ATIS-1000622.1999(R2013)

Message Waiting Indicator Control and Notification Supplementary Services and Associated Switching and Signaling Specifications

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Revision and consolidation
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American National Standard
for Telecommunications –

Message Waiting Indicator Control and Notification Supplementary Services and Associated Switching and Signaling Specifications

Secretariat

Alliance for Telecommunications Industry Solutions

Approved December 15, 1999

American National Standards Institute, Inc.

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Contents

Foreword (This foreword is not part of American National Standard T1.622-1999.)

This standard is a revision of T1.622-1992 and is one of a series of standards on Integrated Services Digital Network (ISDN) supplementary services. The standard being updated defines and describes Message Waiting Indicator Control and Notification service capabilities in the context of the ISDN. This standard provides the switching and signaling specifications to allow a Message Storage and Retrieval (MSR) System to inform its client users about the status of messages recorded at the MSR System. The Message Waiting Indicator Control capability provides a method for the MSR System to request the ISDN to update a logical entity, called a Message Waiting Indicator (MWI), which is maintained by the ISDN and which is associated with the Directory Number of the client user. The state of this MWI indicates whether or not messages are waiting for the client user in the MSR System. The Message Waiting Notification capability provides methods for the ISDN to indicate the status of the MWI to the client user. The form of this indication is dependent on the client user's subscriptions. This standard includes the Digital Subscriber Signaling System No. 1 (DSS1) and the Signaling System No. 7 Transactions Capabilities Application Part protocol and procedures to support these capabilities.

This revised standard also includes T1.622a-1998, the supplement to T1.622-1992, which revised the standard to improve and expand its applicability, in particular, when interfacing to an NT2.

Service providers of Message Storage and Retrieval services will find this standard to be useful in providing a consistent suite of protocols and procedures to support the service capabilities described in this standard. Manufacturers of user and network equipment that use the Integrated Services Digital Network (ISDN) and Signaling System No. 7 can apply this standard to the design and development of their products.

Suggestions for improvement of this standard are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Washington, DC 20005.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Telecommunications, T1. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, Accredited Standards Committee T1 had the following members:

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American National Standard
for Telecommunications –

Message Waiting Indicator Control and Notification Supplementary Services and Associated Switching and Signaling Specifications

1 Scope, purpose, and application

1.1 Scope and purpose

This standard specifies the service capabilities of Message Waiting Indicator Control and Notification (MWICN) services within the context of an Integrated Services Digital Network (ISDN). Message Waiting Indicator Control and Notification service allows a Message Storage and Retrieval (MSR) System to inform its client users about the status of messages recorded at the MSR System. The associated switching and signaling specifications are also provided. This service may be made available by subscription arrangements. The interaction of this service with other ANSI defined service capabilities are included. The purpose of this standard is to allow maximum compatibility among network and user owned telecommunications equipment in order to increase the attractiveness and usefulness of ISDN based capabilities.

1.2 Application

This standard applies to ISDN Basic Accesses and Primary Rate Interfaces and is intended to supplement the Basic Circuit Mode call procedures described in T1.607 and T1.113. It shall be used in conjunction with the other ANSI standards for ISDN supplementary services for a complete understanding of the interactions between this and other services. This supplementary service is not dependent on any particular bearer capability.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

T1.113-1995, *Telecommunications - Signalling System Number 7 (SS7) - Integrated Services Digital Network (ISDN) User Part* [1)]

T1.114-1996, *Telecommunications - Signalling System Number 7 (SS7) - Transaction Capabilities Application Part (TCAP)*[1)]

T1.607-1998, *Telecommunications - Integrated Services Digital Network (ISDN) - Layer 3 Signaling Specification for Circuit Switched Bearer Service for Digital Subscriber System No. 1 (DSS1)*[1)]

[1)] For electronic copies of some standards, visit ANSI's Electronic Standards Store (ESS) at www.ansi.org. For printed versions of all these standards, contact Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112-5704, (800) 854-7179.

T1.610-1998, *Telecommunications - Generic Procedures for the Control of ISDN Supplementary Services*[1)]

T1.610a-1998, *Telecommunications - Generic Procedures for the Control of ISDN Supplementary Services - Modification to the Redirecting Number Information Element* [1)]

T1.611-1991 (R1997), *Telecommunications - Signalling System Number 7 (SS7) - Supplementary Services for non-ISDN Subscribers*[1)]

T1.620-1991 (R1997), *Telecommunications - Integrated Services Digital Network (ISDN) - Circuit-Mode Bearer Service Category Description*[1)]

ITU-T Recommendation X.208, *Specification of Abstract Syntax Notation One (ASN.1)* [1)]

ITU-T Recommendation X.209, *Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)* [1)]

ITU-T Recommendation X.219, *Information processing systems - Text Communication - Remote Operations Part 1: Model, Notation and Service Definition* [1)]

ITU-T Recommendation X.680, *Information Technology - Abstract Syntax Notation One (ASN.1): Specification of Basic Notation* [1)]

ITU-T Recommendation X.690, *Information Technology - ASN.1: Encoding Rules: Specification of Basic Encoding Rules (BER); Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)* [1)]

3 Definitions

3.1 client user: The user for whom messages are stored at an MSR System. The client user may be served by an ISDN access. Client users not served by an ISDN access are beyond the scope of this standard, but specifications for them may be found in T1.611.

