MANUAL

TELECOMMUNICATION STANDARDS

DEP 32.71.00.11-Gen.

July 1996

DESIGN AND ENGINEERING PRACTICE

PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of:

Shell International Oil Products B.V. (SIOP)
and
Shell International Exploration and Production B.V. (SIEP)
and
Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other Service Companies.

They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use DEPs they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will expect them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the DEPs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

The right to use DEPs is granted by SIOP, SIEP or SIC, in most cases under Service Agreements primarily with companies of the Royal Dutch/Shell Group and other companies receiving technical advice and services from SIOP, SIEP or SIC. Consequently, three categories of users of DEPs can be distinguished:

1) Operating companies having a Service Agreement with SIOP, SIEP, SIC or other Service Company. The use of DEPs by these Operating companies is subject in all respects to the terms and conditions of the relevant Service Agreement.

2) Other parties who are authorized to use DEPs subject to appropriate contractual arrangements.

3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) or 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, SIOP, SIEP and SIC disclaim any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any DEP, combination of DEPs or any part thereof. The benefit of this disclaimer shall inure in all respects to SIOP, SIEP, SIC and/or any company affiliated to these companies that may issue DEPs or require the use of DEPs.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, DEPs shall not, without the prior written consent of SIOP and SIEP, be disclosed by users to any company or person whomsoever and the DEPs shall be used exclusively for the purpose for which they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of SIOP and SIEP. The copyright of DEPs vests in SIOP and SIEP. Users shall arrange for DEPs to be held in safe custody and SIOP or SIEP may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

All administrative queries should be directed to the DEP Administrator in SIOP.

NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 SCOPE

This is a revision of an earlier DEP with the same title and number, issued in April 1992. It specifies requirements and gives recommendations for private telecommunication networks and public telecommunication network services. International telecommunication standards are set by agreement through the auspices of the International Telecommunication Union (ITU), a specialised agency of the United Nations dealing with telecommunications. These standards are published by the ITU and take the form of Regulations, Recommendations, Resolutions, Reports and Final Acts.

National telecommunication standards are based on ITU recommendations but may contain significant variations. Some ITU recommendations specially allow for local or regional interpretation. Private networks should follow ITU recommendations as far as possible to gain cost advantage by purchasing standard equipment and to allow interworking with other equipment and networks, especially the public telecommunication network. Public Telecommunication Operators (PTOs) may insist on adherence to local variations and special interface standards. Care should be take to verify applicable local standards for connection.

The International Telecommunication Union via its Consultative Committees adopts standards according to the principle of consensus. As a result of this process the titles of standards are sometimes more a result of the political process rather than a specific reference to its contents. This could hamper the practical value of this DEP and **for this reason some titles have been slightly modified to provide better guidance to their content. However, all standards are listed in logical order, and with their actual titles, in (7).** The titles CCITT and CCIR are retained in this DEP where documents have been issued by those organisations. Because of re-organisation within the ITU, new documents containing standards will be issued by the Telecommunications Standards Division (ITU-T) and radio frequency spectrum matters by the Radiocommunication Division (ITU-R).

Some miscellaneous standards also apply, for instance those of the International Electrotechnical Commission (IEC). These standards are mentioned within the paragraphs concerned.

The provision of aeronautical and maritime communication and navigational aids for offshore platforms and small private airfields is often part of the responsibility of the telecommunication organisations. For this reason the main standards of the International Maritime Organisation (IMO) and the International Civil Aviation Organisation are included in this DEP.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors nominated by them (i.e. the distribution code is "C", as described in DEP 00.00.05.05.-Gen.).

This DEP is intended for use in oil refineries, gas plants, chemical plants, oil and gas production facilities, and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

The **Contractor** is the party which carries out all or part of the design, engineering,

procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.4 ABBREVIATIONS

ADPCM	Adaptive Differential Digital Pulse Code Modulation
ADPNSS	Analogue version of DPNSS
ANSI	American National Standards Institute
ARQ	Automatic Repeat Request
Async	Asynchronous
ATM	Asynchronous Transfer Mode
AT&T	American Telegraph and Telephone Company
BER	Bit Error Ratio
bps	bits per second
BS	British Standard
BSI	British Standards Institution
CCIR	International Radio Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CELP	Code enhanced linear predictive
DASS II	Digital Access Signalling System No 2
DPNSS	Digital Private Network Signalling System
EIA	Electronic Industries Association
EMC	Electro Magnetic Compatibility
ESD	Electro Static Discharge
FDDI	Fibre Distributed Data Interface
FDM	Frequency Division Multiplex
FM	Frequency Modulation
GAT	Group Audio Terminal (Audio conference system)
GHz	GigaHertz
HRC	Hypothetical Reference Circuit
HRX	Hypothetical Reference Connection
ICAO	International Civil Aviation Organisation
IDN	Integrated Digital Network
IEC	International Electrotechnical Commission
IEEE	International Institute for Electric and Electronic Engineers
IMO	International Maritime Organisation
ISDN	Integrated Services Digital Network
ITU	International Telecommunication Union
kbps	kilobits per second
kHz	kiloHertz
LAN	Local Area Network
Mbps	Megabits per second
MHz	MegaHertz
NDB	Non Directional Beacon
NOTAM	A notice containing aeronautical information to personnel concerned with flight operations
PABX	Private Automatic Branch Exchange
PAD	Packet Assembler/Disassembler
PCM	Pulse Code Modulation
PDS	Premises Distribution System

PTO	Public Telecommunication Operator
SHF	Super High Frequency
SOLAS	Safety Of Life At Sea
TDMA	Time Division Multiple Access
UHF	Ultra High Frequency
VHF	Very High Frequency
WARC	World Administrative Radio Conference

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (7).

2. INTERNATIONAL STANDARDS

2.1 GENERAL CHARACTERISTICS OF CARRIERS

2.1.1 General

Summary:

Privately operated networks exist throughout the world because PTOs are often unable to extend their services to remote locations. CCITT recognises private networks and gives guidance on general standards to follow when connecting private networks to the public networks.

Main standards:

CCITT Volume III, Fascicle III-1

G.171 Transmission plan aspects of privately operated networks.

2.1.2 Analogue carriers

Summary:

Analogue carrier systems shall follow the 12 channel multiplex hierarchy and equipment specifications of CCITT. However, local specifications may apply for interconnection to the public network. Carrier systems based on the 8 channel multiplex hierarchy shall not be used.

Main standards:

CCITT Volume III, Fascicle III-2

G.211 Make-up (concept) of carrier links

G.232 Characteristics of basic 12-channel multiplex equipment

G.233 Recommendations concerning basic channel translation equipment into supergroups and mastergroups

G.322 General characteristics for systems on symmetric pair cables

G.371 FDM carrier systems for submarine cable

G.412 Multiplex equipment of radio-relay systems.

2.1.3 Digital carriers

Summary:

Digital carrier systems shall follow either CCITT's 1544 kbps or 2048 kbps hierarchy. The decision as to which hierarchy to follow will be influenced by the existing local public network hierarchy and the availability of equipment and installation/maintenance support.

Main standards:

CCITT Volume III, Fascicle III-4

G.702 Digital hierarchy bit rates

G.703 Characteristics of digital interfaces

G.704 Synchronous frame structures used at primary and secondary hierarchical levels

G.732 Characteristics of primary PCM multiplex equipment operating at 2048 kbps

G.733 Characteristics of primary PCM multiplex equipment operating at 1544 kbps

G.741 to 747 Characteristics of second order multiplex equipment

G.751 to 755 Characteristics of higher order multiplex equipment.

2.2 TRANSMISSION MEDIA

2.2.1 Cables

Summary:

In general cables should be:

- copper-based symmetrical pairs for office and campus size distances;
- coaxial and fibre-optic cable for high bandwidth applications;
- fibre-optic cable for long distances.

Selection should be based on capacity taking into account future requirements and both installation and maintenance costs. Care should be taken when using fibre optic cable to have available the necessary skill and sophisticated instruments required to easily joint and repair the cable.

