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August 27, 1992

MEMORANDUM

TO: Distribution

FROM: Ken Kovarik

SUBJECT: **USER - NETWORK INTERFACE SPECIFICATION, RELEASE 3.0**

Enclosed please find a copy of Northern Telecom's "S/DMS SuperNode Dialable Wideband Service USER-NETWORK INTERFACE SPECIFICATION", Release 3.0, July 1992. There are no major changes within this specification, however, this latest issue does reflect clarification of the specification.

If you have any questions or wish to discuss the document I can be reached at (919) 992-5449.

Regards,

Ken Kovarik/KK

Ken Kovarik
Product Manager
Dialable Wideband Services

KK/kdk

:attachment

northern telecom

S/DMS SuperNode
Dialable Wideband Service
USER-NETWORK INTERFACE SPECIFICATION

NIS A216-1, Release 3.0, July 1992

Notice

This document contains the User-Network Interface Specification for Customer Premises Equipment connecting to Northern Telecom's Dialable Wideband Service, based on the S/DMS SuperNode digital switching system. Dialable Wideband Service is a new on-demand real-time multi-rate circuit-mode service which enables Local Exchange and Inter-Exchange Carriers to satisfy end user needs for flexible wideband connectivity through the public network.

This Specification is based on the Multi-rate Circuit-mode Bearer Service currently being defined by the American National Standards Institute (ANSI) and by the International Telegraph and Telephone Consultative Committee (CCITT).

Northern Telecom makes no representations with respect to and does not warrant any information in this Specification, but furnishes such in good faith and to the best of its knowledge and ability. Without restricting the generality of the foregoing, Northern Telecom makes no representations or warranties as to fitness for a particular purpose, or as to whether or not the use of the information in the Specification may infringe any patent or other rights of any other individual or company. The recipient waives any claims it may have against Northern Telecom in respect of any use which the recipient makes of the information or products derived therefrom.

It is expected this Specification will be revised to reflect domestic and international standards as they evolve, and S/DMS SuperNode service and feature enhancements. Northern Telecom reserves the right to alter or modify the Specification or the equipment to which it relates at any time without notice and without liability.

Northern Telecom intends to continue making submissions to standards bodies and adopt domestic and international standards. The contributions currently being discussed at ANSI T1 committees and CCITT study groups will be monitored and incorporated into future programs whenever deemed appropriate by Northern Telecom.

Notice Addendum:
US SPRINT ISDN n x 64 kbit/s Service

Dialable Wideband Service (**DWS**) is Northern Telecom's new multi-rate, circuit-mode service on the S/DMS SuperNode. DWS will initially be offered on the DMS-100 platform. This document is a specification of the User-Network Interface required for Customer Premises Equipment to interwork with DWS. DWS is based upon the following specifications:

- Multi-Rate Circuit-Mode Bearer Service for ISDN - Addendum to the Circuit Mode Bearer Service Category Description (ANSI T1.620a - 1992)
- Signaling System #7 - ISDN User Part, Draft (ANSI T1S1.3/91-11403)
- Northern Telecom DMS-100 ISDN Primary Rate User-Network Interface Specification (NIS A211-1).
- Northern Telecom DMS-250 ISDN Primary Rate User-Network Interface Specification (NIS A211-4).

In addition to DWS, Northern Telecom has a precursor Wideband Service on the DMS-250 platform, referred to as ISDN n x 64 kbit/s service, for US Sprint. This service has similar functionality to DWS and is scheduled for delivery in BCS34. The US Sprint ISDN n x 64 kbit/s service is based upon the current ISDN standards as defined in the following specifications:

- American National Standard for Telecommunications - Digital Subscriber Signalling System No. 1 - Layer 3 Signalling Specifications for Circuit Switched Bearer Service (ANSI T1.607, 1990).
- AT&T Technical Reference Publications 41449 - ISDN Primary Rate Interface Specification.
- Northern Telecom DMS-250 ISDN Primary Rate User-Network Interface Specification (NIS A211-4).

More information on the US Sprint ISDN n x 64 kbit/s Service as well as its User-Network Interface Specification may be obtained by contacting:

Bernie Schneider
Sprint Data Groups
8320 Ward Parkway
Mail Stop: MOKCMX012
Kansas City, Missouri
U.S.A. 64114

Revision History

Date: July 1992 **Release 3.0**

• First release of NIS A216-1, Release 1.0	August 1991
• Second release of NIS A216-1, Release 2.0	January 1992
• Third release of NIS A216-1, Release 3.0	July 1992

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1.0 INTRODUCTION

Dialable Wideband Service (**DWS**) is a new multi-rate, circuit-mode service on the S/DMS SuperNode which enables Local Exchange Carriers (LECs) and Inter-Exchange Carriers (IECs) to satisfy end user needs for flexible wideband connectivity in the public network. DWS offers a dialable[1], on-demand, real-time switched service over the ISDN Primary Rate Interface (PRI). With DWS, end users can establish network connections at rates of n x 64 kbit/s where n = 2 to 24.

The base Primary Rate User-Network Interface specification in this document is based on Reference [1], the Northern Telecom DMS-100 ISDN Primary Rate Interface User-Network Interface Specification (NIS A211-1) Version 3, and on Reference [2], the Northern Telecom DMS-250 ISDN Primary Rate Interface User-Network Interface Specification (NIS A211-4). All necessary extensions and implementation differences with Reference [1] required for DWS, which are currently under definition in standards, will be explicitly identified throughout this document. The Reference [2] sections corresponding to the Reference [1] sections identified throughout this document are listed in Appendix A and any differences between these sections are described.

1.1 Purpose of document

This document is a specification of the User-Network Interface required for Customer Premises Equipment (CPE) to interwork with Northern Telecom's Dialable Wideband Service.

1.2 Structure of document

This User-Network Interface (UNI) Specification is structured as follows:

- Section 1: Introduction. This section describes the purpose of the document and provides an overview of DWS which includes DWS applications and subscription parameters. A list of technical and administrative contacts for questions about the contents of this specification is given.

- Section 2: Layer 1 Specification. This section describes the physical interface requirements for DWS. An introduction to the requirements of this layer, based on Section B of Reference [1], and the restrictions necessary for the support of DWS are provided.

- Section 3: Layer 2 Specification. This section describes the data link protocol requirements for DWS. The definition is based entirely on Section C of Reference [1].

[1]The term 'dialable' refers to the end user specifying the directory number of the destination user to the network via Q.931 signaling and is used here for convenience.

- Section 4: Layer 3 Specification. This section describes the call control signaling protocol requirements for DWS. An introduction to the requirements of this layer, based on Section D of Reference [1], and the extensions necessary for the support of DWS are provided.

- Section 5: Supplementary Services. This section provides the specifications governing the supplementary services offered by DWS, such as Calling Number Delivery.

- Section 6: Glossary of Terms.

- Section 7: References.

- Appendix A: NIS A211-4 References. The sections of Reference [2], the Northern Telecom DMS-250 ISDN Primary Rate Interface User-Network Interface Specification (NIS A211-4), corresponding to the Reference [1] sections identified throughout this document are listed in appendix A. Any differences between these sections are described.