3.2 Message Storage and Retrieval (MSR) System: The system that provides message entry, storage, and retrieval capabilities to client users and calling users. The MSR System shall be allowed to be served by an ISDN access interface as described in this standard (or by existing nonstandard interfaces).

3.3 Message Waiting Indicator (MWI): A logical entity assigned to the client user's Directory Number (DN), which allows the client user to be informed that messages are waiting at an MSR System for that DN.

3.4 MSR System Identification (MSR Identifier): A parameter used to uniquely identify an MSR System (or a service provided by an MSR System).

3.5 network: In this description, *Network* refers to all telecommunications equipment that has any part in processing a call or a supplementary service for the referred to user. It may include Local Exchanges, Transit Exchanges, and NT2s but does not include the ISDN terminal and is not limited to the "Public network" or any other particular set of equipment.

3.6 service provider: This is a company, organization, business, etc., that sells, administers, maintains, charges for, etc., the service. The service provider may or may not be the provider of the network.

3.7 Stutter Dial Tone: A distinct form of dial tone provided to the MWI client user upon call origination. It consists of a tone of the same frequency and level as normal dial tone (typically 350 + 440 Hz), but it is applied first in bursts of 0.1 seconds on, 0.1 seconds off for at least 2.5 seconds, followed by steady on.

4 Description of the Message Waiting Indicator Control and Notification services from the user's perspective

MWI Control and Notification allows an MSR System to inform its client users about the status of messages recorded at the MSR System. When messages are waiting for a client user at the MSR System, the MSR System requests the network to provide a message waiting indication for the Directory Number associated with the client user. When all messages are retrieved by the client user or otherwise removed by the MSR System, the MSR System requests the network to remove message waiting indication for the Directory Number associated with the client user.

4.1 Description

MWI Control is a service provided by the network to an MSR System provider. The MSR System may request the network to provide an indication to one of its client users that messages are waiting at the MSR System. It may also request that the network remove this indication when all messages are retrieved by the client user or otherwise removed by the MSR System. The client user is identified by a Directory Number in these requests. The MSR System may include a bearer capability in the request. This information would enable the client user to distinguish between notification for different types of messaging (e.g., voice mail or e-mail). The MSR System may also include additional optional information about the waiting messages, e.g., the number of messages waiting. If the network supports such optional information, the network may pass it to the client user. If the network does not support such optional information, the network may discard it and continue processing the MWI request, or reject the request, at the network provider's option.

MWN is a service provided by the network to client users of an MSR System. When MWN service is assigned to a client user's Directory Number, the client user can receive notification that messages are waiting at an MSR System, or that all messages have been retrieved or otherwise removed by the MSR System. This notification can take several forms which include Stutter Dial Tone, Feature Indication, or Detailed Notification, as specified at subscription time. MWN shall be defined so as to allow the network to provide to the client user information about waiting messages, e.g., number of waiting messages, or message priorities (as determined by the MSR System), if such information is provided by the MSR System. MWN shall be defined so as to allow the network to provide this additional information to the client user, if such information is provided by the MSR System. MWN shall be defined so as to provide information that would enable the client user to distinguish between notification for different types of messaging (e.g., voice mail or e-mail), if such information is provided by the MSR System.

Table 1 – Subscription options for client user (per ISDN number)

Subscription options	Values
Number of MWIs subscribed to	1 to N (Note 1)
For each subscribed MWI: MSR Identifier (Note 2)	10 digit number (Note 3)
Stutter Dial Tone form of notification Feature Indication form of notification Detailed Notification form of notification	Yes/No Yes/No Yes/No
Set of allowed "bearer services" (Note 4)	List of services from T1.620

NOTES

1 The maximum allowed value of N is a service provider option.

2 When only one MWI is subscribed to, the MSR identifier is optional. When more than one MWI is subscribed to, all but one MWI must have an associated MSR identifier assigned.

3 This number is provided by the client user after negotiation with the MSR service provider.

4 The inclusion of this subscription option is a network option. If this subscription option is not provided, all bearer services are allowed.