Main standards:

CCITT Volume III, Fascicle III-3

- Copper-based symmetrical cable:

G.611 Characteristics of symmetric cable pairs for analogue transmission

G.612 Characteristics of symmetric cable pairs for transmission of digital signals up to 34 Mbps

G.613 Characteristics of symmetric cable pairs for transmission of digital signals up to 2 Mbps

- Coaxial cable:

G.621 to 623 Characteristics of coaxial cable

- Fibre-optic cable:

G.651 Characteristics of 50/125 micrometre multimode optical fibre cable

G.652 Characteristics of single-mode optical fibre cable.

2.3 VOICE SERVICES

2.3.1 Telephone transmission quality

Summary:

Private voice networks should follow CCITT recommendations regarding absolute and relative power (loudness) levels and transmission standards. Verification of transmission plans on incoming and outgoing levels should adopt CCITT recommended measurements and weighting factors.

Main standards:

CCITT Volume V

P.11 Effect of transmission impairments

CCITT Volume III, Fascicle III-1

G.101 The (Voice) transmission plan.

2.3.2 Interconnection of exchanges

Summary:

Local PTO regulations shall be followed with regard to the interconnection of a private exchange to the public network. Often PTO regulations specify the use of a signalling system based on CCITT standards.

For the interconnection of private exchanges the network planner has a variety of options based on proprietary and de-facto standards. The decision to select a signalling system should take account of:

- whether or not all exchanges in the network will be of the same family, i.e. supplier. In this case a proprietary standard can be adopted providing advanced services;
- whether various types of exchanges from various manufacturers will be used. In this case either a de-facto standard, supported by all of the various manufacturers, or a signalling system based on CCITT standard can be used.

Main standards:

- Analogue type of signalling:

CCITT Volume VI, Fascicle VI-2

Q.1XX Specifications of signalling systems Nos. 4 and 5

CCITT Volume VI, Fascicle VI-3

Q.2XX Specifications of signalling system No. 6

CCITT Volume VI, Fascicle VI-4

Q.3XX and Q.4XX Specifications of signalling systems R1 and R2

- De-facto standard based on CCITT recommendations:

British Telecom

DASS II British standard for digital signalling

- Accepted standard developed and agreed among various vendors:

ADPNSS Analogue version of DPNSS

- Digital Common channel type of signalling:

CCITT Volume VI, Fascicle VI-7 to VI-9

Q.7XX Specifications of signalling system No. 7

- Accepted standard developed and agreed among various vendors:

DPNSS Digital Private Network Signalling Standard.

2.4 DATA SERVICES

2.4.1 Data services over analogue network

Summary:

Modems interfacing with analogue fixed or switched circuits should follow CCITT recommendations for the physical layer interface and signal levels in order to meet (local) PTO type approval specifications. It is further recommended, if applicable, to follow CCITT standards for the interface between modem and terminal.

Main standards:

CCITT Volume VIII, Fascicle VIII-1

- Physical layer interface standards:

V.2 Signal level for data transmission on telephone circuits

V.10/V.28 Electrical characteristics of un-balanced interchange circuits for data communication

V.11 Electrical characteristics of balanced interchange circuits for data communication

- Data link layer interface standards:

V.21 200 baud modem for public switched telephone networks

V.22 bis 2400 bps duplex modem for public switched telephone networks

V.23 600/1200 bps duplex modem for public switched telephone networks

V.24 Interchange circuits (interface) between modem and terminal

V.26 bis 1200/2400 bps modem for 4 wire fixed and switched circuits

V.27 bis 2400/4800 bps modem for 4 wire fixed and switched circuits

V.29 9600 bps modem for 4 wire fixed circuits

V.32 2400/4800/9600 bps modem for 2 wire fixed and switched circuits

V.32 bis 2400/4800/9600/14,400 bps modem for 2 wire switched circuits

V.33 14,400 bps modem for 4 wire fixed circuits

V.34 bis 2400/24,000 bps modem for 2 wire switched circuits

V.35 48,000 bps data transmission on special circuits

- Network layer interface standard:

V.42 Error-correcting procedures for async-modems.

2.4.2 Data services over packet switching networks

Summary:

Private packet switching networks should follow CCITT recommendations for public packet switching networks. Packet switching networks are often referred to under the main interface recommendation "X.25".

Main standards:

CCITT Volume VIII, Fascicle VIII.2

X.3 Packet Assembly Disassembly facility (PAD) in a public data network

X.21 (Public) data networks interface for Sync. terminals

X.21 bis Use of V-series modems on (public) data networks

X.25 Interface between packet mode terminals and networks

X.28 Interface for Async terminals and (public) Packet Assembling/Disassembling facilities (PADs)

X.29 Procedures for interchange of information between a PAD and a packet terminal or other PAD

X.30 Support of X.21, X.21 bis and X.20 bis terminals by an integrated services digital network (ISDN).

2.5 MESSAGE HANDLING SYSTEMS

2.5.1 Telex transmission

Summary:

The importance of public telex is rapidly receding as a result of the move to electronic mail and facsimile. However, outside the industrialised countries telex will, for the coming years, remain one of the most reliable public services and needed to support our activities. International CCITT standards apply and shall be followed in addition to local standards.

Main standards:

CCITT Volume VII, Fascicle VII.1

S.1 International Telegraphic Alphabet No.2

S.11 Use of start-stop reperforating equipment for perforated tape retransmissions

S.12 Conditions that must be satisfied by synchronous systems operating in connection with standard 50-baud teleprinter circuits

S.15 Use of telex network for data transmission at 50 bauds

S.21 Use of display screens in telex machines.

2.5.2 Electronic mail

Summary:

Public electronic mail systems are replacing the public telex service. CCITT standards apply for both the message structure and transmission protocol in addition to standards for harmonised directory services. Private electronic mail systems shall follow these CCITT standards when interfacing the public electronic mail service.

Main standards:

CCITT Volume VIII, Fascicle VIII.8

X.400 Message handling system and service overview

X.402 Message handling systems: Overall architecture

X.500 The Directory - Overview of Concepts, Models and Services

X.501 The Directory models.

2.6 ADDITIONAL SERVICES

2.6.1 Facsimile

Summary:

Facsimile equipment is used to transmit/receive documents via the public switched telephone network. Because of the open nature of facsimile CCITT recommendations should be followed to allow communications to all parties. Group 3 equipment is recommended for general use on analogue networks. Group 4 equipment operates via (public) 64 kbps ISDN lines often more economically, but with limited interconnectivity.

Main standards:

CCITT Volume VII, Fascicle VII-3

T.4 Standardisation of Group 3 facsimile apparatus

T.6 Standardisation of Group 4 facsimile apparatus

T.21 Standardisation test charts for document transmission.

2.6.2 Videoconferencing

Summary:

Standards are available for interactive videoconferencing via n x 64 kbps digital circuits. The lowest bitrate on which videoconferencing can operate is 64 kbps but then the picture quality is limited. The lowest acceptable speed to be offered to the general public is 2 x 64 kbps. Although proprietary standards may offer better picture quality than CCITT standards, in particular on 2 x 64 kbps, they can only be used for inter-company conferences and CCITT recommendations shall be followed to allow for conferencing with third parties. It is therefore recommended to standardise on CCITT H.320 or to select a proprietary system which will support H.320.

Proprietary systems are emerging which use dial-up circuits for videoconferencing. Until standards are available, these systems can only be used between identical units and are restricted in application.

Main standards:

CCITT Volume III, Fascicle III-6. (1990 definition)

H.221 Communication framing, de/multiplexing

H.230 Control and indication signals

H.242 Call set-up/disconnect: point-to-point

H.243 Call set-up/disconnect: Multipoint

H.261 Full motion video coding (a sub-set for compression of H.320)

H.320 Technical requirements for audio-visual systems

G.711 3.1 kHz PCM audio, 64 kbps

G.721/3 Multirate ADPCM audio

G.722 7 kHz audio, 48 or 56 kbps

G.726 Multirate ADPCM audio

G.728 16 kbps low-delay CELP speech, 3400 Hz audio.

