.3.3 A Code Signatory must annually verify the performance of its network and declare compliance by submitting a statement to ACIF. The declaration statement confirms that its network meets the end-to-end performance objectives specified by this Code.
- 7.3.4 The annual declaration statement must be submitted to ACIF on or before the anniversary of becoming a Code Signatory.

7.4 Direction to Demonstrate Compliance

- 7.4.1 In response to industry complaints, or other evidence that indicates that there are reasonable grounds to suspect that there is a systemic performance anomaly, and in accordance with Section 121 of the *Telecommunications Act 1997*, Carriers and CSPs may be directed by the ACA to demonstrate compliance. The references to possible directions in Sections 7 and 8 of this Code do not limit the actions that the ACA may take.
- 7.4.2 Direction to demonstrate compliance may involve either directed operational measurement of end-to-end connectivity parameters and /or verification of the network design to show compliance for the transmission parameters.

Directed Measurement of Connectivity Parameters

- 7.4.3 In the case of the connectivity parameters, Carriers and CSPs may be directed to undertake operational measurement of end-to-end connectivity performance focused at a specified regional area or involving the networks of specified Carriers or CSPs. Section 8.1 specifies detailed testing procedures for undertaking directed connectivity testing.

Network Design Verification

- 7.4.4 Carriers and CSPs may be directed to show compliance against the end-to-end objectives for the transmission parameters. Section 8.2 specifies the procedure for verifying compliance to the end-to-end objectives for the transmission parameters.

8 EXCEPTION TESTING FOR COMPLIANCE

This section describes the methodologies which may be used by Carriers and CSPs to demonstrate compliance in specific cases when directed by the ACA, in line with the relevant administrative considerations of Section 7.4.

These methods will be applied to demonstrate compliance in situations where suspected systemic network performance anomalies have been reported. To demonstrate compliance, the ACA may direct Carriers and CSP to undertake specific End-To-End Network Performance tests or investigations localised to the regions associated with reported network performance anomalies.

8.1 Exception Test Method 1 – Connectivity Testing

- 8.1.1 The ACA may direct co-operative inter-Carrier / CSP testing of end-to-end connectivity performance parameters directed at a specified regional area or involving the networks of particular Carriers or CSPs. Carriers or CSPs may be directed to undertake a series of performance tests to confirm that their networks (either individually or interconnected) meet the end-to-end connectivity performance objectives.
- 8.1.2 Those Carriers and CSPs so directed, will undertake specific end-to-end connectivity testing within their own networks and between networks into which they interwork as required by the ACA, based on call cases that are the subject of the end-to-end performance anomaly.
- 8.1.3 Compliance with the connectivity objectives for end-to-end network performance parameters (i.e. End-to-End Connection Setup Failure Rate and Post Dialling Delay) must be demonstrated by the use of artificially generated test calls or live traffic monitoring.
- 8.1.4 Collection of data (on which to base the verification of compliance) must be in accordance with Clauses 8.1.5 to 8.1.11.

Distribution of Measurement Devices

- 8.1.5 Call measurement devices must be distributed in order to provide a generally representative view of the specified call case scenario that is the subject of the performance anomaly.

Distribution of Measurement Calls

- 8.1.6 A schedule of measurement calls must be developed by ensuring that the test call distribution is generally representative of traffic flows in the network with respect to:
 - (a) distribution of traffic with time of day and day of week;
 - (b) distribution of traffic between origins and destinations; and
 - (c) distribution of traffic between and among Carriers and CSPs.

Measurement Periods

8.1.7 Measurements must:

- (a) be distributed across a 24 hour period; and
- (b) extend over thirty consecutive days.

Number of Measurement Calls Required

8.1.8 The number of measurement calls required (sample size) is determined by both the degree of confidence (e.g. 95%) and the level of precision (e.g. $\pm 10\%$) to which a measured parameter is required to be specified. It is also important to note that the range of the confidence interval (i.e. the precision level) is specified in terms of the defined objective and not the measured result.

8.1.9 Sufficient calls must be made to ensure that the measured value for the End-to-End Connection Setup Failure Rate parameter can be determined to a precision of at least 10% of the value of the specified objective with a 95% degree of confidence. The same calls that are used to determine End-to-End Connection Setup Failure Rate for each service interconnection class (e.g. Fixed-Fixed, Fixed-Mobile, etc.) will also be used to determine the corresponding Post Dialling Delay (PDD) parameters.

NOTE: Sample size requirements for attribute data (i.e. either pass or fail) are much more stringent than for variable data (numerical values e.g. PDD= 4.5 secs). By tying the sample size for Post Dialling Delay to that of End-to-End Connection Setup Failure Rate, the need to separately determine a sample size for PDD measurements is avoided.

