AUSTRALIAN COMMUNICATIONS INDUSTRY FORUM

INDUSTRY CODE

END-TO-END NETWORK PERFORMANCE

ACIF C519: APRIL 2002

Industry Code - *End-To-End Network Performance*
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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 6 (NRP/WC6) on End-To-End Network Performance developed this Code.

Legislative Framework

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. This version of the Code replaces ACIF C519:1998 and will be submitted to the ACA for registration under Section 117 of the Act.

1.6. 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

1.7. One of the matters which may be subject to an Industry Code identified in paragraph 113 (3) (m) of the Act is *"the quality of standard telephone services"*. Section 115 (2) allows for a Code that addresses the quality of Standard Telephone Services by specifying performance requirements.

Benefits to Customers

1.8. This Code aims to ensure voice telephony and basic voice-band data transmission 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 Carriage Service Providers to a defined level of network performance. This Code also 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.

1.9. 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 standard telephone service.

1.10. Registration of this Code by ACA will ensure that all Carriers and Carrier Service Providers 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*

1.11. This Code also aims to assist industry by facilitating the interoperability and the interworking of Carriers' and Carrier Service Providers' 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 voice telephony and basic voice-band data transmission to be provided to end users. Compliance with network design parameters should assist the industry to achieve effective interworking.

1.12. The development of performance standards should foster consumer confidence in relation to the quality of the Standard Telephone Service provided by Carriers and Carriage Service Providers.

1.13. 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 Code will effectively have the weight of law.

Anticipated costs to industry

1.14. 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 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

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

How will the objectives of the code be achieved

1.16. :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

1.17. The method of demonstrating compliance is by self-verification and declaration. All Carriers and Carriage Service Providers (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.

1.18. Carriers and CSPs must verify (by whatever means they consider necessary) that their networks meet the defined performance levels.

1.19. Carriers and CSPs will annually declare compliance by providing a statement (on the anniversary of signing up to the Code) that provides confirmation that their network meets the end-to-end performance objectives specified by this Code.

1.20. Carriers and CSPs who are not signatories to the Code may be directed by the ACA to submit a compliance statement.

1.21. 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.

1.22. 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.

1.23. 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

1.24. Under the ACIF Code signatory arrangements, signatories to this Code (Code Participants) are subject to ACIF G514:2001 Code Administration and Compliance Scheme.

Related ACIF Technical Specifications

1.25. 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 G502:1998, 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:

Representative	Organisation
Davorka Karacic (Chair)	Vodafone Network
Peter Hicks (Editor)	Telstra Corporation
Peter Hull (Secretary)	Nortel Networks
Ken Bell	Australian Communications Authority (ACA)
Kevin Sutherland	Australian Communications Authority (ACA)
Sam Mangar	Optus
Samir Abdallah	Optus
Allan Sangster	Sangster Communications
Julian Gorman	Vodafone Network
Michel Azzi	Vodafone Network

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 performance levels for end-to-end network performance for voice telephony and basic voice-band data transmission. The Code provides visible and specific criteria through which end-to-end network performance can be assessed. Compliance to 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 Carriage Service Providers that supply a Standard Telephone Service across:

(a) public fixed circuit switched networks; or

(b) public digital mobile circuit switched networks

Note 1: The Standard Telephone Service includes the provision of services alternative to voice telephony for end users with a disability e.g. the provision of voice-band data transmission at a rate of at least 2400 bit/s across public fixed circuit switched networks to support teletypewriter (TTY) or equivalent equipment.

Note 2: Some public digital mobile circuit switched networks do not currently support voice-band data transmission. However it should be noted that these networks do have an inherent digital transmission capability which may be used with appropriate customer equipment. At the time of publication, a cost effective and practical customer terminal equipment capable of providing real-time text and text/voice communication via public digital mobile circuit switched networks requires further development by equipment manufacturers.

Note 3: In the cases where this Code does not apply, the performance levels may be used by Carriers and Carriage Service Providers as a reference for indicative target objectives.

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 circuit switched network geographic numbers to public fixed circuit switched network geographic numbers;

(b) calls between public fixed circuit switched network geographic numbers and public digital mobile circuit switched network numbers; and

(c) calls from public digital mobile circuit switched network numbers to public digital mobile circuit switched network numbers.