NOTE P x 64 kbps is not mentioned in the Blue Book series of 1988. However, CCITT has adopted P x 64 kbps under the H.261 standard instead of the n x 384 kbps standard mentioned in the Blue Book.

2.6.3 Audioconferencing

Summary:

If the round trip echo (acoustic feedback) can be suppressed then conventional telephone systems can be used for interactive audioconferencing. Echo suppression systems are not standardised and de-facto standards have not emerged. CCITT gives guidance only on the transmission performance of the audio conference equipment and the performance of the echo suppression system.

Main standard:

CCITT Volume V

P.30 Transmission performance of group audio terminals (GATs).

2.7 INTEGRATED SERVICES

2.7.1 The Integrated Services Digital Network (ISDN)

Summary:

The public analogue telephone network will gradually change to an Integrated Services Digital Network (ISDN). This network is designed to support data, voice, image and text services via a limited number of standard interfaces. The service layer will rest on the Integrated Digital Network or IDN. Digital public network services already available such as packet switching (X.25) and digital leased circuits will become an integrated part of ISDN and available through these standard interfaces. Although ISDN will be a public service its impact on private network topology and technology will be significant. Therefore private network design should take into account the basic infrastructure of ISDN, i.e. 2 x 64 kbps plus 16 kbps (2B + D) to all outlets. In general both switching and cabling systems must be able to support or be upgradable to ISDN. However, this criterion does not apply if it can be foreseen that ISDN will not be used within the lifespan of the private switching and cabling system.

Main standards:

- Interfaces and architecture:

CCITT Volume III, Fascicle III-8

I.324 ISDN network architecture

I.410 ISDN user-network interfaces. General aspects

I.411 ISDN user-network interfaces. Reference configuration

I.412 ISDN user-network interfaces. Interface structures and access capabilities

I.420 Basic user interface (2 x 64 kbps)

I.421 Primary rate interface (30 x 64 kbps).

3. RECOMMENDED ENGINEERING PRACTICE

3.1 PERFORMANCE AND AVAILABILITY CRITERIA OF PRIVATE NETWORKS

3.1.1 Noise objectives for analogue circuits

Summary:

It is widely accepted that, in practice, only transmission circuits and multiplex equipment contribute to the overall availability and performance of analogue telecommunication networks. There is no contribution from switching equipment (exchanges). CCITT and CCIR recommendations for availability and performance during availability are expressed in picoWatt noise and are given for Hypothetical Reference Circuits (HRC) only. These parameters have to be sub-divided into the actual circuit under design. All private circuits connected to the public telecommunication network should follow CCITT and CCIR recommendations unless special circumstances apply, for instance exceptional isolation of locations.

Main standards:

CCITT	Volume III, Fascicle III-2
G.215	Hypothetical reference circuit of 5000 km for analogue systems
G.222	Noise objectives for design of carrier-transmission systems of 2500 km
G.223	Guidelines for the calculation of noise on hypothetical reference circuits.

3.1.2 Error performance of digital circuits

Summary:

It is widely accepted that, in practice, only transmission circuits contribute to the overall availability and performance of digital telecommunication networks. There is no contribution from switching equipment (exchanges) and multiplex equipment. CCITT recommendations for availability and performance during availability are expressed in bit error ratio (BER) and are given for a Hypothetical Reference Connection (HRX). CCITT makes a distinction between local-grade, medium-grade and high-grade sections of the HRX. It is recommended to design spur links according to local-grade sections and backbone links according to medium-grade sections. High-grade sections are normally not found within private networks. Since the HRX consists of two medium-grade circuits, i.e. either end of the high-grade circuit, the objectives to be used for radio relay services shall be a composite of the performance of both ends, i.e.:

- Degraded minutes -	minutes with BER	$> 10^{-6}$	=	3%
- Severely errored seconds -	seconds with BER	$> 10^{-3}$	=	0.08%
- Errored seconds (seconds with at least one error)			=	2.4%

Each time percentage is the permissible threshold for the worst month.

The provisions of Notes (4) and (5) to CCIR Report 1052-1 are applied in obtaining these requirements.

For digital radio systems which form all of a local grade circuit, e.g. area radio systems (TDMA) or low-capacity digital VHF/UHF radio links, the following error performance objectives apply in each direction and to each 64 kbit/s channel and take account of fading, short-term interference and all other sources of performance degradation:

1. The BER should not exceed 1×10^{-3} for more than 0.05% of any month for an integration time of 1 second.
2. The BER should not exceed 1×10^{-6} for more than 1.5% of any month with an integration time of 1 minute.
3. The residual BER should not exceed 1×10^{-8}.

The unavailability objective for a 64 kbit/s circuit due to propagation, namely fading and

interference, shall not exceed 0.1% of the time. When radio equipment, power supply equipment and external plant failure are included, this becomes 0.4% of the time.

CCITT recommendations take into account that satellite links and microwave links, with their special characteristics, may form part of the HRX.

Main standards:

CCITT Volume III, Fascicle III.5

G.801 Digital transmission models

G.811 Timing requirements of primary reference clocks suitable for plesichronous operations of international digital links

G.821 Error performance of digital connections

G.822 Controlled clock slip rate objectives

G.823 The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy

G.824 The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy

G.921 Digital sections based on the 2048 kbit/s hierarchy.

CCIR Reports, 1990

379-5 Characteristics of simple radio relay equipment operating in Bands 8 and 9 for the provision of telephone trunk connections in rural areas

380-3 Radio Systems operating in Bands 8 and 9 for the provision of subscriber telephone connections in rural areas

930-2 Performance objectives for digital radio-relay systems

1052 Error performance and availability objectives for digital radio-relay systems used in the "medium grade" portion of an ISDN connection

1053 Error performance and availability objectives for digital radio-relay systems used in the" local-grade" portion of an ISDN connection.

3.2 DESIGN PARAMETERS OF RADIO LINKS

3.2.1 Analogue and digital multi-channel radio links

Summary:

Analogue and digital multi-channel radio links are used extensively within the oil industry to interconnect private networks and to connect those networks to the public network. It is recommended that these radio links should follow CCIR engineering guidelines with respect to fading, noise and bit error ratio margins to meet overall CCITT performance and availability criteria. However, there are many circumstances where, by the nature of the terrain and/or distances involved, it cannot be economically justified to follow CCITT and CCIR recommendations. In those circumstances a balance has to be struck between the minimal operational availability and performance required and the international standards to be followed.

Main standards:

- General:

CCIR Volume V

Rep.238 Propagation data and prediction methods for trans-horizon radio-relay systems

Rep.338 Propagation data and prediction methods for line-of-sight radio-relay systems

Rep.564 Propagation data and prediction methods for satellite systems.

- Analogue:

CCIR Volume IX - Part 1

Rec.391 Hypothetical Reference Circuits for radio-relay systems for telephony using frequency-division multiplex with a capacity between 12 and 60 telephone channels

Rec.392 Hypothetical Reference Circuits for radio-relay systems for telephony using frequency-division multiplex with a capacity above 60 telephone channels

Rec.393 Allowable noise power in the Hypothetical Reference Circuit for radio-relay systems for telephony using frequency-division multiplex

Rec.395 Noise in the radio-portion of circuits to be established over real radio-relay links for FDM

Rec.397 Allowable noise power in the Hypothetical Reference Circuit of trans-horizon radio-relay systems for telephony using frequency-division multiplex

Rec.593 Noise in real circuits of multi-channel trans-horizon FM radio-relay systems.