An ISDN client user with MWN service can have one or more MWIs per Directory Number. If an ISDN client user has a single MWI, that MWI may be associated with a particular MSR System provider using an MSR Identifier, as a service provider option. If an MWI is assigned an MSR Identifier, then only the MSR System associated by the network with that MSR Identifier may control the MWI. If an MSR Identifier is not assigned to an MWI, then that MWI may be controlled by the network at the request of any MSR System provider. (This is to allow for casual use of messaging service providers.) If an ISDN client user has more than one MWI, each MWI may be associated with a different MSR System provider (or a particular service offered by such a provider) using different MSR Identifiers.

4.2. Procedures

4.2.1 Provision/withdrawal

4.2.1.1. Client user

MWN shall be provided to the client user after prearrangement with the service provider. MSR provider(s) are selected at subscription time. A customer may add MSR provider(s) or modify MSR provider(s).

MWN is offered with the following subscription options for ISDN client users. ISDN users are allowed to subscribe to the assignment of multiple (logical) Message Waiting Indicators (MWIs). The number of allowed MWIs is a subscription option. If a single MWI is assigned, the MWI may be associated with a Messaging service provider (or to a particular service offered by a Messaging service provider) using an MSR Identifier. If more than one MWI is assigned, then each MWI may be associated with a different Messaging provider (or to a particular service offered by a Messaging service provider) using an MSR Identifier. If an ISDN client user has more than one MWI, all but one of the MWIs must have an MSR Identifier assigned. For each MWI assigned to a client user, at least one form of notification shall be able to be selected. The subscription options for assigning MWIs to the client user are shown in table 1.

4.2.1.2 MSR system

The MSR system may subscribe to MWI Control.

The MSR system shall be uniquely associated with one or more MSR identifiers by the network.

4.2.2 Normal procedures

4.2.2.1 Activation/deactivation

The number of MWIs and the association of an MSR Identifier with each for an ISDN client user is chosen at subscription time.

The form(s) of notification for each MWI is also chosen at subscription time. Procedures to allow the client user's MWI subscription options to be activated, deactivated, or changed from the client user's access interface are not provided in this standard.

4.2.2.2 Invocation and operation

The interactions between the calling users or client users and the MSR System are beyond the scope of this standard.

4.2.2.2.1 Client user's view

Initially there are no messages for the client user. When the first message for the ISDN client user arrives at the MSR System, the status of the MWI is updated and the ISDN client user is notified of the message's arrival.

The ISDN client user is notified of the status of the MWI by the use of any one or a combination of a special Stutter Dial Tone on call originations, or by the means of a feature indication (to control a lamp, for example), or by means of a Detailed Notification, based on subscription options. The number of the party who left the message (i.e., the calling number if it is known or other information provided by the MSR System) may be included in this and subsequent notifications (if the MSR System sends a message waiting indication for the arrival of subsequent messages). If the client user has an access interface that is capable of receiving a calling number or other information provided by the MSR System (i.e., is subscribed to Detailed Notification), then the number of the individual that left the message shall be delivered (if it is available). If a bearer capability is indicated in the MWI control request received from an MSR System, the network shall provide this information to the client user, if the client user's subscriptions are configured to support receiving this information (i.e., Detailed Notification = "Yes").

The client user retrieves messages by making a call to the MSR System and interacting with the system (this interaction is beyond the scope of this standard). When a user has retrieved all messages, or if all messages are otherwise removed by the MSR System, the message waiting indication is removed at the request of the MSR System. If the ISDN client user is subscribed to receive the Stutter Dial Tone form of notification, the use of normal dial tone may be used on call originations. For ISDN client users with the Feature Indication form of notification, the MWI feature indication status is updated. (See figure 1 for SDLs.)

If more than one MWI is associated with the same means of Message Waiting Notification (MWN), the network shall coordinate the representation of the Message Waiting Notification so that if any one of those MWIs is in an active state, the form of notification shall indicate an active state. For example, if both MWI #1 and MWI #2 are assigned the "Stutter Dial Tone" form of notification, then the client user shall receive the special form of dial tone if either one or both of MWI #1 or MWI #2 is in an active state.