8.1.10 Information on the relationship between sample sizes and measurement precision is given in Appendix A. To ensure statistical significance, for intra-networking testing the number of test calls over a 30 day period must not be less than 10,000. The number of test calls over a 30 day period for inter-networking testing must not be less than 1,000.

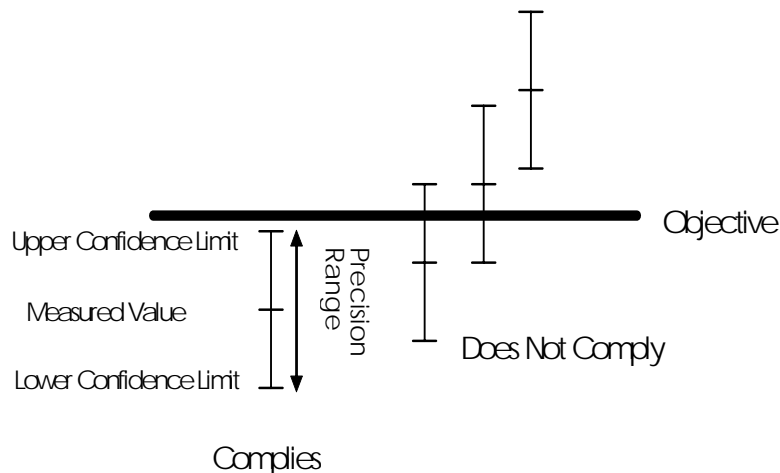


FIGURE 8-1

Criteria for the achievement of Objectives

Interpretation of Measurement Samples

8.1.11 The objectives (performance targets) will be deemed to have been achieved as follows:

- (a) for measurements of the mean value - if the upper limit of the 95% confidence interval is less than or equal to the objective; and
- (b) for measurements of the percentile of delay parameters - if the percentile value (as determined from the total call sample for the service interconnection class) is less than or equal to the specified objective.

The above situation is illustrated in Figure 8-1.

8.2 Exception Test Method 2 – Network Design Verification of Transmission Performance

8.2.1 The method for demonstrating compliance with the transmission performance objectives in response to a direction from the ACA, is based on a self-assessment of relevant network design documentation. For the purpose of demonstrating that they meet the transmission performance objectives, Carriers and CSPs (when directed) must provide network design documentation that details the principles and design practices used within their networks. The documentation must be of such a standard that it substantiates compliance with the transmission performance requirements of this Code.

8.2.2 Whilst this Code does not specify the precise format of the network design documentation, it is envisaged that such documentation may contain the following components:

- (a) the different call case scenarios provided by the Carrier or CSP, e.g. showing access network and/or transit network operation;
- (b) network plans, (network architecture including transmission and switching practices);
- (c) other Carrier's or CSP's Networks used;
- (d) equipment specifications; and
- (e) network design specifications.

9 CODE ADMINISTRATION, COMPLIANCE AND REVIEW

9.1 Code Administration And Compliance

- 9.1.1 Under the ACIF Code Signatory arrangements, a signatory to this Code (Code Signatory) is subject to ACIF G514 Code Administration and Compliance Scheme.
- 9.1.2 Any information provided regarding compliance will be treated in accordance with the confidentiality provisions of the ACIF G514 Code Administration and Compliance Scheme.
- 9.1.3 Complaints may be made under this Code to ACIF by a member of the industry (or a voluntary or non-profit consumer organisation or similar body) (an "Industry Complaint") about a contravention of this Code by a Signatory.
- 9.1.4 Complaints by a member of the industry (or a voluntary or non-profit consumer organisation or similar body) about a contravention of this Code by a Code Signatory may be referred from the ACA under the power granted to the ACA in section 514 of the Act, subject to ACIF's agreement to accept the referral. Without limiting the grounds on which ACIF may withhold its agreement to accept a referral, ACIF may withhold its agreement where it considers that the complaint can be more conveniently dealt with in another forum or that handling the complaint may impose an unreasonable cost burden on ACIF.
- 9.1.5 ACIF must handle complaints under 9.1.3 or 9.1.4 in accordance with the provisions of the ACIF G514 Code Administration and Compliance Scheme.

9.2 Code Review

- 9.2.1 This Code may be revised at a future time to cater for new and emerging technologies. In line with ACIF practice, the Code will be reviewed within five years of the date of publication.

APPENDIX A: RELATIONSHIP BETWEEN SAMPLE SIZES AND MEASUREMENT PRECISION (INFORMATIVE)

Assumptions:

In order to calculate the relationship between sample size and measurement precision it is assumed that an approximation to normal distribution can be applied to sampled calls used to measure End-to-End Connection Setup Failure Rate and Post Dialling Delay.