- Digital:

Rec.556 Hypothetical reference digital path for radio-relay systems

Rec.594 Allowable bit error ratio (BER) in the hypothetical reference digital path

Rec.634 Error performance objectives for high-grade digital radio-relay links

Rec.696 Error performance objectives for medium-grade radio-relay links

Rec.697 Error performance objectives for local-grade radio-relay links

Rep.1052 Error performance objectives for medium-grade digital radio-relay links

Rep.1053 Error performance objectives for local-grade digital radio-relay links.

3.2.2 Single channel fixed and mobile radio systems

Summary:

Single channel radio systems are mainly used for communication to mobiles (including ships and aircraft) and for fixed spur-links in rural telephone networks. They operate in frequency bands below 1 Ghz in contrast to most multi-channel radio links which operate in frequency bands above 1 Ghz. Design criteria for availability and performance are not given either by CCITT or CCIR due to the nature of the application. However, CCIR gives guidelines for the propagation curves which can be used to assess the coverage of the radio link and the output power and antenna height required.

Main standards:

CCIR Volume V

Rec.528 Propagation curves for aeronautical mobile and radio-navigation services in the VHF, UHF and SHS band

Rep.567 Methods and statistics for estimating field-strength values in land mobile services using frequencies between 30 Mhz and 1 Ghz.

3.2.3 Shortwave radio links with single and double sideband modulation

Summary:

Despite the progress in satellite communication, shortwave radio links are still used frequently to establish over-the-horizon communication to mobiles and to camps. The main reasons are the hesitation of many local authorities to give permission for satellite communication and not least the cost of satellite communications. Shortwave radio links use the reflective features of the ionosphere to communicate beyond the horizon. However, these reflections are very unstable and are only predictable in the long term. It is recommended to use the CCIR guidelines to calculate the optimum frequencies for the link under consideration before applying for frequency licences. CCIR guidelines can be used further to select the right type of antenna for the particular distance.

Main standards:

CCIR

Supplement to Report 252:
Second CCIR computer-based interim method for estimating sky-wave field strength and transmission loss at frequencies between 2 and 30 MHz.

Report 340:
CCIR Atlas of ionospheric characteristics.

CCIR Volume VI

Rec.435 Prediction of sky-wave field strength between 150 and 1600 kHz

Rep.575 Methods for predicting sky-wave field strengths at frequencies between 150 and 1600 kHz.

NOTE The computer program of report 252-2 is available from SIEP-EPD/76.

3.3 FREQUENCY BANDS FOR MICROWAVE AND MOBILE RADIO

3.3.1 Frequency selection

Summary:

The frequency bands for fixed and mobile communications are allocated by local authorities following the framework set by the WARC which is held on average every 5 years. WARC 1992 l formalised the re-division of frequency bands below 2.7 GHz to allow more bandwidth for mobile communications. As a result fixed microwave links operating below 2.7 GHz could be forced to change their frequency dependent upon the national authority for frequency allocations.

Microwave links are mainly used by PTOs and it is recommended to apply for frequencies within the bands specified by CCIR (but above 2.5 GHz) to gain the advantage of a large availability of equipment.

The use of frequency bands below 1 GHz is not standardised and differs by region and country. Mobile communication in the VHF band is very congested and there is a move toward the UHF band. The use of the UHF band instead of the VHF band offers certain advantages, for instance a better penetration inside structures such as oil platforms. The VHF bands offers better communication around the line-of-sight horizon.

Main standards:

ITU: Radio Regulations of the WARC

CCIR Volume IX, Part 1

Rec.382 Radio-channel arrangements for radio-relay systems with 600 to 1800 telephone channels or 2 x 34 Mbps and 2 x 45 Mbps digital capacity operating in the 2 and 4 GHz band

Rec.383 Radio-channel arrangements for analogue radio-relay systems with 1800 telephone channels and digital systems with 140 Mbps operating in the 6 GHz band

Rec.384 Radio-channel arrangements for analogue radio-relay systems with 1260 or up to 2700 telephone channels and digital systems with 140 Mbps operating in the 6 GHz band

Rec.385 Radio-channel arrangements for 60, 120 and 300 channel radio-relay systems in the 7 GHz band

Rec.635 Radio-channel arrangements for digital radio-relay systems with capacities in the order of 90, 140 or 200 Mbps operating in the 4 GHz band.

NOTE Digital micro-wave links with capacities of 2, 2 x 2, 8 and 2 x 8 Mbps make frequent use of the 7 GHz band.

4. RECOMMENDED MAINTENANCE PRACTICE

4.1 GENERAL PRINCIPLES OF MAINTENANCE

4.1.1 Maintenance philosophy for telecommunication networks

Summary:

Maintenance of (private) telecommunication networks is required to have the lowest overall lifetime cost with the highest availability and performance. CCITT gives guidelines on maintenance philosophy for telecommunication networks in order to establish worldwide accepted parameters for network maintenance. It is recommended to follow the general principles of CCITT.

Main standards:

CCITT Volume IV, Fascicle IV-1

M.20 Maintenance philosophy for telecommunication networks

M.30 Principles for a telecommunication management network

M.60 Maintenance terminology and definitions.

4.2 MAINTENANCE OF CIRCUITS

4.2.1 Maintenance of analogue circuits

Summary:

Analogue circuits are classified either to carry voice or data. Voice grade circuits can only support low speed data. High speed data up to 19.2 kbps can be carried only by special data rate circuits. It is recommended to follow CCITT recommendations for the maintenance of private circuits and for the acceptance tests of leased voice and data circuits. CCITT recommendations cover both terrestrial and satellite circuits. Switched circuits via the marine satellite (Inmarsat) system are covered by a special recommendation.

Guidance on voice quality and relative signal levels can be found in the P series of recommendations. See (2.3.1).

Main standards:

CCITT Volume IV, Fascicle IV-2

M.810 Setting up and lining up an international voice-frequency telegraph link

M.1020 Characteristics of special quality international leased circuits with special bandwidth conditioning

M.1025 Characteristics of special quality international leased circuits with basic bandwidth conditioning

M.1030 Characteristics of ordinary quality leased circuits forming part of a private switched telephone network

M.1040 Characteristics of ordinary quality international leased circuits

M.1100 General maintenance aspects of maritime satellite systems.

4.2.2 Maintenance of digital circuits

Summary:

The degradation in performance of digital circuits is difficult to measure and is noticeable only near the unavailability threshold. Although not intended for maintenance purposes, the design criteria given by CCITT for digital circuits are often used as a framework to set maintenance standards. In this respect (3.1.2) should be consulted.

Main standards:

CCITT Volume IV, Fascicle IV-2

M.1350 Setting up, lining up and characteristics of international data transmission systems in the range of 2.4 to 14.4 kbps

M.1375 Maintenance of international data transmission systems operating at 48 kbps and above.

4.2.3 Measurement equipment

Summary:

There are basically two types of test equipment:

1. for the measurement of essential specifications for telecommunications equipment;
2. for the measurement of operational matters, e.g. procedures for bringing circuits into service and routine checks of performance.

Specification checks are more comprehensive. These are usually employed to certify compliance with design objectives and are normally performed prior to installation. Operational checks are performed systematically and repetitively and require:

1. conformity of results when tests may be performed using test equipment supplied by more than one manufacturer;
2. a common measurement technique to ensure compatibility when a test requires test equipment at both ends of a circuit.

Standards are necessary primarily to meet the requirement for compatibility and conformity in operations.

Main standards:

CCITT Vol. IV, Fascicle IV-4

Rec. O.3 Climatic conditions and relevant tests for measuring equipment

Rec. O.6 1020 Hz reference test frequency

Rec. O.11 Maintenance access lines

Rec. O.41 Psophometer for use on telephone-type circuits.

5. MISCELLANEOUS STANDARDS

5.1 CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Summary:

The fault location and repair of outside cables etc. may entail considerable expense in addition to the interruption of company data and telephone service. The occurrence of outside plant faults is mainly determined by the construction, installation and protective measures applied to minimise the impact of environmental conditions such as temperature changes, moisture and lightning, and mechanical damage caused by human, insect or animal activities. The occurrence of faults can be minimised if during outside plant design attention is given to these measures. The design principles should at least follow CCITT recommendations and guidance given in the various CCITT manuals on these subjects.