3.2.4. This Code does not apply to calls:

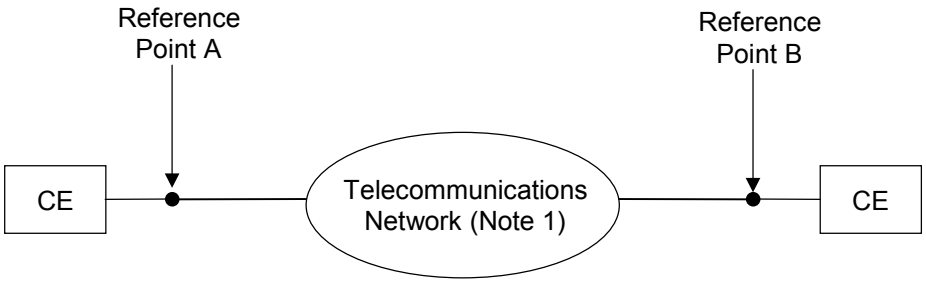
(a) using an international roaming service;

(b) made to non-geographic service number Fixed Network Terminations (FNTs); 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.

3.2.6. The Code defines the performance of a statistical sample of calls during the normal operation of public fixed circuit switched and public digital mobile circuit switched networks. The Code does not apply to or define 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.



Note 1: The "telecommunications network" include carrier networks making up the connection between two CEs.

CE: Customer Equipment (eg. telephone or teletypewriter (TTY)).

Figure 3-1
Reference Telecommunications Network.

3.2.7. This Code does not apply to voice telephony services and voice-band data transmission services provided on a customer interface that use Internet Protocol (IP), packet, frame or cell-based switching for voice telephony and voice-band data transmission connections (for example: Voice over Internet, Voice over IP, Fax over IP, Voice over ATM, Voice over FR).

3.2.8. This Code does not apply to Private Networks.

Note: Guidelines for Private Networks are provided in the Australian Network Performance Plan ACIF G502:1998.

4. REFERENCED STANDARDS AND PUBLICATIONS

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

Publication	Title
ITU-T Rec E.721 (05/99)	Network grade of service parameters and 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 (05/00)	One-way transmission time
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
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 Q.552 (11/01)	Transmission characteristics at 2-wire analogue interfaces of digital exchange
ITU-T Rec V.34 (03/98)	A modem operating at data signalling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits

Table 4-1
ITU-T Recommendations

Description	Title
	Australia - *Telecommunications Act 1991* (No.98 1991)
	Australia - *Telecommunications Act 1997* (No.47 1997)
	Australia - *Telecommunications (Transitional Provisions and Consequential Amendments) Act 1997* (No.59 1997)
	Australia - *Telecommunications (Consumer Protection and Service Standards) Act 1999*
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
ACIF G514:2000	Code Administration and Compliance Scheme

Table 4-2
Australian Publications

5. ABBREVIATIONS AND DEFINITIONS

5.1 Abbreviations

ACA Australian Communications Authority

ACIF Australian Communications Industry Forum

AN Access Network

ATM Asynchronous Transfer Mode

CE Customer Equipment

CSP Carriage Service Provider

FNT Fixed Network Termination

FR Frame Relay

ISDN Integrated Services Digital Network

ITU-T International Telecommunication Union - Telecommunication-Standardization Sector

MAI Mobile Air Interface

PCM Pulse Code Modulation

POI Point of Interconnection

TS Technical Standard

TTY Teletypewriter

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 telecommunications network that a customer or end-user terminal is directly connected to in order to initiate or receive telephone calls. In the case of calls traversing more than one network, the Access Network connects the customer or end-user terminal to the nearest POI.

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.*

Code Participant means a Carrier or Carriage Service Provider who is a signatory to this Code.

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.

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, for instance in telephony, 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 all interconnecting public networks, from a FNT or MAI to another FNT or MAI. Note: In the case of Overall Loudness Rating, end-to-end network performance includes the performance of telephone handsets.

Fixed Network Termination (FNT) is the point where CE connects to a fixed AN. The FNT is the boundary of a telecommunications network and is ascertained in the terms of an agreement between a customer and a Prime Service Deliverer or as defined under section 22 of the *Telecommunications Act 1997*. (As defined in the Australian Network Performance Plan,- ACIF G502: 1998, a Prime Service Deliverer is the Service Deliverer contracted by a customer to provide a telecommunications service).