1.3 Dialable Wideband Service Overview

1.3.1 Definition of Dialable Wideband Service

Dialable Wideband Service (DWS) is a new multi-rate (n x 64 kbit/s) circuit-mode bearer service currently being defined in ANSI T1S1, CCITT, and Bellcore TA-NWT-1203. The initial release of DWS offers on-demand, user-selectable bandwidth from 128 kbit/s (i.e. 2 DS0s) to 1536 kbit/s (i.e. 24 DS0s) in increments of 64 kbit/s over ISDN PRI. Multiple DWS calls can be handled over a given Primary Rate Interface DS1 facility.

DWS provides the end-user with the convenience of dialing a directory number to establish a digital wideband connection across the public network to a subscriber of any service with compatible bandwidth and signaling. This network connection is transparent to user information - voice, data, video or image - and is set up in real time by the call processing capability at the originating, terminating and tandem switching nodes.

DWS is particularly attractive for applications which require large continuous bandwidth for a short period of time - from seconds to hours. The S/DMS SuperNode implementation of DWS, however, allows the end user to establish connections which can be maintained for days or months.

Inter-office signaling for DWS requires the enhanced messaging capability offered by Common Channel Signaling # 7 (CCS7). The modifications to CCS7 ISDN User Part protocols to support DWS are currently under development in the standards forums.

The DWS network consists of DWS-capable switching nodes connected by DWS trunk groups using CCS7 inter-office signaling. CCS7 capability is required for each node in the DWS network. The switched network architecture for DWS is essentially the same as for narrowband services.

Customer Premises Equipment (CPE) access to DWS consists of an ISDN Primary Rate Interface (PRI). The general access configuration for DWS is shown in Figure 1.

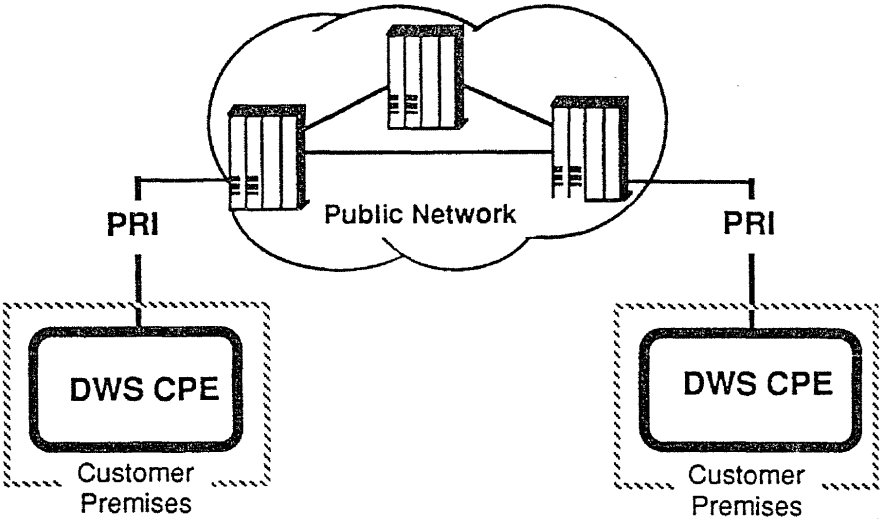

Figure 1
DWS Access Configuration

The key capabilities offered by DWS to the end user are the following:

- On-demand dial-up connectivity
- Flexible access to fractional DS1 and DS1 bandwidths
- Information transparency
- Billing based on usage, distance, and bandwidth

1.3.2 DWS Applications

The key initial applications fueling demand for DWS are business video-conferencing, high-speed file transfer, and data center recovery. DWS satisfies these demands by providing the level of control and convenience of recent switched 56 kbit/s services, with higher bandwidth for improved response time and/or quality. Other DWS data applications include LAN interconnection, disaster recovery, and time of day alternate routing.

Applications meeting the following criteria are most appropriate for DWS:

- Constant delay - Video and voice information cannot tolerate differential delay in transmission across the network for all DS0s in a given DS1.
- Guaranteed bandwidth required - Certain data applications will fail if the full bandwidth is not available for the duration of the call.

- Open community of interest - The public network provides access to an open community of interest where the origination user is not limited to a fixed set of users. For instance, FAX machines require an open community of interest.
- Point to point communication - DWS is primarily used for one to one applications, although video conference bridges are able to provide some extension to this.

Higher picture quality services for video-conferencing have traditionally been offered with reservation based fractional DS1 services. With DWS, the user can set up a video conference on-demand by simply dialing the directory number of the destination party. Therefore, the user will have the flexibility to demand any bandwidth from the network at call set up time, up to the maximum capacity of either the access loop or the service capacity. The configuration for this application is illustrated in Figure 2.

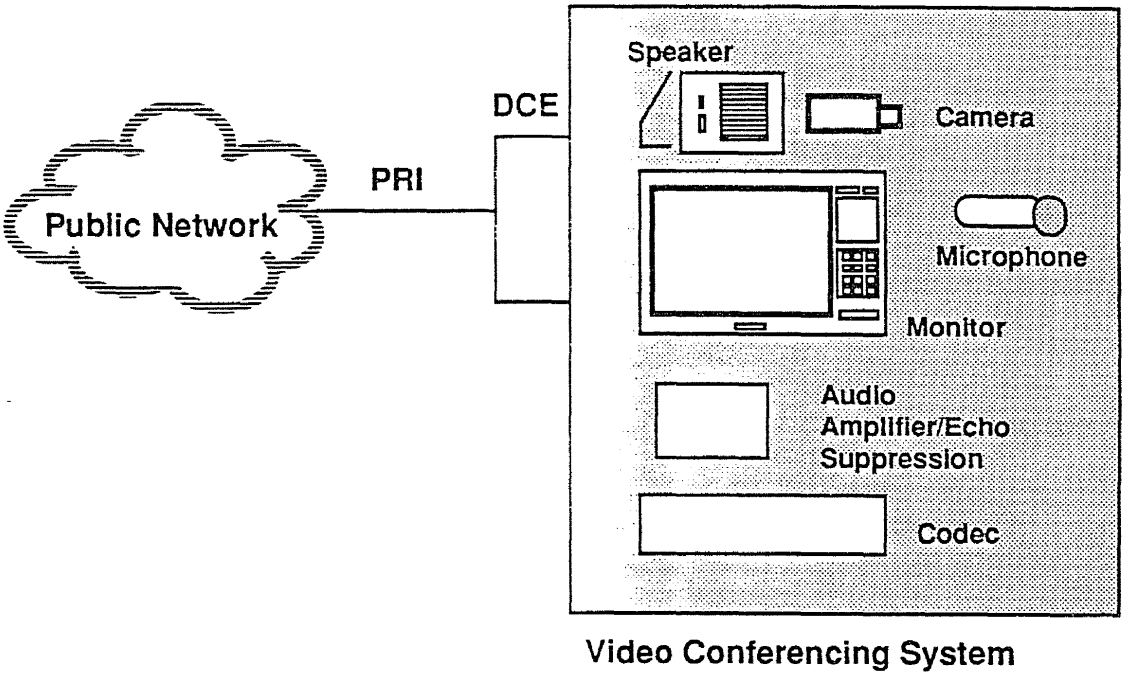

Figure 2
Video Conferencing Configuration

The image file transfer application involves the high speed transfer of large image files between two locations. DWS offers on-demand dial-up wideband connectivity which enables rapid transmission of a wide range of information. The availability of DWS at 1536 kbit/s will permit the transmission of a 2 Megabyte image file in about 10 seconds as opposed to more than 3 minutes via switched 56 kbit/s service.