Main standards:

CCITT Volume IX

L.3 Armouring of cables
L.10 Optical fibre cables for duct, tunnel, aerial and buried application.

CCITT manuals:

- Construction, installation, jointing and protection of optical fibre cables
- The protection of telecommunication lines and equipment against lightning discharges.

DEP 32.37.20.10-Gen.: Instrument signal lines

DEP 32.37.20.31-Gen.: System cabling.

5.2 PROTECTION AGAINST INTERFERENCE (ELECTRO MAGNETIC COMPATIBILITY)

Summary:

Interference on outdoor and indoor wiring/cables is of growing concern, and is reported to be the main cause of digital errors in modern networks. Although interference may have a temporary cause, for instance electric welding activities, in many cases the poor and uncontrolled design of both the communication and electrical power cable networks is the major contribution to interference. Interference results not only in digital errors and background noise but could also be a threat to the safety of telecommunication engineers working on telecommunication circuits and cables. Local regulations apply and have to be followed. CCITT also gives guidance.

Main standards:

CCITT Volume IX

K.8 Separation in the soil between telecommunication cables and earthing system of power facilities

K.11 Principles of protection against overvoltages and overcurrents

K.12 Characteristics of gas discharge tubes for the protection of telecommunication installations

K.19 Joint use of trenches and tunnels for telecommunication and power cables

K.20 Resistibility of telecommunication switching equipment to overvoltages and overcurrents

K.21 Resistibility of subscribers' terminals to overvoltages and overcurrents

IEC 801 Series Electro Magnetic Compatibility (see Note)

801-1 Introduction

801-2 Electro Static Discharge (ESD)

801-3 High Frequency Fields

801-4 Transients

801-5 Surges

801-6 Conducted immunity.

NOTE Electro Magnetic Compatibility or EMC is the generic term often used within standards.

5.3 STRUCTURED CABLING SYSTEMS

Summary:

With the increasing requirement for networking of personal computers and the growth of the client/server relationship, cabling in buildings is becoming a major component of any new building or in renovations. Existing cabling is proving inadequate to meet these requirements and new systems have evolved to extend the operating speeds available. These systems are grouped under the term "Structured Cabling Systems".

Main standards:

IC Report No. IC94-029: Guidelines for structured cabling systems

DEP 32.71.00.30-Gen.: Structured cabling systems

EIA/TIA 568/569/570/606/TSB-36/TSB-40: Commercial building wiring standards

Theoretical standards:

IEEE 802.2: FDDI.

IEEE 802.3: 100Base-T

IEEE 802.12: 100VG-AnyLAN.

5.4 EQUIPMENT IN HAZARDOUS AREAS

Summary:

For the selection of type of protection and installation of electrical apparatus for use in gas hazardous areas the recommendations of publication IEC-79-14 shall apply as a minimum. Local regulations may be more stringent. Intrinsically safe equipment achieves safety by limiting the ignition energy and surface temperature that can arise in normal operation, or under certain foreseeable fault conditions, to levels that are insufficient to ignite an explosive atmosphere.

There are two standards acceptable for intrinsically safe telecommunications equipment:

1. IEC;
2. Factory Mutual/ Underwriters Laboratories (FM/UL).

Countries accepting the IEC standards include Europe, Australia, New Zealand, South Africa whilst Factory Mutual/Underwriters Laboratories standards are commonly used in the USA and Canada.

In countries where IEC standards are not applied, then FM/UL certified equipment may be considered. FM/UL standards allow higher power and are usually more economic than IEC standard handheld radios.

Main standard:

IEC 79 Electrical apparatus for explosive atmospheres

Part 14: Electrical installation in explosive gas atmospheres (other than mines).

Classification / Degree of hazard

IEC		FM/UL	
Zone 0	Explosive gas-air mixture continuously present, or present for long periods	Class 1, Division 1	Hazardous concentrations of flammable gases or vapours continuously, intermittently or periodically present under normal operating conditions
Zone 1	Explosive gas-air mixture is likely to occur in normal operations		
Zone 2	Explosive gas-air mixture not likely to occur and, if it occurs, it will exist only for a short time	Class 1, Division 2	Volatile flammable liquids or flammable gases present, but normally confined within closed containers or systems, from which they can escape only under abnormal operating or fault conditions

Classification / Ignition by spark

IEC	FM/UL
Apparatus is grouped according to the energy produced under fault conditions, in terms of the gas-air mixture that it will not ignite. Representative gases are: Group IIC hydrogen, acetylene Group IIB ethylene Group IIA propane Group I methane	Explosive atmospheres are grouped according to their ignition energy. Representative atmospheres are: Class I Group A acetylene Group B hydrogen Group C ethylene Group D propane Class II Group E metal dust Group F carbon dust Group G flour, starch, grain

Classification / Ignition by hot surface (both IEC and FM/UL)

Hazardous area apparatus is classified according to the maximum surface temperature produced under fault conditions at an ambient temperature of 40 °C (or as otherwise specified).

T1	T2	T3	T4	T5	T6
450 °C	300 °C	200 °C	135 °C	100 °C	85 °C

5.5 RADIO-INDUCED IGNITION OF FLAMMABLE ATMOSPHERES

Summary:

Radio energy will induce electrical currents in metal and carbon fibre objects. Normally the induced energy is low but there could be occasions where the amount of energy would be sufficient to cause sparks. The amount of energy induced is a function of the output power and frequency of the radio transmitter, the distance to the transmitting station and the receiving efficiency of the objects. When flammable atmospheres are present radio waves are a potential danger and preventive actions shall be taken to minimise the risk. These actions shall take account of both private fixed and mobile radio applications as well as the potential danger from public broadcast stations, marine and aeronautical navigation, etc.

Main standards:

BS 5345 Code of practice for selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres (other than mining applications or explosive processing manufacture).

BS 6656 Guide to the prevention of inadvertent ignition of flammable atmospheres by radio-frequency radiation.

BS 6657 Guide to the prevention of inadvertent initiation of electro-explosive devices by radio-frequency radiation.

5.6 ALTERNATIVES TO HALONS

Summary:

As a result of the Montreal Protocol (Revised 1992), the manufacture of Halon gases has had to cease in signatory countries from 1st January, 1994. In telecommunication systems, Halon has been widely used in total flooding systems for fire protection. Although Halon stored in sealed containers of a fire protection system cannot damage or harm the environment directly, every practicable effort should be made to phase out its use.

Main standard:

Shell Health, Safety and Environmental Committee: Recommendations for alternatives to fire fighting halons.

5.7 TELECOMMUNICATION EQUIPMENT ENCLOSURES

Summary:

The type of enclosure required to protect telecommunication equipment is a function of the actual operational environment which can be indoor, outdoor, submerged in water, etc. Where appropriate the type of enclosure shall be specified according to IEC norms.

Main standard:

IEC 529 Classification of degrees of protection provided by enclosures

Classifications: IP XXX where X represents the numbers as follows:

First number Protection against solid objects

0 No protection

1 Solid objects more than 50 mm (e.g. unintentional hand contact)

2 Solid objects more than 12 mm (e.g. finger)

3 Solid objects more than 2.5 mm (e.g. tools or wires)

4 Solid objects more than 1 mm (e.g. small tools or wires)

5 Dust-protected

6 Dust-tight

Second number Protection against water

0 No protection

1 Vertical drips of water (condensation)

2 Drops of water falling up to 15° from vertical

3 Rain water up to 60° from vertical

4 Against water projected from all directions

5 Against hosing with water from all directions

6 Against swamping with water

7 Immersion

8* Immersion for extended periods under pressure (submersible equipment)

* Under conditions specified by the manufacturer.