Loudness Rating is a measure expressed in decibels, for characterising the loudness performance of complete telephone connections or of 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.

Mobile Air Interface (MAI) is the air interface between a mobile handset and its Public Digital Mobile Network.

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

Nominal Relative Network Level at a point is the network level allocated to this point to give an optimum performance for the connection. This level is generally equal to the difference in transmission loss at the reference frequency between this point and a transmission reference point in a network connection which is considered average of all network connections.

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.

Point of Interconnection (POI) is the point at which an Access Network connects to a Transit Network or another Access Network. Carriage Service Providers' networks interconnect with each other at Points of Interconnection.

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 (RVA).

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.

Receive Loudness Rating (Reference: AS/ACIF S004:2001) is a measure of the electro-acoustic characteristic of telephone equipment with respect to the reception of speech signals from a telecommunications network. (ITU-T Recommendation G.100). The loudness loss between an electrical interface in the network and the listening subsciber's ear. The loudness loss is defined as the weighted (dB) average of driving e.m.f to measures sound pressure.

Send Loudness Rating (Reference: AS/ACIF S004:2001) is a measure of the electro-acoustic characteristic of telephone equipment with respect to the transmission of speech signals to a telecommunications network. (ITU-T Recommendation G.100). 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 measures voltage.

Slip is defined as 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.

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 Vg 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 $Zg(f_0)$ are the impedances at a reference frequency f_0, e.g. 1020 Hz.

Voice-band Data Transmission is the transmission of data at 2400 bits/s within the frequency range from 300 Hz to 3400 Hz for use by a teletypewriter (TTY) or equivalent equipment.

Voice Telephony is real time two-way 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 Standard Telephone Services across interconnecting public networks within Australia, from a FNT or MAI to another FNT or MAI. The end-points are defined in the generic network reference model for voice telephony as shown in Figure 6-1.

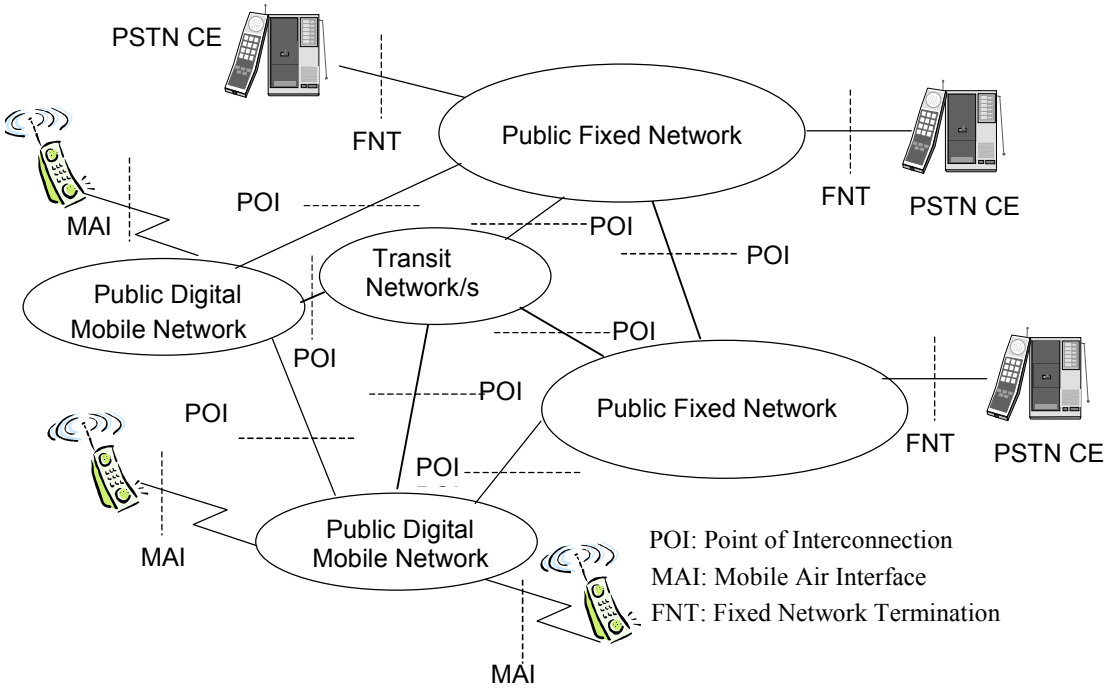


Figure 6-1
Generic network reference model for voice telephony

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 Set-up Failure Rate and Post Dialling Delay) and transmission network performance parameters (Transmission Loss, Nominal Relative Network Levels, Overall Loudness Rating, Circuit Noise, Transmission Delay, Echo Control, Network Synchronisation and Slip and Voice-band Data Transmission).