Data center recovery involves being able to re-establish the high speed communication links to the data center if they are disrupted and to connect the communication links to an alternate data processing facility if the data center itself goes down. DWS can provide this required connectivity more cost effectively than dedicated facilities.

1.3.3 Terminal Equipment Configurations

The configuration of Terminal Equipment (TE) at the customer premises required to support DWS is application dependent. Several Terminal Equipment configurations are discussed briefly in this section.

Terminal Equipment should allow automated dialing. In the short term, Terminal Equipment support of DWS applications may involve:

- using RS-366 or V.25 bis for dialing, as shown in Figure 3, (extensions enabling bandwidth specification are being developed by several CPE vendors in conjunction with the Switched Digital Services Applications Forum), or
- dialing may be via a personal computer or workstation connected to the Data Communications Equipment (DCE).

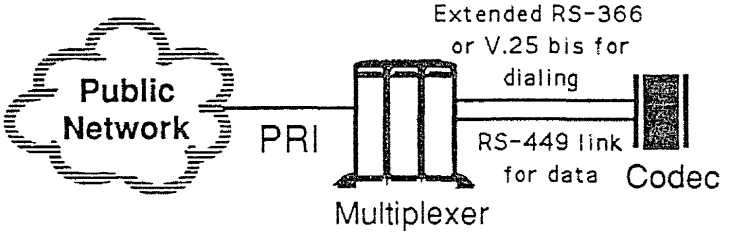

Figure 3
Short Term TE Configuration

In the long term, an optimal interface could involve extending the PRI connectivity to the Terminal Equipment. The Terminal Equipment would compose the PRI D-channel messages and provide them to the DCE. Therefore, the PRI signaling may be performed at the DCE as illustrated in Figure 4 or directly at the Terminal Equipment as shown in Figure 5.

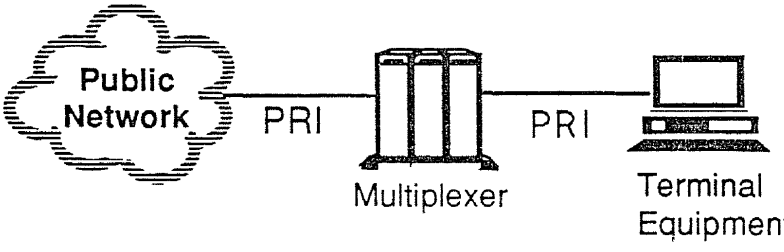

Figure 4
Long Term TE Configuration - Option 1

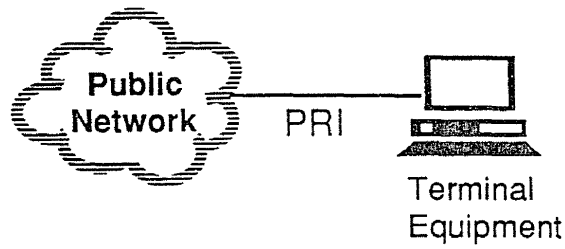

Figure 5
Long Term TE Configuration - Option 2

1.4 Dialable Wideband Service UNI Protocol Architecture

Customer Premises Equipment (CPE) connected to the DWS User-Network Interface could support one or more of the DWS applications described in Section 1.3.2. of this document as presented in Figure 6.

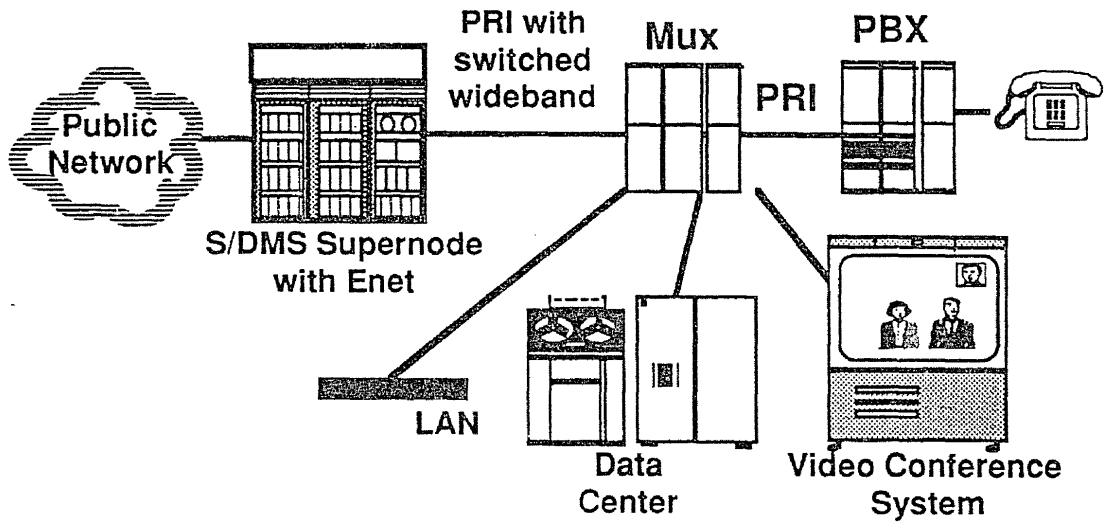

Figure 6
DWS CPE Configuration

The CPE connected to the DWS User-Network Interface must conform to the protocol architecture shown in Figure 7.

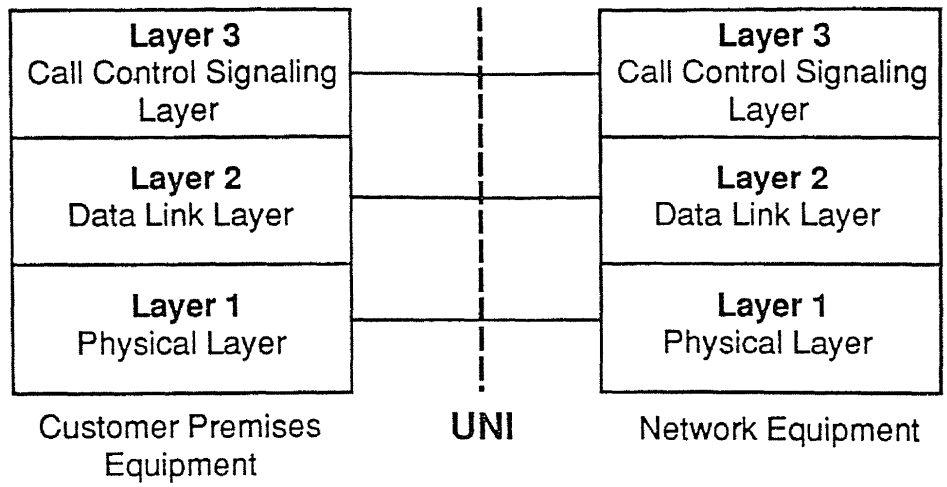

Figure 7
DWS UNI Protocol Architecture

The three Open Systems Interconnection (OSI) Layers of the architecture shown in Figure 7 are the following:

- Layer 1, specified in Section 2 of this document, describes the electrical, functional, and mechanical characteristics of the Primary Rate Interface required for DWS. The implementation of DWS requires restrictions to the Layer 1 characteristics described in Section B of Reference [1].