Third number Mechanical strength

0 No protection

1 Impact energy 0.225 joules (150 gms dropped 15 cm)

2 Impact energy 0.375 joules (250 gms dropped 15 cm)

3 Impact energy 0.500 joules (250 gms dropped 20 cm)

4 Impact energy 2.00 joules (500 gms dropped 40 cm)

5 Impact energy 6.0 joules (1.5 kg dropped 40 cm)

6 Impact energy 20.0 joules (5 kg dropped 40 cm).

5.8 AERONAUTICAL SERVICES

Summary:

The operation of helicopter and fixed wing aircraft services may require communication and navigation equipment to be installed on platforms, small airstrips, etc. Often Non Directional Beacons (NDBs) or locators are needed to give guidance during the final approach. Both the radio communication systems and navigation equipment are internationally standardised and under the control of the International Civil Aviation Organisation (ICAO). ICAO standards shall be followed for all airfields listed by NOTAM and are recommended for non-listed airfields. In general local regulations are in line with ICAO standards.

Main standard:

ICAO, International standards and recommended practices

Annex 10, part 1

Chapter 3 Specification for radio navigation aids

Chapter 4 Communication systems

Annex 10, part 2

Chapter 2 Distress frequencies

Chapter 3 Utilisation of frequencies below 30 Mhz.

5.9 MARINE SERVICES

Summary:

International standards for marine communication and navigation are given by the International Marine Organisation (IMO). IMO's main recommendation is laid down in the Safety Of Life At Sea standard (SOLAS). Equipment mandated according to this standard shall be installed on all vessels including floating storage units and oil platforms when they fall under the terms of SOLAS. Additional technical standards for radio-based terrestrial and satellite marine communication are given by CCIR and CCITT. These standards shall be followed with respect to the radio systems mandated by SOLAS.

Where automatic Telex Over Radio communication systems with ARQ are used to send messages via public coastal radio station CCIR standards shall be followed.

Main standards:

IMO standards:

- SOLAS Safety Of Life At Sea
- MODU CODE Mobile offshore drilling units

CCITT Volume IV, Fascicle IV.2

M.1100 General maintenance aspects of maritime satellite systems

CCIR Volume VIII

Rec.476 Direct-printing telegraph equipment in the maritime mobile service.

5.10 POWER SUPPLIES

Summary:

The provision of a reliable power source for telecommunications is a critical factor in meeting system availability criteria. Mains power, either generated by a public utility or privately, is the most economical and reliable source. In remote areas, alternative sources such as solar or wind power are often used.

Main standards:

DEP 33.65.50.31-Gen.: Static DC uninterruptible power supply unit (Static DC UPS unit)

DEP 33.65.50.32-Gen.: Static AC uninterruptible power supply unit (Static AC UPS unit).

6. IC PUBLICATIONS

Summary:

Whilst not classified as standards, a number of publications dealing with specific telecommunications subjects have been issued by the IC Function in Shell International. These publications are listed for information purposes and may be read in conjunction with relevant standards on the subject.

- General reports:

IC92-129 Technical Infrastructure - Metrics Guide

IC92-026 Key Issues in Communications

IC92-085 Overview of Connectivity and Networking

- Network management:

IC93-034: Recommendations for a Systems and Network Management Framework

IC92-052: The Developing Standards in Network Management

IC94-54/55/56: Product Recommendations - Systems and Network Management

- Network security:

IC92-113: Guide to Long-Distance Emergency Communications

IC92-061: PABX Security Implementation Guideline

- User access:

IC91-054: Mobile Communications

IC94-068: Remote LAN Access

- Network applications:

IC92-104: Provision and Interconnection of Electronic Mail Systems

IC92-135: The Status of Videoconferencing Within Shell

IC92-114: Satellite Communications

- Network protocols and equipment:

IC91-082: Introduction to Private Voice Services & Equipment

IC92-093: Digital Voice Compression

- Office cabling and outlets:

IC94-029: Guidelines for Structured Cabling Systems

IC94-069: Building Routed Networks

IC94-070: LAN HUBS

- Public network services:

IC92-136: The Status of Virtual Private Voice Network Services

IC93-080: The Status of Fast Packet Switching and Frame Relay Technologies

Above publications can be ordered from:

Focal Point - ICG/2, Shell International.

7. REFERENCES

In this DEP, reference is made to the following publications:

NOTES
1. Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.
2. For ease of use, the number of the section of this DEP wherein the publication is referenced is also shown after each reference.
3. For IC publications (for information purposes) see (6).

SHELL STANDARDS		Paragraph
Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.	1.2
Instrument signal lines	DEP 32.37.20.10-Gen.	5.1
System cabling	DEP 32.37.20.31-Gen.	5.1
Structured cabling systems	DEP 32.71.00.30-Gen.	5.3
Static DC uninterruptible power supply unit	DEP 33.65.50.31-Gen.	5.10
Static AC uninterruptible power supply unit	DEP 33.65.50.32-Gen.	5.10
Recommendations for alternatives to fire fighting halons, November 1994	H,S & E Publications	5.6
Guidelines for structured cabling systems	IC94-029	5.3

AMERICAN STANDARDS

Commercial building wiring standards	EIA/TIA 568/569/570/606/ TSB-36/TSB-40	5.3

Issued by:
Electronics Industries Association
2001 Pennsylvania Ave, N.W.
Washington, DC 20006
USA.

FDDI	IEEE 802.2	5.3
100Base-T	IEEE 802.3	5.3
100VG-AnyLAN	IEEE 802.12	5.3

Issued by:
Institute of Electrical and Electronics Engineers
345 East 47th Street
New York, NY 10017
USA.

BRITISH STANDARDS

Code of practice for selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres (other than mining applications or explosive processing manufacture).	BS 5345	5.5

Prevention of inadvertent ignition of flammable atmospheres by radio-frequency radiation	BS 6656: 1986	5.5
Guide to the prevention of inadvertent initiation of electro-explosive devices by radio-frequency radiation.	BS 6657	5.5

Issued by:
British Standards Institution
389 Chiswick High Road
London W4 4AL
United Kingdom.

INTERNATIONAL STANDARDS

Electrical Apparatus for Explosive Gas Atmospheres Part 14: Electrical Installations in Explosive Gas Atmospheres (other than mines)	IEC 79	5.4
Degrees of protection provided by enclosures (IP Code)	IEC 529	5.7
Electromagnetic Compatibility for Industrial-Process Measurement and Control Part 1: General Introduction Part 2: Electrostatic Discharge Requirements Part 3: Radiated Electromagnetic Field Requirements Part 4: Electrical Fast Transient/Burst Requirements Part 5: Surges Part 6: Conducted Immunity	IEC 801	5.2

Issued by:
Central Office of the IEC
3 Rue de Varembé
CH-1211 Geneva 20
Switzerland.
Copies may also be obtained through national standards organisations.

International Convention for the Safety Of Life At Sea	SOLAS MODU	5.9

Issued by:
International Maritime Organisation
4 Albert Embankment
London SE1 7SR
United Kingdom.
Copies may also be obtained from national standards organizations.