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 objectives defined in ITU-T Recommendations E.721, E.771, G822 and P.79.

6.2.3 Carriers and CSPs must demonstrate compliance with the specified network Performance Requirements utilizing the method described in Section 7.

Parameter / Capability	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	✓	✖	Note 1	6.2.6
Nominal Relative Network Levels	✓	✖	Note 1	6.2.7
Overall Loudness Rating	✓	✖	Note 2	6.2.8, 6.2.9
Circuit Noise	✓	✖	Note 1	6.2.10
Transmission Delay	✓	✓		6.2.11
Echo Control	✓	✓		6.2.12, 6.2.13
Network Synchronisation and Slip	✓	✓		6.2.14
Voice-band Data Transmission	✓	✖	Note 3	6.2.15

Note 1: Transmission Loss, nominal relative network levels and noise which are voice-frequency band (300 Hz to 3400 Hz) network performance parameters, 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 from the MAI to the POI. For mobile networks, all loudness loss is incurred in the mobile handsets.

Note 3: Some public digital mobile circuit switched networks do not currently support voice-band data transmission. However it should be noted that these networks do have an inherent digital transmission capability which may be used with appropriate customer equipment. At the time of publication, a cost effective and practical customer terminal equipment capable of providing real-time text and text/voice communication via public digital mobile circuit switched networks requires further development by equipment manufacturers.

Table 6-1
End-To-End Network Performance Parameters

End-to-End Connection Setup Failure Rate

6.2.4 Table 6-2 specifies the minimum network performance levels for End-to-End Connection Setup Failure Rate.

Connection Service Type	End to End Connection Setup Failure Rate
FNT-FNT (Local)	3%
FNT-FNT (Long Distance)	4.5%
FNT-MAI	8%
MAI-FNT	8%
MAI-MAI	10%

Table 6-2
Minimum network performance levels for End-to-End Connection Setup Failure Rate

Post Dialling Delay

6.2.5 Table 6-3 specifies the minimum network performance levels for Post Dialling Delay.

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

Connection Service Type	Maximum Mean Value (Seconds)	95th Percentile (Seconds)
FNT-FNT (Local)	6	9
FNT-FNT (Long Distance)	9	12
FNT-MAI	15	20
MAI-FNT	10	15
MAI-MAI	19	25

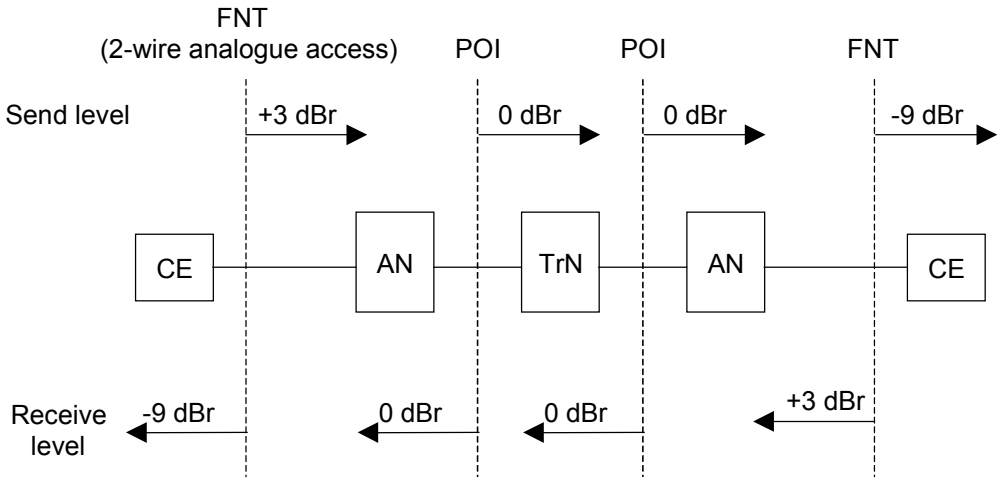
Table 6-3
Minimum network performance levels for Post Dialling Delay

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.