- Layer 2, specified in Section 3 of this document, describes the data flow initialization, control, termination, and error recovery characteristics of the Primary Rate Interface required for DWS. This specification is based entirely on Section C of Reference [1].

- Layer 3, specified in Section 4 of this document, describes the Primary Rate Interface call control signaling protocol required for DWS. The PRI call control signaling, CCITT Recommendation Q.931, is currently being modified in ANSI and CCITT standards to support multi-rate circuit mode connections. The implementation of DWS requires extensions to the PRI call control signaling protocol in Section D of Reference [1].

1.5 DWS Subscription Parameters

The DWS subscriber will be offered the following parameters which must be pre-arranged with the service provider when the service is requested:

1. Number of Primary Rate Interfaces per user-network access arrangement controlled by a single D-channel.

2. Number of information channels per Primary Rate Interface.

3. Identification of the Primary Rate Interface(s) having a D-channel.

4. Identification of the channel used as a backup D-channel.

5. Default transit network identification.

6. Choice of whether the user's search for the required number of free time slots in the Primary Rate Interface, for the requested DWS call, will be in ascending or descending sequential order. If more than one PRI exists on the user-network access arrangement, the sequential order selected will also be used to search for one PRI on the user-network access arrangement with the required number of free time slots, for the requested DWS call. The search order is determined by the first occurrence of a PRI being datafilled on the PRI access arrangement. Therefore, this search will be either top-down or bottom-up which corresponds to the descending and ascending sequential orders, respectively. The opposite scheme must be used by the network to minimize the number of call collisions.

7. Choice of the Dialable Wideband Service option, shown in Figure 8. The time slot allocation scheme, information transfer rate coding scheme, and slot map corresponding to DWS options 1, 2 and 3 are described in Sections 4.3.1, 4.3.2 and 4.3.3 of this document, respectively.

DWS OPTION 1	• n x 64 kbit/s rates, with n= 2 to 24 • flexible time slot allocation scheme • will accept the floating and fixed time slot allocation schemes • base rate and multiplier information transfer rate coding scheme • the B-channel slot map is required for n= 2 to 23 • for n= 24, the B-channel slot map is NOT allowed
DWS OPTION 2	• n x 64 kbit/s rates, with n= 2 to 24 • floating time slot allocation scheme • will accept the fixed time slot allocation scheme • base rate and multiplier information transfer rate coding scheme • the B-channel slot map is required for n= 2 to 23 • for n= 24, the B-channel slot map is NOT allowed
DWS OPTION 3	• H_0 (384 kbit/s) and H_{11} (1536 kbit/s) rates only • fixed time slot allocation scheme • 384 kbit/s and 1536 kbit/s codepoints are used to code the information transfer rate • the B-channel slot map is required for H_0 • for H_{11}, the B-channel slot map is NOT allowed

Figure 8
DWS Options

1.6 Interworking with Other Circuit Mode Services

Interworking between DWS and other switched wideband circuit-mode services at compatible rates is a Northern Telecom goal. The DWS network will take care of any necessary signaling protocol translations and will ensure that the origination and destination CPE interact, as specified, with their respective subscriber services.

1.7 Technical and Administrative Contacts

The contact for the technical content of this specification is:

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  Research Triangle Park, N.C., U.S.A.
  27709
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  Fax: (919) 992-8190

2.0 LAYER 1 SPECIFICATION

2.1 Scope

This section is a general description of the physical Primary Rate Interface required for CPE to interwork with DWS and is based on the following sections of Section B of Reference [1]:

Section 5.0: Electrical Specifications
Section 6.0: Framing Formats
Section 7.0: Clear Channel Capability
Section 8.0: Maintenance
Section 9.0: Connector Arrangements

The restrictions to Section B of Reference [1] required for DWS are outlined in Section 2.2 of this document.

In general, Section B of Reference [1] defines the characteristics of the metallic interface between a carrier and the customer premises at the DS-1 level which includes electrical specifications, framing formats, and a physical definitions of the connectors. Both normal operating signals and maintenance signals are described. Signals that appear as a result of the environment (e.g., induced voltages and currents, lightning hits etc.) are not covered.

2.2 DWS Layer 1 Restrictions

Although the base Layer 1 PRI specification given in Section B of Reference [1] is supported, DWS requires the unrestricted 64 kbit/s information transfer capability offered only by the Bipolar 8 Zero Substitution (B8ZS) scheme. The Extended Super Frame (ESF) format is also required for DWS. Therefore, it is important to note that the Zero Code Suppression (ZCS) scheme and the Standard Framing (SF) format are not supported for DWS.

Therefore, all references to the ZCS scheme and the SF format in the following sections of Reference [1] are not appropriate for DWS:

Section 1.1: Technical Conformance
Section 4.2: Services Offered by the Physical Layer
Section 6.1: General
Section 6.2: Frame
Section 8.1: Remote Alarm Indication

Also, A/B bit signalling is not supported on DWS calls. On the other hand, bit robbed signaling (e.g. A/B bits) will be supported on a per DS-0 basis, allowing ISDN PRI DS-0 channels (i.e. B and D-channels) to be inter-mixed on the same DS-1 facility as conventional trunks.

3.0 LAYER 2 SPECIFICATION

3.1 Scope

This section is a general description of the Link Access Procedures on the D-channel (LAPD) of the ISDN Primary Rate Interface required for CPE to interwork with DWS and is based entirely on the following sections of Section C of Reference [1]:

Section 2.0: Frame Structure for Peer-to-Peer Communication
Section 3.0: Elements of Procedures and Format Fields for Data Link Layer Peer-to-Peer Communication
Section 4.0: Elements of Layer-to-Layer Communications
Section 5.0: Definition of the Peer-to-Peer Procedures for Data Link Layer

In general, Section C of Reference [1] defines the Layer 2 protocol and specifies the frame structure, elements of procedure, format of fields and procedures for the proper operation of the Link Access Procedures on the D-channel of the PRI. These definitions are aligned with ANSI T1.602 and CCITT Recommendation Q.921.

3.2 Overview Description of LAPD Functions and Procedures

LAPD is the Layer 2 protocol for PRI. The purpose of LAPD is to convey information between Layer 3 entities across the ISDN PRI using the D-channel. The protocol defines the procedures required to establish, maintain and disconnect the link. LAPD is independent of the transmission bit rate and requires a duplex, bit transparent D-channel. All data link layer messages are transmitted in frames which are delimited by flags. A flag is a unique bit pattern.

Data link layer functions provide the means for information transfer between multiple combinations of data link connection endpoints. For PRI, the information transfer is via point-to-point data link connections in which a frame is directed to a single endpoint.