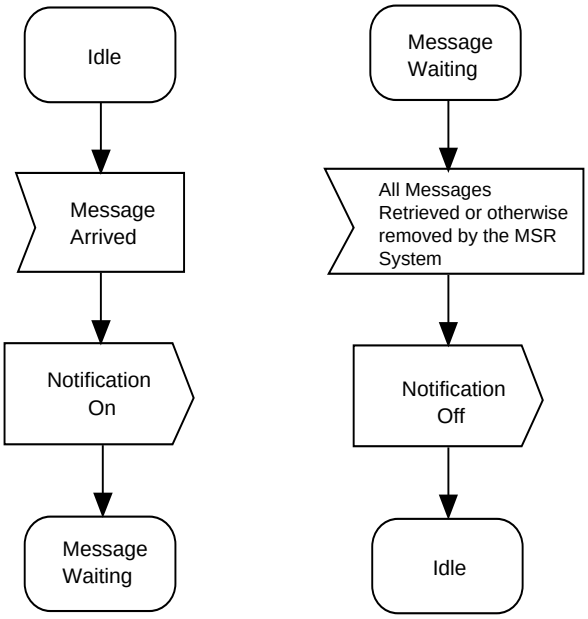


Figure 1 - MWI activation and deactivation information flows

4.2.2.2.2 MSR System view

An MSR System may request the network to inform a client user that messages are waiting for the client user at the MSR System. The network shall be able to accept a request from the MSR System to include an indication of the priority of the waiting messages. The network shall be able to accept from the MSR System a request to update the status of a client user's MWI which includes an indication of an appropriate bearer capability. Having received a request from the MSR System to update the status of an MWI, and having successfully updated the status of the appropriate MWI, the network shall send an indication of successful completion to the MSR System. If the network is unable to act upon the request, the network shall send to the MSR System an indication of failure, and the reason for that failure.

An indication of success means that the MWI has been updated, not necessarily that notification has already been provided to the client user. However, after returning an indication of success, the network shall attempt to deliver Message Waiting Notification to the client user at the first opportunity. For example, if the client user has subscribed to the Stutter Dial Tone form of notification, the client user will receive Stutter Dial Tone upon the next call origination.

4.2.2.2.3 MSR security

The network may take precautions to ensure that a client user's Message Waiting Indicator status is not modified by unauthorized systems. This is accomplished by using an MSR Identifier to identify the MSR System that is making the request.

4.2.2.2.4 Data loss

In the event that the network loses the status of a client user's MWI, the indicator shall be reset to active (i.e., message waiting).

4.2.3 Exceptional procedures

4.2.3.1 Activation/deactivation

None identified.

4.2.3.2 Invocation and operation

None identified.

4.2.4 Alternative procedures

None identified.

4.3 Network capability for charging

It shall be possible for the service provider to charge accurately for this service.

4.4 Interworking considerations

If SS7 connectivity does not exist between the switch serving the MSR System and the switch serving the client user, it will not be possible to support the service, except on an intra-switch basis.

4.5 Interactions with other supplementary services

None identified.

5 Functional capabilities and information flows needed for Message Waiting Indicator Control and Notification

One way of dividing the overall functionality of MWI Control and Notification services into functional units, each of which could be placed in one location. The overall functionality results from communication between the functional units (called entities) using information flows, which are also identified in this clause. An information flow is an abstraction which is subsequently realized in clauses 6 through 8 by means of additions to existing signaling system messages or by new messages. Finally, one or more specific ways are identified in which the functional entities of MWI Control and Notification services can be located in specific user or network equipment.

5.1 Functional entity model for Message Waiting Indicator Control and Notification

One way of partitioning the MWI Control and Notification services into functional entities and actions that occur in each functional entity. Each functional entity is an abstract representation that could be implemented in more than one kind of telecommunication equipment (e.g., in terminal equipment, in a local switching machine, or in a database). Functional entities may be combined in a single piece of telecommunication equipment. Figure 2 shows the MWI Control and Notification services functional model.

Figure 2 - Functional model

NOTE - The arrows between FE2 and FE3 and between FE3 and FE4 are depicted with dashes because FE3 does not appear in all scenarios in the functional model.

5.1.1 Description of Functional Entity 1

Functional Entity 1 (FE1) provides the following functionality in support of the MSR System and FE2:

101 Interprets MWI control requests from the MSR System and accesses the service providing capabilities of FE2 by way of service requests.

102 Receives functional indications relating to responses from FE2 (i.e., MWI control acknowledgement/failure), then processes and relays them to the MSR System.

5.1.2 Description of Functional Entity 2

Functional Entity 2 (FE2) provides the following functionality in support of FE1 and FE3:

201 Receives service requests from FE1, and verifies the invocations.

202 FE2 is responsible for ensuring that a valid MSR identification is placed in MWI control requests. This may be done by:

a) maintaining a single default MSR Identifier per FE1 and inserting it as the MSR Identifier when an MWI control request is received from an MSR System represented by that particular FE1, or

b) screening a received MSR Identifier against an allowable list for a particular FE1 and only using values that pass screening as indexes to produce MSR Identifiers.

203 Sends appropriate information through the network toward the client user (e.g., receives an MWI control request from FE1 and relays the request toward the client user).

204 Receives functional indications of acknowledgement/failure of MWI control requests (relayed from FE4), and then relays them to FE1.