Nominal Relative Network Levels

6.2.7 Carrier and CSP networks must achieve the Nominal Relative Network Levels defined in the fixed network reference connection given in Figure 6-2.



AN - Access Network
CE - Customer Equipment
FNT - Fixed Network Termination
POI - Point of Interconnection
TrN - Transit Network

Figure 6-2
Nominal relative levels in a fixed network reference connection

Overall Loudness Rating

6.2.8 The maximum Overall Loudness Rating allowable is 29.5 dB.

6.2.9 This assumes the following:

(a) Customer Equipment (CE) send and receive loudness sensitivities must conform to at least AS/ACIF S004:2001.

(b) use of nominal design values for CE send and receive loudness ratings (excluding manufacturing tolerance).

(c) use of nominal design loudness ratings of network components, e.g. cables, PCM codecs.

(d) 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.

(e) transmission loss as defined in Section 5.2 must be used in the calculation of loudness ratings.

Circuit Noise

6.2.10 The End-to-End design limit for Circuit Noise must not be more than -41 dBm0p. The received relative level at the FNT is assumed to be a -9 dBr point.

Transmission Delay

6.2.11 The maximum Transmission Delays are specified in Table 6-4.

Network Portion	Specific Conditions	Mean One-way Propagation Time (non-satellite connections)	Mean One-way Propagation Time (including one satellite hop)
FNT-FNT		150 ms	410 ms
FNT- MAI	Mobile handset delay is not included	150 ms	410 ms
MAI-MAI	Fixed network portion delay and mobile handset delay are not included.	150 ms	410 ms
FNT-POI		75 ms	335 ms

Table 6-4
Maximum Transmission Delays

Echo Control

6.2.12 Echo cancellers must be employed when the round trip delay exceeds 34 ms. This requirement does not apply to calls made to non-geographic service FNTs 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.

Network 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%

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

Table 6-5
Controlled slip performance on a 64 kbit/s connection

Voice Band Data Transmission

6.2.15 A Carrier's or Carriage Service Provider's network must be able to support the carriage of voice-band data transmission at a rate of at least 2400 bit/s.

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 Participant to demonstrate compliance to 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 conclude that the design of their network is such that they comply with the end-to-end 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 should maintain adequate levels of documentation to substantiate their compliance claims.

7.2.4 While some Carriers and CSPs may opt to conduct network testing (of for example 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) being directed to comply with this Code.

Initial Compliance Declaration

7.3.2 On becoming a signatory to this Code, 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 Carriers and CSPs must annually verify the performance of their networks and declare compliance by submitting a statement to ACIF. The declaration statement confirms that their network meets the end-to-end performance objectives specified by this Code.

7.3.4 The declaration statement must be submitted to ACIF on the anniversary of becoming a Code Participant.

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.

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 (ie End-to-End Connection Set-up 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 The timing and extent of measurements are:

(a) measurements must be distributed across a 24 hour period; and

(b) the measurements must 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. ±10%) to which a measured parameter is required to be specified. It is also important to note that the range of the confidence interval (ie the precision

level) is specified in terms of the defined objective and not the measured result.

8.1.9 Sufficient calls will be made to ensure that the measured value for the End-to-End Connection Set-up 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 Set-up Failure Rate for each service interconnection class (e.g. FNT-FNT, FNT-MAI, etc.) will also be used to determine the corresponding Post Dialling Delay (PDD) parameters.

Note: Sample size requirements for attribute data (ie 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 1. To ensure statistical significance the minimum number of test calls over a 30 day period for intra-networking testing is 10,000. The minimum number of test calls over a 30 day period for inter-networking testing is 1,000.