Therefore, LAPD includes functions for:

- The provision of one or more data link connections on a D-channel. Discrimination between the data link connections is by means of a Data Link Connection Identifier (DLCI) contained in each frame.
- Frame delimiting, alignment and transparency, allowing recognition of a sequence of bits transmitted over a D-channel as a frame.
- Sequence control, to maintain the sequential order of frames across a data link connection.
- Detection of transmission, format and operational errors on a data link connection.
- Recovery from detected transmission, format, and operational errors.
- Notification to the management entity of unrecoverable errors.
- Flow control.

4.0 LAYER 3 SPECIFICATION

4.1 Scope

This section describes the Primary Rate Interface call control signaling protocol required for CPE to interwork with DWS and is based on the following sections of Section D of Reference [1]:

Section 2.0	Overview of Call Control
Section 3.0	Message Functional Definition and Content
Section 4.0	General Message Format and Information Elements Coding
Section 5.0	Circuit Switched Call Control Procedures
Section 6.0	Maintenance Procedures
Section 7.0	Connectionless Signaling Procedures
Section 8.0	List of System Parameters
Section 9.0	Annexes

Extensions to the general format and procedures of the Layer 3 call control protocol found in CCITT Q.931 [9] and ANSI T1.607 [5] recommendations are required for DWS. These extensions, currently being defined in ANSI and CCITT standards bodies, will be explicitly identified in this section. More specifically, the following sections of Section D of Reference [1] require extensions for the support of DWS:

Section 4.5.5	Bearer Capability
Section 4.5.11	Channel Identification
Section 5.1	Call Establishment at the Originating Interface
Section 5.1.1	Call Request
Section 5.1.2	B-Channel Selection - Originating
Section 5.1.4	Call Proceeding
Section 5.2.1	Incoming Call
Section 5.2.3	B-Channel Selection - Destination
Section 5.3	Call Clearing
Section 5.4	In-Band Tones and Announcements
Section 5.8	Call Collisions
Annex G	Cause Definitions

4.2 DWS Call Control Procedures

This section gives an overview of call control procedures required for a DWS call which includes a description of the sequence of messages associated with the control of wideband circuit switched connections. It is important to note that only the extensions to Reference [1] required for DWS are discussed in this section.

4.2.1 DWS Call Establishment at the Originating Interface

Reference [1] Section 5.1

A DWS call is originated by a user dialing to set up a wideband connection across the network to another bandwidth and signaling compatible user.

Before call establishment procedures at the origination interface are invoked, a reliable data link connection must be established between the user and the network. Layer 2 data link services are described in Section 3 of this document.

4.2.1.1 DWS Call Request

Reference [1] Section 5.1.1

The origination user initiates DWS call establishment by transferring a SETUP message across the UNI. The bearer capability, channel identification and called party number information elements are mandatory in the SETUP message.

The information transfer rate requested for the DWS call is coded in the bearer capability information element as described in Sections 4.3.1.2, 4.3.2.2, and 4.3.3.2 of this document. This rate will remain unchanged for the duration of the call. The maximum value of the information transfer rate of a Primary Rate Interface is given in Figure 9. When the D-channel is located on a Primary Rate Interface, the maximum information transfer rate available on that PRI is 1472 kbit/s. If the D-channel is located on another PRI than the one being used to send information, then the maximum information transfer rate available on the PRI being used is 1536 kbit/s.

Interface Type	Maximum Information Transfer Rate
PRI of 1544 kbit/s with D-channel	1472 kbit/s
PRI of 1544 kbit/s without D-channel	1536 kbit/s

Figure 9
Maximum Information Transfer Rate

4.2.1.2 B Channel Selection - Originating

Reference [1] Section 5.1.2

The origination user requesting a DWS call must specify which aggregate of B-channels is to be used for the call. Therefore, the SETUP message from the user must contain the channels selected and no alternative channels are acceptable. Channel negotiation is not allowed.

4.2.1.3 DWS Call Proceeding

Reference [1] Section 5.1.4

The failure scenarios described in Section 5.1.4 of Reference [1] can be divided into the following situations:

1. If the origination user is attempting to establish a call with a destination user who is identified by the network as busy, then the network will initiate call clearing by returning cause value #34 "no channel/circuit available" or cause value #17 "user busy" to the origination user.

2. If the origination user is attempting to establish a call with a destination user who cannot meet the information transfer rate requirements of the origination user or who is not subscribed to DWS, then the network will initiate call clearing by returning cause value #57 "bearer capability not authorized" to the origination user.

3. If the network does not support the information transfer rate or the bearer capability requested by the origination user, then the network will initiate call clearing by returning cause value #65 "bearer capability not implemented" to the origination user.

4.2.2 DWS Call Establishment at the Destination Interface

4.2.2.1 Incoming DWS Call

Reference [1] Section 5.2.1

At the destination User-Network Interface, the network will indicate the arrival of a DWS call by transferring a SETUP message across the interface. This message is sent only if the service is authorized and if the information transfer rate requested by the origination user can be satisfied by the destination user. More specifically, the required number of B-channels needed satisfy the information transfer rate must be available at the destination UNI. If the DWS call cannot be offered to the destination user, the origination user will receive an appropriate call failure indication as described in Section 4.2.1.3 of this document.

4.2.2.2 B Channel Selection - Destination

Reference [1] Section 5.2.3

In the SETUP message, the network will indicate the B-channels to be used for the DWS call with no acceptable alternatives. If the indicated B-channels are acceptable, then the destination user selects these channels for the DWS call. Channel Negotiation is not allowed.

4.2.3 Tones and Announcements

Reference [1] Sections 5.3 and 5.4

No tones and announcements are provided for DWS.

4.2.4 Call Collisions

Reference [1] Section 5.8

A channel selection conflict occurs when the channels selected for an incoming and an outgoing call do not constitute two disjoint sets of time slots. In the case of such conflicts, the network shall give priority to the incoming call and the outgoing call will be cleared with cause value #44 "requested circuit/channel not available".

Since DWS calls may involve several time slots simultaneously, channel selection conflicts can occur. The following channel selection method should be used in order to reduce the occurrence of channel selection conflicts:

As described in Section 1.5, the user will specify, at subscription time, whether the required number of free time slots in the Primary Rate Interface, for the requested DWS call, will be in ascending or descending sequential order. If more than one PRI exists on the user-network access arrangement, the sequential order selected will also be used to search for one PRI on the user-network access arrangement with the required number of free time slots, for the requested DWS call. The search order is determined by the first occurrence of a PRI being datafilled on the PRI access arrangement. Therefore, this search will be either top-down or bottom-up which corresponds to the descending and ascending sequential orders, respectively. The opposite scheme must be used by the network to minimize the number of call collisions.

4.2.5 Error Procedures and Cause Values

Reference [1], Annex G

No new error procedures and cause values are required for DWS.

4.3 Information Element Enhancements

As introduced in Section 1.5 of this document, the user may subscribe to one or more DWS options. DWS options 1, 2 and 3 are described in Sections 4.3.1, 4.3.2, and 4.3.3 of this document, respectively. This description includes the definition of each DWS option and a description of the corresponding bearer capability and channel identification information elements.

4.3.1 DWS Option 1

4.3.1.1 Definition of DWS Option 1

As introduced in Figure 8 of Section 1.5, DWS option 1 has the following characteristics:

- the full n x 64 kbit/s rates, where n = 2 to 24, are available.