5.1.3 Description of Functional Entity 3

Functional Entity 3 (FE3) provides the following functionality in support of FE2 and FE4:

301 Receives MWI control requests from FE2, and relays them toward FE4.

302 Receives indications of acknowledgement/failure of MWI control requests from FE4 and relays them toward FE2.

5.1.4 Description of Functional Entity 4

Functional Entity 4 (FE4) provides the following functionality in support of FE2, FE3, and FE5:

400 Maintains the Message Waiting Notification profile for client user DNs (i.e., the number of MWIs, the MSR Identifier associated with each, the form(s) of notification for each, and the Directory Number of the remote user for remote notification if applicable).

401 Receives and validates MWI control request (i.e., valid, assigned DN, and MWN assigned to DN).

402 Screens the MSR Identifier provided with the MWI control request, to determine whether it matches one of the MSR Identifier(s) in the Message Waiting Notification subscription parameters of the client user DN.

403 If the MWI control request is valid, and passes screening, FE4 updates the status of the appropriate MWI assigned to the client user. The MWI status shall only be modified if the identifiers match. If there is not an MSR Identifier assigned to an MWI in the client user's profile, FE4 shall accept any request to modify the status of the MWI, with the following ex-

ception. If the received MSR Identifier matches another MWI in the client user's profile, then FE4 shall not modify the status of the MWI which has no MSR Identifier assigned.

404 If the MWI control request is valid and passes screening, FE4 sends an indication of acknowledgement of the MWI control request back toward the MSR System.

405 If the MWI control request is not valid or does not pass screening, FE4 sends an indication of failure of the MWI control request back toward the MSR System.

406 Sends functional indications to FE5 (e.g., messages or tones) at the appropriate times to provide the appropriate forms of Message Waiting Notification to the client user, according to the client user's subscription parameters.

407 Upon receiving acknowledgements of successful Message Waiting Notification from FE5, sends an indication of success of the MWI control request back toward the MSR System.

408 Upon receiving functional indications of failure from FE5, sends an indication of failure of the MWI control request back toward the MSR System.

5.1.5 Description of Functional Entity 5

Functional Entity 5 (FE5) provides the following functionality in support of the client user and FE4:

501 Receives and attempts to inform the client user of the appropriate form(s) of Message Waiting Notification.

502 Returns an acknowledgement of Message Waiting Notification.

503 Returns an indication of failure to provide Message Waiting Notification.

5.2 Information flow model for Message Waiting Indicator Control and Notification

This subclause identifies the information that needs to be passed between functional entities, and when to permit overall operation of the MWI Control and Notification services. Each information flow is an abstract representation that could be implemented as a new message or as an addition to an existing message in a signaling system. See figures 3, 4, 5, and 6.

5.2.1 Definition of individual information flows

In this description, two types of MWI control requests are defined: MWI Activation Request and MWI Deactivation Request. Two types of responses are defined: MWI Control Acknowledgement and MWI Control Failure. Either of these responses can be sent in response to either type of MWI Control request. The MWI Notification defined below could take different forms, and occur at different times, depending on the client user's subscription options.

5.2.1.1 MWI Activation Request

When the MSR System has messages waiting for a client user that it serves, it may request the network to inform the client user that there is a message waiting. The MWI Activation Request is the information sent from FE1 to FE2 (toward FE4) to request that the network inform the client user that there is a message waiting. It contains parameters to indicate an MWI control request to "activate" the client user's MWI. The client user is identified using a destination Directory Number. An MSR Identifier to identify the MSR System (or MSR System service) may be included in this request at the option of the MSR System when this information is sent between FE1 and FE2. An MSR Identifier shall be included if the Request is relayed on from FE2.

Additional parameters that may be included in the request at the option of the MSR System include:

- the Directory Number of the calling user (who left a message);
- a timestamp indicating the time of arrival of the message;
- an indication of the number of messages waiting to be retrieved from the MSR System;
- display text;
- an MWI type to indicate additional information about the waiting message, as arranged between the client user and the MSR provider (e.g., message priorities); and
- information to identify a suggested bearer capability that would enable the client user to distinguish between notification for different types of messaging (e.g., voice mail or e-mail).

5.2.1.2 MWI Deactivation Request

When the client user retrieves all messages or all messages are otherwise removed by the MSR System, an MSR System may send a request to the network requesting that the network remove the Message Waiting Notification for the client user.

The MWI Deactivation Request is the information sent from FE1 to FE2 (toward FE4) to request that the network remove the Message Waiting Notification for the client user. It contains parameters to indicate an MWI control request to “deactivate” the client user’s MWI. The client user is identified using a destination Directory Number. An MSR Identifier to identify the MSR System (or MSR System service) may be included in this request at the option of the MSR System when this information is sent between FE1 and FE2. An MSR Identifier shall be included if the Request is relayed on from FE2.