For Attribute Data (e.g. Connection Setup Failure)

$$\text{Precision (Absolute)} \quad d = \pm Z \sqrt{\frac{p(1-p)}{n}}$$

$$\text{Precision (as \% of } p) \quad d' = \frac{d}{p} = \pm \frac{Z}{p} \sqrt{\frac{p(1-p)}{n}}$$

where:

Z = reliability coefficient (i.e. 1.96 for 95% confidence)

p = Failure rate

n = sample size

For Variable data (e.g. Post Dialling Delay)

$$\text{Precision (Absolute)} \quad d = \pm Z \sigma_{\mu}$$

$$\text{Precision (as \% of } \mu) \quad d' = \frac{d}{\mu} = \pm Z \frac{\sigma_{\mu}}{\mu} = \pm Z \frac{\sigma}{\mu \sqrt{n}} = \pm Z \frac{C}{\sqrt{n}}$$

where:

Z = reliability coefficient (e.g. 1.96 for 95% confidence and large samples)

σ = sample standard deviation

σ_{μ} = standard error of the mean, = σ/\sqrt{n}

μ = sample mean

C = Coefficient of variation = σ/μ

n = sample size

Application of Formulae

ATTRIBUTE DATA

		95% Confidence Interval					
		Failure Rate (p)					
		0.1%	0.5%	1%	2%	5%	10%
FAILURES	Precision (as % of p)	Failures (pn)					
	5%	1535	1529	1521	1506	1460	1383
	10%	384	382	380	376	365	346
	20%	96	96	95	94	91	86
	25%	61	61	61	60	58	55
SAMPLES		Samples (n)					
	5%	1535103	305791	152127	75295	29196	13830
	10%	383776	76448	38032	18824	7299	3457
	20%	95944	19112	9508	4706	1825	864
	25%	61404	12232	6085	3012	1168	553

VARIABLE DATA

		95% Confidence Interval		
		Coefficient of Variation (sd/mean)		
		0.5	1	2
SAMPLES	Precision (as% of mean)	Samples (n)		
	5%	385	1537	6147
	10%	97	385	1537
	20%	25	97	385
	25%	16	62	246

**APPENDIX B:
PARAMETER REFERENCE SOURCES (INFORMATIVE)**

Parameter / Network Capability	DR ACIF C519:2004 Clause reference(s)	International Recommendation(s) and other specifications used as basis for DR ACIF C519:2004 reference(s)
End-to-End Connection Setup Failure Rate	6.2.4	ITU-T Recommendations E.721 & E.771
Post Dialling Delay	6.2.5	ITU-T Recommendations E.721 & E.771
Transmission Loss	6.2.6, 6.2.7	ITU-T Recommendations G.100, G.101, G.113
Overall Loudness Rating	6.2.8	ITU-T Recommendations P.79, G.111, G.121
Circuit Noise	6.2.9	ITU-T Recommendations G.102, Q.552, G.712
Access Path Attenuation Asymmetry	6.2.10	ITU-T Recommendations G.100.1. & G.121
Transmission Delay	6.2.11	ITU-T Recommendation G.114
Echo Control	6.2.12, 6.2.13	ITU-T Recommendations G.131, G.165, G.168
Synchronisation & Slip	6.2.14	ITU-T Recommendation G.822
Real-time Text Telephony - Character Corruption Ratio	6.2.16	ITU-T Recommendation F.700

TABLE B-1

Cross referencing of parameters / capabilities with DR ACIF C519:2004 sections and relevant international specifications and/or ITU-T Recommendations

The policy objective of the greatest practicable use of industry self-regulation without imposing undue financial and administrative burdens on industry is central to the regulatory scheme of the *Telecommunications Act 1997*.

ACIF was established to implement the policy of industry self-regulation. It is a company limited by guarantee and is a not-for-profit membership-based organisation. Its membership comprises carriers/carriage service providers, business and residential consumer groups, industry associations and individual companies.

ACIF's mission is to develop collaborative industry outcomes that foster the effective and safe operation of competitive networks, the provision of innovative services and the protection of consumer interests. In the development of Industry Codes and Technical Standards as part of its mission, ACIF's processes are based upon its principles of openness, transparency, consensus, representation and consultation. Procedures have been designed to ensure that all sectors of Australian society are reasonably able to influence the development of Standards and Codes. Representative participation in the work of developing a Code or Standard is encouraged from relevant and interested parties. All draft Codes and Standards are also released for public comment prior to publication to ensure outputs reflect the needs and concerns of all stakeholders.



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