- the flexible time slot allocation scheme is used to obtain the aggregate of B-channels required for a DWS call. In this scheme, the time slots can occupy contiguous or non-contiguous positions within a single DS1 frame. Contiguous implies that if the first time slot is i, then time slots i+1, i+2,... will also be allocated. Therefore, the time slots can occupy any position within a single DS1 frame.

- the information transfer rate requested for a DWS call is indicated in the bearer capability information element using the base rate and rate multiplier information transfer rate coding scheme. The corresponding B-channel slot map is indicated in the channel identification information element. Note that the B-channel slot map is not allowed for n=24.

The bearer attributes for DWS option 1 are given in Figure 10.

Information transfer mode	Circuit
Information transfer rate	n x 64 kbit/s up to the maximum information transfer rate of the PRI (Figure 9)
Information transfer capability	Unrestricted digital information
Structure	8 kHz with Time Slot Sequence Integrity (Figure 11)
Establishment of communication	Demand (circuit-switched)
Communication configuration	Point-to-point
Symmetry	Bi-directional symmetric
Base Rate	Multi-rate 64 kbit/s (Figure 12)
Rate Multiplier	2 to 24 (Figure 13)

Figure 10
DWS Option 1 Bearer Attributes

The structure attribute of DWS option 1 is provisionally called "8 kHz with Time Slot Sequence Integrity". This property insures that the sequence of the time slots within a single DS1 frame is maintained from the origination UNI and to the destination UNI. This attribute is illustrated in Figure 11.

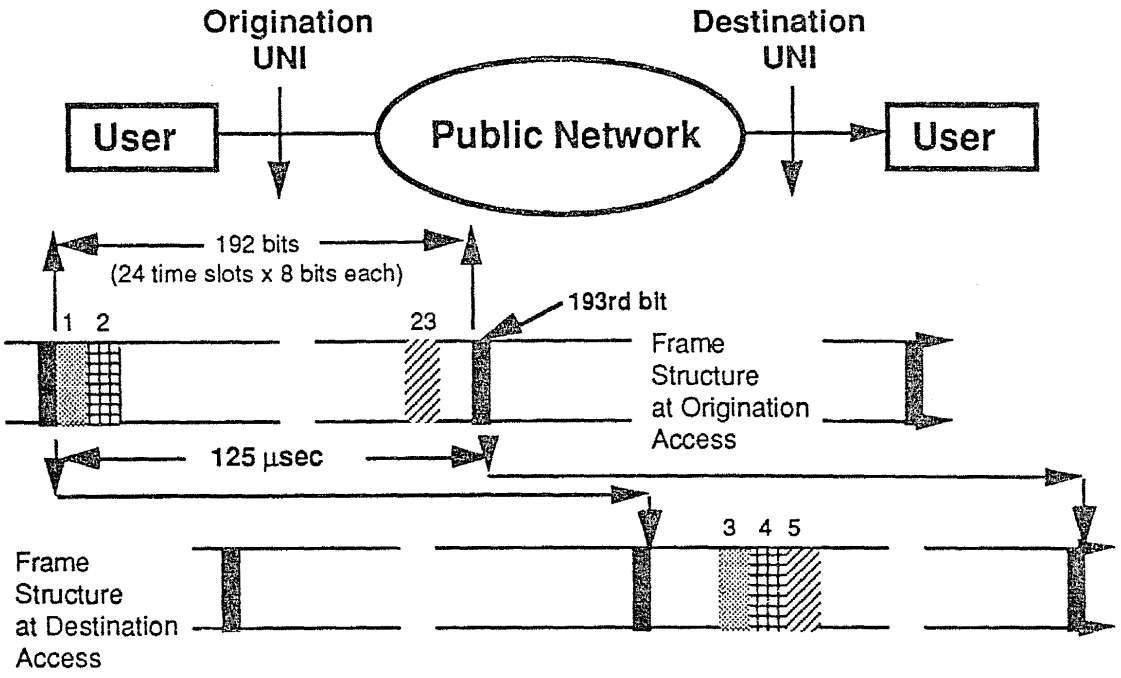

Figure 11
8 kHz with Time Slot Sequence Integrity

4.3.1.2 DWS Option 1 Bearer Capability Information Element

Reference [1] Section 4.5.5

The DWS option 1 bearer capability information element is shown in Figure 12.

Octet	8	7	6	5	4	3	2	1
1	Bearer Capability Information Element Identifier							
2	Length of Information Element							
3	1 ext	Coding Standard 0 0 (note 1)		Information Transfer Capabability 0 1 0 0 0 (unrestricted digital information)				
4	1 ext	Transfer Mode 0 0 (circuit)		Information Transfer Rate 1 1 0 0 0 (note 2)				
4.1 (note 3)	1 ext	Rate Multiplier						

Figure 12
Bearer Capability Information Element for DWS Option 1

Note 1 - CCITT standard as in Recommendation Q.931.
Note 2 - The 64 kbit/s base rate codepoint of the multi-rate circuit-mode bearer service is used.
Note 3 - Octet 4.1 is a new octet required if octet 4, bits 5 to 1, indicate the multi-rate circuit mode bearer service. It will not be present otherwise.

The information transfer rate of the DWS call is obtained by multiplying the base rate indicated in the information transfer rate field (octet 4, bits 5 to 1) by the rate multiplier (octet 4.1, bits 7 to 1). The base rate is equal to 64 kbit/s and is indicated by the 1 1 0 0 0 multi-rate codepoint. Note that octet 4a of the bearer capability information element is not coded when DWS Option 1 is requested. The rate multiplier codepoints corresponding to the information transfer rate of the DWS call are shown in Figure 13.

Information Transfer Rate	Rate Multiplier	Octet 4.1 Bits 7 6 5 4 3 2 1
128 kbit/s	2	0 0 0 0 0 1 0 (2)
192 kbit/s	3	0 0 0 0 0 1 1 (3)
256 kbit/s	4	0 0 0 0 1 0 0 (4)
.	.	.
.	.	.
1536 kbit/s	24	0 0 1 1 0 0 0 (24)

Figure 13
Allocation of Codepoints to the Rate Multiplier Field

4.3.1.3 DWS Option 1 Channel Identification Information Element

Reference [1] Section 4.5.11

For DWS option 1, the channel identification information element used to specify the aggregate of B-channels required for a DWS call is shown in Figure 14.

The values of each field of the channel identification information element for n= 2 to 23 differ from the corresponding field values for n= 24. Consequently, the values for n= 2 to 23 and for n= 24 are listed separately in the following section.

Octet	8	7	6	5	4	3	2	1
1	Channel Identification Information Element Identifier							
2	Length of Information Element							
3	1 ext	Int Id Present	Int Type	0 Spare	Pref/ Excl	D-ch ind	Channel Selection	
3.1	0/1	Interface Identifier						
3.2	1 ext	Coding Standard 0 0		Numb/ Map 1	Channel/Map Element Type 0 0 1 1			
3.3.1	24	23	22	21	20	19	18	17
3.3.2	16	15	14	13	12	11	10	9
3.3.3	8	7	6	5	4	3	2	1

Figure 14
Channel Identification Information Element for DWS Option 1

For DWS option 1 **with n= 2 to 23**, the fields of the channel identification information element must be coded as follows:

1. *Interface Identifier Present (octet 3, bit 7):*

   a. 0 Interface implicitly identified. The interface which includes the D-channel carrying this information is indicated. In this case, octet 3.1 is omitted.
   b. 1 Interface explicitly identified in octet 3.1. This is used in the case when more than one DS1 is controlled by a single D-channel and the interface identified does not include the D-channel.