5.2.1.3 MWI Control Acknowledgement

The MWI Control Acknowledgement is the information sent from FE4 toward the MSR System to return an indication that the MWI status has been updated (i.e., activated or deactivated) and that MWN has or will be provided to the client user. It contains information to correlate the acknowledgement with the original request.

5.2.1.4 MWI Control Failure

The MWI Control Failure is the information sent from FE4 toward the MSR System to return an indication of failure to update the status of the MWI (i.e., activate or deactivate), or of a failure to provide detailed notification, if the Detailed Notification subscription option has been chosen for the client user’s MWI. It contains information to correlate the failure with the original request. It also contains information to indicate the reason the MWI control request failed. FE2 may also include parameters that were received in the original MWI control request in the failure indication sent to FE1.

5.2.1.5 MWI Notification

MWI Notification is information sent from FE4 to FE5 to provide an indication of the status of the MWI(s) supported by FE4 for the client user. This notification is sent at appropriate times, depending on the client user’s subscription options regarding the form(s) of notification for each of the client user’s MWIs.

Table 2 – Allocation of function scenarios

Scenario	FE1	FE2	FE3	FE4	FE5
1	TE or NT2	LE	TR	LE	TE
2	TE or NT2	LE	TR	LE	NT2

TE = Terminal Equipment
NT2 = Network Termination – Type 2
LE = Local Exchange
TR = Transit Exchange

5.2.1.6 MWI Notification Acknowledgement

The MWI Notification Acknowledgement is the information sent from FE5 to FE4 to indicate that notification has been received. This information is only provided when the Detailed Notification option has been subscribed by the client user.

5.2.1.7 MWI Notification Failure

The MWI Notification Failure is the information sent from FE5 to FE4 to indicate that notification has failed. This information is only provided when the Detailed Notification option has been subscribed by the client user.

5.3 Allocation of functions to equipment

This subclause identifies a number of different plans, called *scenarios*, for allocating the functional entities of Message Waiting Indicator Control and Notification services to specific network or user equipments (table 2).

In any of these scenarios, Functional Entity 3 may not exist, and Functional Entity 2 and 4 may be provided by the same ISDN equipment.

The signaling to support the Stutter Dial Tone and Feature Indication forms of notification apply to Scenario 1, and the signaling to support Detailed Notification applies to Scenarios 1 and 2.

6 Switching and signaling specifications for Message Waiting Indicator Control and Notification services at the user/network interface

6.1 Formats and coding

Clause 6 describes the messages, information elements within these messages, and coding required for the invocation and control of MWI Control and Notification services.

The Networked Call Independent, Connection-Oriented Signaling (NCICS) messages SETUP, CONNECT, FACILITY, RELEASE, and RELEASE COMPLETE as well as the INFORMATION message shall be used for the invocation of MWI Control and Notification service, as defined in T1.607 and T1.610:

a) The NCICS messages shall be used to send MWI Control requests and responses between the MSR System and the network. The NCICS messages shall also be used to send detailed notification to an ISDN Client User.

b) The INFORMATION message shall be used to provide MWI Notification service to the ISDN client user.

Clause 6 contains ASN.1 notation description of MWI Control (Activation/Deactivation) and Message Waiting Detailed Notification. ITU-T Recommendation X.208, “Specification of Abstract Syntax Notation One (ASN.1)” defines Abstract Syntax Notation One (ASN.1). ASN.1 is a language used for specifying types and data values for applications. ITU-T Recommendation X.209, “Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1),” defines how a transfer syntax (bit level representation) is derived from an ASN.1 description of a protocol. The Basic Encoding Rules in this specification are assumed for the coding of the contents of this ASN.1 description. The access signaling component procedures described in this document for MWI Control by an ISDN MSR System and for Message Waiting Detailed Notification use the protocol described in this ASN.1 description. They also use the definitions of the OPERATION and ERROR macros from ITU-T Recommendation X.219.

6.1.1 Messages

The Networked Call Independent, Connection-Oriented Signaling (NCICS) messages [SETUP, CONNECT, FACILITY, RELEASE, and RELEASE COMPLETE]**,** the INFORMATION message and the REGISTER message, shall be used for the invocation of MWI Control and Notification service, as defined in T1.607 and T1.610:

a) The NCICS messages shall be used to send MWI Control requests and responses between the MSR System and the network. The NCICS messages shall also be used to send detailed notification to an ISDN Client User.

b) The INFORMATION message shall be used to provide MWI Notification service to the ISDN client user.

c) The REGISTER, FACILITY, and RELEASE COMPLETE messages may be used to send detailed notification to an ISDN TE.