CCIR RECOMMENDATIONS AND REPORTS

CCIR recommendations:

Rec.382	Radio-frequency channel arrangements for medium and high capacity analogue radio-relay systems, operating in the 2 and 4 GHz band or for medium and high capacity digital radio-relay systems operating in the 4 GHz band	3.3.1
Rec.383	Radio-frequency channel arrangements for high capacity	3.3.1

	analogue or digital radio-relay systems operating in the lower 6 GHz band	
Rec.384	Radio-frequency channel arrangements for medium and high capacity analogue or high capacity digital radio-relay systems operating in the upper 6 GHz band	3.3.1
Rec.385	Radio-frequency channel arrangements for low capacity analogue radio-relay systems operating in the 7 GHz band	3.3.1
Rec.391	Hypothetical Reference Circuit for radio-relay systems for telephony using frequency-division multiplex with a capacity of 12 to 60 telephone channels	3.2.1
Rec.392	Hypothetical Reference Circuits for radio-relay systems for telephony using frequency-division multiplex with a capacity of more than 60 telephone channels	3.2.1
Rec.393	Allowable noise power in the Hypothetical Reference Circuit for radio-relay systems for telephony using frequency-division multiplex	3.2.1
Rec.395	Noise in the radio portion of circuits to be established over real radio-relay links for FDM telephony	3.2.1
Rec.397	Allowable noise power in the hypothetical reference circuit of trans-horizon radio-relay systems for telephony using frequency-division multiplex	3.2.1
Rec.435	Prediction of sky-wave field strength between 150 and 1600kHz	3.2.3
Rec.476	Direct-printing telegraph equipment in the maritime mobile service	5.9
Rec.528	Propagation curves for aeronautical mobile and radio navigation services using the VHF, UHF and SHF bands	3.2.2
Rec.530	Propagation data and prediction methods required for the design of terrestrial line of sight systems	3.3.1
Rec.556	Hypothetical reference digital path for radio-relay systems which may form part of an integrated services digital network with a capacity above the second hierarchical level	3.2.1
Rec.593	Noise in real circuits of multi-channel trans-horizon FM radio-relay systems of less than 2500 km	3.2.1
Rec.594	Allowable bit error ratios at the output of the hypothetical reference digital path for radio-relay systems which may form part of an integrated services digital network	3.2.1
Rec.634	Error performance objectives for real digital radio-relay links forming part of a high-grade circuit within an integrated services digital network	3.2.1
Rec.635	Radio-frequency channel arrangements based on a homogeneous pattern for digital radio-relay systems with a capacity of the order of 90 Mbit/s, 140 Mbit/s or 200 Mbit/s operating in the 4 GHz band	3.3.1
Rec.696	Error performance and availability objectives for Hypothetical Reference digital sections utilizing digital radio-relay systems forming part or all of the medium grade portion of an ISDN connection	3.2.1
Rec.697	Error performance objectives for the local-grade portion of each end of an ISDN connection utilizing digital radio-relay systems	3.2.1

CCIR reports:

Rep.238	Propagation data and prediction methods required for trans-horizon radio-relay systems	3.2.1
Supplement to Report 252-2		
	Second CCIR computer-based interim method for estimating sky-wave field strength and transmission loss at frequencies between 2 and 30 MHz	3.2.3
Rep.338	Propagation data and prediction methods required for line-of-sight radio-relay systems	3.2.1
Rep.340	CCIR Atlas of Ionospheric Characteristics	3.2.3
Rep.379-5	Characteristics of simple radio relay equipment operating in Bands 8 and 9 for the provision of telephone trunk connections in rural areas	3.1.2
Rep.380-3	Radio systems operating in Bands 8 and 9 for the provision of subscriber telephone connections in rural areas	3.1.2
Rep.564	Propagation data and prediction methods required for earth-space telecommunication systems	3.2.1
Rep.567	Methods and statistics for estimating field-strength values in the land mobile services using frequency range 30 Mhz to 1 Ghz	3.2.2
Rep.575	Methods for predicting sky-wave field strengths at frequencies between 150 kHz and 1600 kHz	3.2.3
Rep.930-2	Performance objectives for digital radio-relay systems	3.2.1
Rep.1052	Error performance and availability objectives for digital radio-relay systems used in the "medium grade" portion of an ISDN connection	3.1.2, 3.2.1
Rep.1053	Error performance and availability objectives for digital radio-relay systems used in the local-grade portion of an ISDN connection	3.1.2, 3.2.1

Issued by: *CCIR - International Radio Consultative Committee*
Place des Nations
CH-1211 Geneva 20
Switzerland.

CCITT MANUALS AND RECOMMENDATIONS

CCITT manuals:

Construction, installation, jointing and protection of optical fibre cables		5.1
The protection of telecommunication lines and equipment against lightning discharges		5.1

CCITT recommendations:

G.101	The transmission plan	2.3.1
G.171	Transmission plan aspects of privately operated networks	2.1.1
G.211	Make-up of a carrier link	2.1.2
G.215	Hypothetical reference circuit of 5000 km for analogue systems	3.1.1
G.222	Noise objectives for design of carrier-transmission systems of 2500 km	3.1.1
G.223	Assumptions for the calculation of noise on hypothetical reference circuits for telephony	3.1.1
G.232	12-channel terminal equipments	2.1.2
G.233	Recommendations concerning translating equipment	2.1.2
G.322	General characteristics recommended for systems on symmetric pair cables	2.1.2
G.371	FDM carrier systems for submarine cable	2.1.2
G.412	Terminal equipments of radio-relay systems forming part of a general telecommunication network	2.1.2
G.611	Characteristics of symmetric cable pairs for analogue transmission	2.2.1
G.612	Characteristics of symmetric cable pairs designed for the transmission of systems with bit rates of the order 6 to 34 Mbit/s	2.2.1
G.613	Characteristics of symmetric cable pairs usable wholly for the transmission of digital systems with a bit rate of up to 2 Mbit/s	2.2.1
G.621	Characteristics of 0.7/2.9 mm coaxial cable pairs	2.2.1
G.622	Characteristics of 1.2/4.4 mm coaxial cable pairs	2.2.1
G.623	Characteristics of 2.6/9.5 mm coaxial cable pairs	2.2.1
G.651	Characteristics of 50/125 micrometre multimode grade index optical fibre cable	2.2.1
G.652	Characteristics of single-mode optical fibre cable	2.2.1
G.702	Digital hierarchy bit rates	2.1.3

G.703	Physical/electrical characteristics of hierarchical digital interfaces	2.1.3
G.704	Synchronous frame structures used at primary and secondary hierarchical levels	2.1.3
G.711	3.1 kHz PCM audio, 64 kbps	2.6.2
G.721/3	Multirate ADPCM audio	2.6.2
G.722	7 kHz audio, 48 or 56 kbps	2.6.2
G.726	Multirate ADPCM audio	2.6.2
G.728	16 kbps low-delay CELP speech, 3400 Hz audio	2.6.2
G.732	Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s	2.1.3
G.733	Characteristics of primary PCM multiplex equipment operating at 1544 kbit/s	2.1.3
G.741	General considerations on second order multiplex equipments	2.1.3
G.742	Second order digital multiplex equipment operating at 8448 kbit/s and using positive justification	2.1.3
G.743	Second order digital multiplex equipment operating at 6312 kbit/s and using positive justification	2.1.3
G.744	Second order PCM multiplex equipment operating at 8448 kbit/s	2.1.3
G.745	Second order digital multiplex equipment operating at 8448 kbit/s and using positive/zero/negative justification	2.1.3
G.746	Characteristics of second order PCM multiplex equipment operating at 6312 kbit/s	2.1.3
G.747	Second order digital multiplex equipment operating at 6312 kbit/s and multiplexing three tributaries at 2048 kbit/s	2.1.3
G.751	Digital multiplex equipments operating at the third order bit rate of 34,368 kbit/s and the fourth order bit rate of 139,264 kbit/s and using positive justification	2.1.3
G.752	Characteristics of digital multiplex equipment based on a second order bit rate of 6312 kbit/s and using positive justification	2.1.3
G.753	Third order digital multiplex equipment operating at 34,368 kbit/s and using positive/zero/negative justification	2.1.3
G.754	Fourth order digital multiplex equipment operating at 139,264 kbit/s and using positive/zero/negative justification	2.1.3
G.755	Digital multiplex equipment operating at 139,264 kbit/s and multiplexing three tributaries at 44,736 kbit/s	2.1.3
G.801	Digital transmission models	3.1.2