2. *Interface Type (octet 3, bit 6):*

   a. 1 Primary Rate Interface.

3. *Preferred/Exclusive (octet 3, bit 4):*

   a. 1 Exclusive. Only the indicated time slots are acceptable. Channel negotiation is not allowed.

4. *D-channel Indicator (octet 3, bit 3):*

   a. 0 The channel identified is not the D-channel.

5. *Channel Selection Information (octet 3, bits 2-1):*

    a. 0 1 Channel indicated in the following octets.

6. *Interface Identifier (octet 3.1):*

    This octet indicates the binary code assigned to the interface at service subscription time. If bit 8 of octet 3.1 is a 1, then the Interface Identifier field is longer than 1 octet.

    Note that if the Interface Identifier Present field (octet 3, bit 7) indicates that the interface is implicitly identified, then octet 3.1 is omitted.

7. *Coding Standard (octet 3.2, bits 7-6):*

    a. 0 0 CCITT standardized coding.

8. *Number/Map (octet 3.2, bit 5):*

    a. 1 Channel is indicated only by the (B-channel) slot map in the octets to follow.

9. *Channel Type/Map Element Type (octet 3.2, bits 4-1):*

    a. 0 0 1 1 B channel units.

10. *Slot Map (octets 3.3.1, 3.3.2 & 3.3.3):*

    This is the B channel slot map of the 1536 kbit/s Primary Rate Interface. The numbers 1 to 24 identify the corresponding time slots (B channels) of the DS1 used for a DWS call.

For DWS option 1 **with n= 24**, the fields of the channel identification information element shown in Figure 14 must be coded as follows:

Note that the B-channel slot map is NOT allowed for a DWS call with n= 24. This is because all the time slots of the interface, which is explicitly identified in octet 3.1, are used for the call. Therefore, use of the slot map is redundant. In this case, both octet 3.2 and octet 3.3 should not be encoded.

1. *Interface Identifier Present (octet 3, bit 7):*

    a. 1 Interface explicitly identified in octet 3.1. This is the only value possible because the interface identified in octet 3.1 does not include the D-channel. The interface identified includes the 24 B-channels of the DWS call.

2. *Interface Type (octet 3, bit 6):*

    a. 1 Primary Rate Interface.

3. *Preferred/Exclusive (octet 3, bit 4):*

    a. 1 Exclusive. Only the indicated time slots are acceptable. Channel negotiation is not allowed.

4. *D-channel Indicator (octet 3, bit 3):*

    a. 0 The channel identified is not the D-channel.

5. *Channel Selection Information (octet 3, bits 2-1):*

    a. 0 0 No channel indicated. This is because the B-channel slot map is not required for a DWS call with n=24.

6. *Interface Identifier (octet 3.1):*

    This octet indicates the binary code assigned to the interface at service subscription time. If bit 8 of octet 3.1 is a 1, then the Interface Identifier field is longer than 1 octet.

4.3.2 DWS Option 2

4.3.2.1 Definition of DWS Option 2

As introduced in Figure 8 of Section 1.5, DWS option 2 has the following characteristics:

- the full n x 64 kbit/s rates, where n = 2 to 24, are available.

- the floating time slot allocation scheme is used to obtain the aggregate of B-channels required for a DWS call. In this scheme, the time slots occupy contiguous positions within a single DS1 frame which implies that if the first time slot is i, then time slots i+1, i+2,... will also be allocated. The first time slot can be at any point within a single DS1 frame but the contiguous sequence of time slots cannot cross a DS1 frame boundary.

- the information transfer rate requested for a DWS call is indicated in the bearer capability information element using the base rate and rate multiplier information transfer rate coding scheme. The corresponding B-channel slot map is indicated in the channel identification information element. Note that the B-channel slot map is not allowed for n= 24.

The bearer attributes for DWS option 2 are identical to those of DWS option 1 given in Figure 10 of Section 4.3.1.1. Therefore, DWS option 2 also requires the 8 kHz with Time Slot Sequence Integrity structure described in Figure 11.

4.3.2.2 DWS Option 2 Bearer Capability Information Element

The bearer capability information element corresponding to DWS option 2 is identical to the DWS option 1 bearer capability information element described in Section 4.3.1.2.

4.3.2.3 DWS Option 2 Channel Identification Information Element

The channel identification information element corresponding DWS option 2 with n= 2 to 23 is identical to the channel identification information element for DWS option 1 with n= 2 to 23 described in Section 4.3.1.3. As well, the channel identification information element corresponding DWS option 2 with n= 24 is identical to the channel identification information element for DWS option 1 with n= 24 described in Section 4.3.1.3. The only difference is that the time slots for a DWS call with n= 2 to 23 must be contiguously assigned in the B-channel slot map (octets 3.3.1, 3.3.2, and 3.3.3).

4.3.3 DWS Option 3

4.3.3.1 Definition of DWS Option 3

As introduced in Figure 8 of Section 1.5, DWS option 3 has the following characteristics:

- only H_0 (384 kbit/s) and H_{11} (1536 kbit/s) rates are available.
- the fixed time slot allocation scheme is used to obtain the aggregate of B-channels required for a DWS call. In this scheme, the time slots are contiguous and the first time slot is constrained to specific starting points. Contiguous implies that if the first time slot is i, then time slots i+1, i+2,... will also be allocated. For a DWS call with n= 6, the user must use either time slots 1 to 6, 7 to 12, 13 to 18, or 19 to 24. For a DWS call with n= 24, time slots 1 to 24 must be used in sequence.
- the information transfer rate requested for a DWS call is indicated in the bearer capability information element using the corresponding codepoints listed in Figure 16. The B-channel slot map is used only for the H_0 rate (384 kbit/s) and is not required for the H_{11} rate (1536 kbit/s).

The bearer attributes for DWS option 3 are given in Figure 15.

Information transfer mode	Circuit
Information transfer rate	H_0 (384 kbit/s) and H_{11} (1536 kbit/s) rates only
Information transfer capability	Unrestricted digital information
Structure	8 kHz with Time Slot Sequence Integrity (Figure 11)
Establishment of communication	Demand (circuit-switched)
Communication configuration	Point-to-point
Symmetry	Bi-directional symmetric

Figure 15
DWS Option 3 Bearer Attributes

Therefore, DWS option 3 also requires the 8 kHz with Time Slot Sequence Integrity structure described in Figure 11.

4.3.3.2 DWS Option 3 Bearer Capability Information Element

For DWS option 3, only the information transfer rate encoding of the bearer capability information element will be different from the DWS option 1 bearer capability information element described in Figure 12. The information transfer rate requested for an option 3 DWS call will be specified in octet 4, bits 5 to 1 using the corresponding codepoints given in Figure 16. Octet 4.1 will be omitted in this case.