6.1.2 Codesets

All information elements are in codeset “0.”

6.1.3 Information elements

The following information elements, defined in T1.607, are used: Protocol discriminator, Call reference, Message type, Calling party number, and Called party number.

The following information elements, defined in T1.610, are used: Bearer capability, Channel identification, Facility, and Feature indication.

6.1.4 Codepoints

The codepoints, as defined in T1.610 and in this standard, shall be utilized in the MWICN service operation, as appropriate. In addition, the protocol profile field of the Facility information element shall be coded to "Networking Extensions" for this service. The NFE may be excluded if a local NCICS connection is established; otherwise it shall be included. When included, the NFE shall be coded as follows: sourceEntity = endPINX, destinationEntity = endPINX.

6.2 Procedures for Message Waiting Indicator Control and Notification services

6.2.1 Service states and timers

6.2.1.1 States

MWICN is call independent as defined in T1.610 and utilizes the connection-oriented signaling procedures. Additional service states required are:

a) *Service null:* No service has been requested.

b) *Service requested:* Awaiting response.

6.2.1.2 Timers

Timer MWI-T1: This timer is used to limit the length of time any particular MWI control request/transaction can be held outstanding against the ISDN access interface (and Call Reference) that requested it. The range of this timer shall be from 10 to 25 seconds. The suggested default value is 10 seconds.

Timer MWI-T2: This timer specifies the maximum length of time that the serving switch will wait for a response to a Detailed Notification message sent to the client user's terminal equipment. The range of this timer shall be from 0.5 to 4 seconds. The suggested default value is 2 seconds.

Timer MWI-T3: This timer specifies the maximum length of time that the serving switch will wait for a response to a Detailed Notification sent to an NT2. The range of this timer shall be from 4 seconds to 7 seconds. The default value is 4 seconds.

6.2.2 Invocation

The MWI Control service is invoked by an MSR System by sending an Invoke component to the network in a Facility information element contained in an NCICS SETUP or FACILITY message.

6.2.3 Notification

Notification of waiting messages is provided to the client user in any one or a combination of three forms as described in 6.2.4.2.

Notification of waiting messages is provided to an NT2 as described in 6.2.4.3.

6.2.4 Normal operation

6.2.4.1 Message Waiting Indicator Control request function

6.2.4.1.1 Overview

When the MSR System wishes to notify a client user of a waiting message, the MSR System shall send an MWI Control request to its serving network. The MWI Control request is carried in the Facility information element contained in the NCICS SETUP or FACILITY message that uses the Call reference established by an NCICS SETUP message. A FACILITY message may be sent at any time by the MSR System after receiving the CALL PROCEEDING message in accordance with T1.610. The network shall send an acknowledgement of a successful or unsuccessful completion to the MSR System in a Facility information element contained in an NCICS CONNECT or FACILITY message with the same Call reference. The MSR System is allowed to initiate multiple MWI control transactions using the same Call reference. The MSR System should clear the call reference with a RELEASE message when the following conditions exist:

– all outstanding invocations have received a response from the network; and

– the MSR does not wish to initiate any additional invocations for the moment.

Under normal conditions, the network should not initiate clearing of an NCICS connection initiated by the user side of the ISDN interface.

Each logical MWI entity that resides in a network switch shall be assigned an E.164 address for the purpose of establishing an NCICS connection. In the case of a user directly served by the public network, the MSR System establishes an NCICS connection to its serving network switch over which MWI Control requests are sent. The TON/NPI field of the Called Party Number information element is coded to Subscriber number/(ISDN/telephony numbering plan) with digits representing the local 7-digit address of the logical MWI entity or National number/(ISDN/telephony numbering plan) with digits representing the national 10-digit address of the logical MWI entity. When the network switch receives an NCICS SETUP message containing this addressing information, it shall establish an NCICS connection between the MSR System and the logical MWI entity indicated by the E.164 address digits.

The contents of the Facility information element used to carry MWI control requests and responses are described in general in 6.2.4.1.9.

To request MWI Control, the MSR System user sends an Invoke Component specifying the "messageWaitingIndicatorControl" operation and an ordered sequence of arguments. The encoding of this operation and responses are as defined in the ASN.1 description shown in 6.2.4.1.9.

The user must include a control type and a destination DN. All the other arguments are provided at the user's option.

The "messageWaitingIndicatorControl" operation is a Class 2 operation (i.e., an acknowledged operation). No ASN.1 description after the "RESULT" indicates that no results are to be sent in the Return Result component. The ASN.1 description after "ERRORS" maps into the contents of the Return Error component. The parameters contained in the "ERROR" descriptions are provided under the conditions described in the Error Handling clause.