G.811	Timing requirements at the outputs of primary reference clocks suitable for plesichronous operation of international digital links	3.1.2
G.821	Error performance of an international digital connection forming part of an integrated services digital network	3.1.2
G.822	Controlled slip rate objectives on an international digital connection	3.1.2
G.823	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy	3.1.2
G.824	The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy	3.1.2
G.921	Digital sections based on the 2048 kbit/s hierarchy	3.2.1
H.221	Frame structure for a 64 kbit/s channel in audiovisual teleservices	2.6.2
H.230	Control and indication signals (Draft)	2.6.2
H.242	Call set-up/disconnect: point-to-point	2.6.2
H.243	Call set-up/disconnect: Multipoint	2.6.2
H.261	Codec for audiovisual services at n x 384 kbits (see note in text)	2.6.2
H.320	Technical requirements for audio-visual systems (Draft)	2.6.2
I.324	ISDN network architecture	2.7.1
I.410	General aspects and principles relating to Recommendations on ISDN user-network interfaces	2.7.1
I.411	ISDN user-network interfaces - Reference configurations	2.7.1
I.412	ISDN user-network interfaces - Interfaces structures and access capabilities	2.7.1
I.420	Basic user-network interface	2.7.1
I.421	Primary rate user-network interface	2.7.1
K.8	Separation in the soil between telecommunication cables and earthing system of power facilities	5.2
K.11	Principles of protection against overvoltages and overcurrents	5.2
K.12	Characteristics of gas discharge tubes for the protection of telecommunications installations	5.2
K.19	Joint use of trenches and tunnels for telecommunications and power cables	5.2
K.20	Resistibility of telecommunication switching equipment to overvoltages and overcurrents	5.2
K.21	Resistibility of subscribers' terminals to overvoltages and overcurrents	5.2
L.3	Armouring of cables	5.1

L.10	Optical fibre cables for duct, tunnel, aerial and buried application	5.1
M.20	Maintenance philosophy for telecommunications networks	4.1.1
M.30	Principles for a telecommunication management network	4.1.1
M.60	Maintenance terminology and definitions	4.1.1
M.810	Setting up and lining up an international voice-frequency telegraph link for public telegraph circuits (for 50, 100 and 200 baud modulation rates)	4.2.1
M.1020	Characteristics of special quality international leased circuits with special bandwidth conditioning	4.2.1
M.1025	Characteristics of special quality international leased circuits with basic bandwidth conditioning	4.2.1
M.1030	Characteristics of ordinary quality international leased circuits forming part of private switched telephone networks	4.2.1
M.1040	Characteristics of ordinary quality international leased circuits	4.2.1
M.1100	General maintenance aspects of maritime satellite systems	4.2.1/5.7
M.1350	Setting up, lining up and characteristics of international data transmission systems operating in the range 2.4 kbit/s to 14.4 kbit/s	4.2.2
M.1375	Maintenance of international data transmission systems operating at 48 kbit/s and above	4.2.2
O.3	Climatic conditions and relevant tests for measuring equipment	4.2.3
O.6	1020 Hz reference test frequency	4.2.3
O.11	Maintenance access lines	4.2.3
O.41	Psophometer for use on telephone-type circuits	4.2.3
P.11	Effect of transmission impairments	2.3.1
P.30	Transmission performance of group audio terminals (GATs)	2.6.3
Q.1XX	Specifications of signalling systems Nos. 4 and 5	2.3.2
Q251 to Q300		
	Specifications of signalling No.6, Volume VI, Fascicle VI.3	2.3.2
Q.310 to Q332 (R1) and Q400 to Q490 (R2)		
	Specifications of signalling systems R1 and R2 Volume VI, Fascicle VI.4	2.3.2
Q.721 to Q766		
	Specifications of signalling No. 7 Volume VI, Fascicle VI.8	2.3.2

Q.771 to Q.795	Specifications of signalling system No. 7 Volume VI, Fascicles VI.8 and VI.9	2.3.2
S.1	International Telegraphic Alphabet No.2	2.5.1
S.11	Use of start-stop reperforating equipment for perforated tape retransmissions	2.5.1
S.12	Conditions that must be satisfied by synchronous systems operating in connection with standard 50-baud teleprinter circuits	2.5.1
S.15	Use of telex network for data transmission at 50 bauds	2.5.1
S.21	Use of display screens in telex machines	2.5.1
T.4	Standardisation of Group 3 facsimile apparatus for document transmission	2.6.1
T.6	Facsimile coding schemes and coding control functions for Group 4 facsimile apparatus	2.6.1
T.21	Standardized test charts for document facsimile transmissions	2.6.1
V.2	Power levels for data transmission over telephone lines	2.4.1
V.10	Electrical characteristics for unbalanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications	2.4.1
V.11	Electrical characteristics of balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications	2.4.1
V.21	200 bits per second duplex modem standardized for use in the general switched telephone network	2.4.1
V.22 bis	2400 bits per second duplex modem using the frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits	2.4.1
V.23	600/1200-baud modem standardized for use in the general switched telephone network	2.4.1
V.24	List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)	2.4.1
V.26 bis	2400/1200 bits per second modem standardized for use in the general switched telephone network	2.4.1
V.27 bis	4800/2400 bits per second modem with automatic equalizer standardized for use on leased telephone-type circuits	2.4.1
V.28	Electrical characteristics for unbalanced double-current interchange circuits	2.4.1
V.29	9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits	2.4.1
V.32	A family of 2-wire, duplex modems operating at data signalling	2.4.1

	rates of up to 9600 bit/s for use on the general switched telephone network and on leased telephone-type circuits	
V.32 bis	A duplex modem operating at data signalling rates of up to 14,400 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits	2.4.1
V.33	14,400 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits	2.4.1
V.34 bis	A modem operating at data signalling rates of up to 28,800 bit/s for use on the general switched telephone network and on leased point-to point 2 wire telephone type circuits	2.4.1
V.35	Data transmission at 48 kilobits per second using 60-108 kHz group band circuits	2.4.1
V.42	Error-correcting procedures for DCES using a synchronous-to-synchronous conversion	2.4.1
X.3	Packet assembly disassembly facility (PAD) in a public data network	2.4.2
X.21	Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on public data networks	2.4.2
X.21 bis	Use on public data networks of data terminal equipment (DTE) which is designed for interfacing to synchronous V-series modems	2.4.2
X.25	Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit	2.4.2
X.28	DTE/DCE interface for a start-stop mode data terminal equipment accessing the packet assembly/disassembly facility (PAD) in a public data network situated in the same country	2.4.2
X.29	Procedures for the exchange of control information and user data between a packet assembly/disassembly (PAD) facility and a packet mode DTE or another PAD	2.4.2
X.30	Support of X.21, X.21 bis and X.20 bis based data terminal equipments (DTEs) by an integrated services digital network (ISDN)	2.4.2
X.400	Message handling system and service overview	2.5.2
X.402	Message handling systems: Overall architecture	2.5.2
X.500	The Directory - Overview of Concepts, Models and Services	2.5.2
X.501	The Directory models	2.5.2

Issued by: *International Telecommunication Union*
General Secretariat - Sales Section
Place des Nations
CH-1211 Geneva 20
Switzerland.

MISCELLANEOUS STANDARDS

ADPNSS	Analogue version of DPNSS	2.3.2
DASS II	British public standard for digital signalling	2.3.2
DPNSS	Digital Private Network Signalling System	2.3.2

Contact point for information on ADPNSS, DAS II and DPNSS:

British Telecom UK
NSET/6.2.4
Room 479
Williams National House
11-13 Holborn Viaduct
London EC1A 2AT
United Kingdom.

ICAO STANDARDS

International Standards and Recommended Practices

Aeronautical Telecommunications

Annex 10 to the Convention of International Civil Aviation		5.8
Volume 1	Part 1 Equipment and Systems Part 2 Radio Frequencies	
Volume 2	Communication Procedures	

Issued by *International Civil Aviation Organisation*
Attention: Distribution Officer
PO BOX 400, Place de l'Aviation internationale
100 Sherbrooke Street West
Montreal
Quebec, 3A 2R2
Canada.

WARC STANDARDS

Radio Regulations	3.3.1

Issued by: *International Telecommunication Union*
General Secretariat - Sales Section
Place des Nations
CH-1211 Geneva 20
Switzerland.