Information Transfer Rate	Octet 4 Bits 5 4 3 2 1
384 kbit/s	1 0 0 1 1
1536 kbit/s	1 0 1 0 1

Figure 16
Information Transfer Rate

4.3.3.3 DWS Option 3 Channel Identification Information Element

The channel identification information element corresponding to an H_0 DWS option 3 call is identical to the DWS option 1 channel identification information element for n= 6 described in Section 4.3.1.3. Also, the channel identification information element corresponding to an H_{11} DWS option 3 call is identical to the DWS option 1 channel identification information element for n= 24 described in Section 4.3.1.3.

5.0 SUPPLEMENTARY SERVICES

5.1 Scope

The supplementary services supported for DWS in the initial release are the following:

1. Calling Number Delivery
2. Backup D-Channel
3. 24 B-Channel Access

A brief description of these services will be provided in this section. The first two service descriptions are directly based on Section E of Reference [1].

5.2 Calling Number Delivery

Reference [1] Section E

The Calling Number Delivery (CND) service provides the directory number of the calling, or origination, party for calls terminating on a Primary Rate Interface. It is available as an option on a per ISDN PRI basis.

When the CND option is active, the calling party number will be contained in the calling party number information element and is delivered in the SETUP message, unless the calling party number is restricted or is not available.

The procedures for CND service cover the requirements both when the PRI user sends a call setup request to the network and when the network sends a call setup request to the PRI user. Intra-network procedures for the sending and restriction of calling party numbers is briefly discussed in Section E of Reference [1].

5.3 Back-up D-Channel

Reference [1] Section E

Backup D-Channel service is available as an option on a per ISDN PRI basis. This service provides a procedure for employing a standby D-channel which is used if the primary D-channel fails. All active calls are maintained during the switch-over to the standby D-channel.

Backup D-Channel service increases the reliability of signaling for non-facility associated signaling. When a single D-channel is used to provide call control signaling for more than one DS-1 interface, the reliability may be unacceptable. Further information on this service is provided in Section E of Reference [1].

5.4 24 B-Channel Access

The 24 B-Channel Access service enables one D-channel to provide call control signaling for more than one Primary Rate Interface on the user access arrangement. Therefore, a PRI can contain 24 B-channels and correspond to a D-channel on another PRI in the same user access arrangement. The maximum information transfer rate of this PRI will then be 1536 kbit/s as opposed to 1472 kbit/s if the D-channel was present on this PRI.

6.0 GLOSSARY OF TERMS

ANSI	American National Standards Institute
B8ZS	Bipolar 8 Zero Substitution
Carrier	Telephone company - LEC, IEC, Bell Canada
CCITT	International Telegraph and Telephone Consultative Committee
CCS7	Common Channel Signalling #7
CND	Calling Number Delivery
CPE	Customer Premises Equipment
DCE	Data Communications Equipment
DWS	Dialable Wideband Service
ESF	Extended Super Frame
IEC	Inter-Exchange Carrier
ISDN	Integrated Services Digital Network
kbit/s	Kilo bits per second
LAN	Local Area Network
LAPD	Link Access Procedures on the D-channel
LEC	Local-Exchange carrier
OSI	Open Systems Interconnection
PBX	Private Branch Exchange
PRI	Primary Rate Interface
S/DMS	SONET Digital Multiplex System
SF	Super Frame
SONET	Synchronous Optical Digital Network
TE	Terminal Equipment
UNI	User-Network Interface
ZCS	Zero Code Suppression

7.0 REFERENCES

[1] Northern Telecom NIS A211-1,Version 3, DMS-100/ ISDN Primary Rate User-Network Interface Specification, December 1990.

[2] Northern Telecom NIS A211-4, DMS-250/ ISDN Primary Rate User-Network Interface Specification, March 1991.

[3] ANSI T1S1.1/91 - 500R1, "Proposed Draft American National Standards for Telecommunications - Multi-Rate Circuit-Mode Bearer Service for ISDN - Addendum to the Circuit Mode Bearer Service Category", August 1991.

[4] Bellcore TA-NWT-1203, Issue 1, Generic requirements for the Switched DS1/Switched Fractional DS1 Service Capability from an ISDN Interface (SWF-DS1/ISDN), April 1991.

[5] ANSI T1.607, "Layer 3 Signalling Specification for Circuit Switched Bearer Service"- draft , September 26 1989.

[6] ANSI T1.408, "ISDN Primary Rate Interface - Customer Installation Metallic Interface - Layer 1 Specification"- draft , 1989.

[7] ANSI T1.602, "ISDN Signaling Specification for Application at the User-Network Interface - Layer 2 Specification".

[8] CCITT Recommendation Q.921 (I.441), "ISDN User-Network Interface Data Link Layer Specification".

[9] CCITT Recommendation Q.931 (I.451), "ISDN User-Network Interface Layer 3 Specification".

[10] CCITT Recommendation I.412, "ISDN User-Network Interfaces Interface Structures and Access Capabilities".

[11] ANSI T1.113, "Signaling System #7 - ISDN User Part", Draft Issue 2.

8.0 APPENDIX A: NIS A211-4 REFERENCES

All extensions to Reference [1], the Northern Telecom DMS-100 ISDN Primary Rate Interface User-Network Interface Specification (NIS A211-1), required for DWS are explicitly identified throughout this document. The sections of Reference [2], the Northern Telecom DMS-250 ISDN Primary Rate Interface User-Network Interface Specification (NIS A211-4), corresponding to the sections of Reference [1] identified throughout this document, are listed in the following appendix. Only minor differences exist between these corresponding sections.

It is important to note that Reference [2] only specifies the Layer 3 PRI call control signaling procedures supported by the DMS-250. The DMS-250 uses the common DMS-family Layer 1 and Layer 2 procedures defined in Reference [1]. Therefore, Reference [2] corresponds to Section D of Reference [1].

Table 1 lists the sections of Reference [2] corresponding the sections of Reference [1] which are referenced in Section 4 of this document. Table 2 briefly describes the minor differences existing between several of the corresponding Reference [1] and Reference [2] sections.

Sections of the DWS UNI	Sections of Section D of Reference [1]	Sections of Reference [2]
4.2.1	5.1	5.1
4.2.1.1	5.1.1	5.1.1
4.2.1.2	5.1.2	5.1.1
4.2.1.3	5.1.4	5.1.2
4.2.2.1	5.2.1	5.2.1
4.2.2.2	5.2.3	5.2.2
4.2.3	5.3 and 5.4	5.3
4.2.4	5.8	5.8
4.2.5	Annex G	Appendix G
4.3.1.2	4.5.5	4.5.4
4.3.1.3	4.5.11	4.5.12

Table 1
Corresponding Sections

Sections of DWS UNI	Concept	Reference [1] Approach	Reference [2] approach
Section 4.2.5	Cause values	Annex G Cause value #9 is not specified	Appendix G Cause values # 3, 6, 19, 27, 41, and 57 are not specified
Section 4.3.1.3	Corresponding octets	Section 4.5.11 Octet 3.1 -> Octet 3.2 -> Octet 3.3 ->	Section 4.5.12 Octet 4 Octet 5 Octet 6

Table 2
Differences between Sections