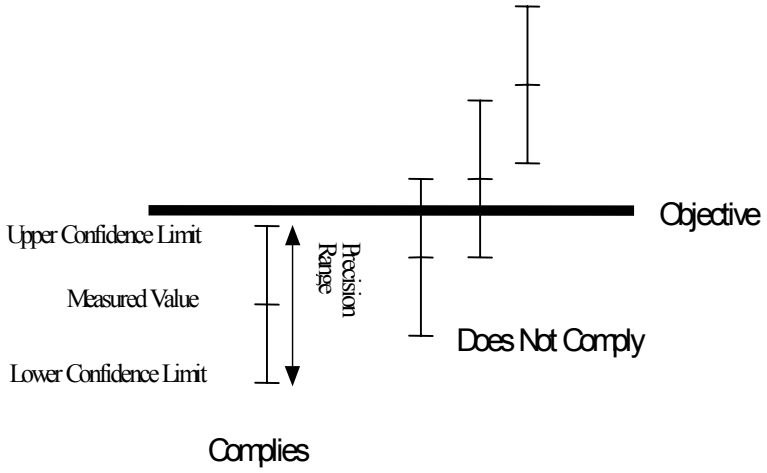


Figure 8-1
Criteria for the achievement of Objectives

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.

(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 to 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

9.0.1 Under the ACIF Code signatory arrangements, signatories to this Code (Code Participants) are subject to ACIF G514:2001 Code Administration and Compliance Scheme.

9.0.2 Any information provided regarding compliance will be treated in accordance with the confidentiality provisions of the ACIF G514:2001 Code Administration and Compliance Scheme.

9.0.3 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.

9.0.4 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 to this Code.

9.0.5 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 Signatory to this Code may be referred from the ACA under the power granted to the ACA in section 514 of the *Telecommunications Act 1997*, 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.

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)

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

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

where:

Z = reliability coefficient (ie 1.96 for 95% confidence)

p = Failure rate

n = sample size

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

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

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

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, $= \sigma/\sqrt{n}$

μ = sample mean

C = Coefficient of variation $= \sigma/\mu$

n = sample size

Application of Formulae

ATTRIBUTE DATA

95% Confidence Interval — **Failure Rate (p)**

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

VARIABLE DATA

95% Confidence Interval — **Coefficient of Variation (sd/mean)**

	Precision (as% of mean)	**0.5**	**1**	**2**
		Samples (n)		
	5%	385	1537	6147
	10%	97	385	1537
SAMPLES	20%	25	97	385
	25%	16	62	246

APPENDIX B PARAMETER REFERENCE SOURCES (INFORMATIVE)

Parameter	C519:2002 reference(s)	International Recommendation(s) and other standards used as basis for C519:2002 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	ITU-T Recommendations G.100, G.101, G.113
Nominal Relative Network Levels	6.2.7	ITU-T Recommendation G.100.1
Overall Loudness Rating	6.2.8, 6.2.9	ITU-T Recommendations P.79, G.111
Circuit Noise	6.2.10	ITU-T Recommendations G.102, Q.552. G.712
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
Network Synchronisation & Slip	6.2.14	ITU-T Recommendation G.822
Voice Band Data Transmission	6.2.15	ITU-T Recommendation V.34

Table B-1

Cross referencing of parameters with ACIF C519:2002 sections and relevant international Standards and/or Recommendations

The Australian Communications Industry Forum Ltd (ACIF) is a communications self-regulatory body established in 1997 by the industry to manage communications self-regulation within Australia.

ACIF's role is to develop and administer technical and operating arrangements that promote both the long term interests of end-users and the efficiency and international competitiveness of the Australian communications industry. This primarily involves

- developing Standards, Codes and other documents to support competition and protect consumers;
- driving widespread compliance; and
- facilitating/coordinating the cooperative resolution of strategic and operational industry issues

ACIF comprises a Board, an Advisory Assembly, seven standing Reference Panels, various task specific Working Committees, a number Industry Facilitation/Coordination Groups and a small Executive.

The ACIF Standards and Codes development process involves the ACIF Board, Reference Panels, Working Committees and the ACIF Executive. The roles and responsibilities of all these parties and the required operating processes and procedures are specified in the ACIF Operating Manual.

ACIF Standards, Codes and other documents are prepared by Working Committees made up of experts from industry, consumer, government, and other bodies. The requirements or recommendations contained in ACIF published documents are a consensus of views of representative interests and also take into account comments received from other stakeholders.

Care should be taken to ensure that material used is from the current version of the Standard or Code and that it is updated whenever the Standard or Code and is amended or revised. The number and date of the Standard or Code should therefore be clearly identified. If in doubt please contact ACIF.

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