The national-specific operation value for the "messageWaitingIndicatorControl" operation is defined with an Open Systems Interconnection (OSI) object identifier in number form as { 1 2 840 10005 0 1 }. In name form, this object identifier can be written as {iso member-body us t1-610 operations 1}. The numbers (and names) in braces represent, in sequence, International Organization for Standardization [ISO], member body, United States of America, T1.610, operations, and the specific subidentifier for Message Waiting Indicator Control.

Error values that have been defined in ITU-T Recommendation Q.950 are shown as integers. The national-specific error values needed for the "message waiting indicator control" operation are defined with OSI object identifiers in number form as { 1 2 840 10005 1 xxx }, where xxx is the subidentifier that represents the specific Error. In name form, this object identifier can be written as {iso member-body us ansi-t1-610 errors xxx}. The numbers (and names) in braces represent, in sequence, the International Organization for Standardization [ISO], member body, United States of America, T1.610, errors, and the specific subidentifier for the Error type.

Each "::=" in the figure defines a parameter structure or a value. A comment is indicated by "--" and is shown in italics.

6.2.4.1.2 Message Waiting Indicator Activation Request

The contents of the Facility information element used to convey a request to activate a client user's MWI are as follows. The Facility information element contains an Invoke component. The Invoke contains the invoke identifier value, the operation value corresponding to *Message Waiting Indicator Control*, and arguments:

"controlType-activate,"
"destinationDN,"
"mSRID" (optional),
"bearerCapability" (optional),
"callingNumber" (optional),
"timestamp" (optional),
"numberOfMessages" (optional),
"displayText" (optional),
"mwiType" (optional).

6.2.4.1.3 Message Waiting Indicator Deactivation Request

The contents of the Facility information element used to convey a request to deactivate a client user's MWI are as follows. The Facility information element contains an Invoke component. The Invoke contains the invoke identifier value, the operation value corresponding to *Message Waiting Indicator Control*, and arguments:

"controlType-deactivate",
"destinationDN",
"mSRID (optional)," and
"bearerCapability (optional)."

6.2.4.1.4 Validation of request

If the "destinationDN" argument is present, and the network determines that the argument contains a valid DN, or that a valid DN can be derived from the contents of the "destinationDN" argument, the network checks for an "mSRID" argument. This identifier could be supplied explicitly by the MSR System in the optional mSRID argument, or could be inferred by the network serving the MSR System. If the mSRID argument is included in the MWI control request, then the network compares the argument with a (set of) valid MSRID parameter(s) assigned to the ISDN access interface over which the request was received. If a valid parameter has been received, the network includes the identification in the attempt to update the MWI for the client user DN. If the "mSRID" argument is not present, then a default identification is inferred by the network from the Default MSRID parameter as arranged by the Messaging provider in the service order process.

6.2.4.1.5 Other optional arguments

The network may receive a "bearerCapability" argument provided at the option of the MSR System in an MWI control request. The contents of this "bearerCapability" argument may be used by the network to distinguish MWIs that are used to provide Message Waiting Notification for different types of messages that may be stored in a messaging system: for example, voice messages or data messages. If the "bearerCapability" argument is included in the request from the MSR System, it can be used in the attempt to update the client user's MWI.

The network may receive "callingNumber" or "timestamp" arguments, provided at the option of the MSR System in an MWI control request. The calling number and timestamp arguments refer to the message for which notification is being sent. Calling number is not to be confused with the Calling Party Number (CPN) for the MSR ISDN access interface. The network does not act upon or examine these arguments.

The network serving the MSR System may receive an "mwiType" argument in an MWI control request. This argument is provided at the option of the MSR System and may be used to indicate message priorities, for example, as arranged between the network provider, the MSR System provider and its client users. If the "mwiType" argument is included in the request from the MSR System, it can be used in the attempt to update the client user's MWI.

The network serving the MSR System may receive a "numberOfMessages" argument in an MWI control request. This argument is provided at the option of the MSR System and is used to indicate the number of waiting messages, as arranged between the network provider, the MSR System provider and its client users. If the "numberOfMessages" argument is included in the request from the MSR System, it can be used in the attempt to update the client user's MWI.

The network serving the MSR System may receive a "displayText" argument in an MWI control request. This argument is provided at the option of the MSR System and is used to provide display text to supplement the MWI type. If the "displayText" argument is included in the request from the MSR System, it can be used in the attempt to update the client user's MWI.

6.2.4.1.6 Responses to valid requests

After receiving a valid MWI control request, the network attempts to update an MWI for the DN, according to the subscription options of the client user. These procedures are not included in this standard. The network starts Timer MWI-T1, and retains the (client user) destination DN, the MSRID used, the mwi type (and any other additional optional parameters) if one was included in the MWI control request, and an association of this transaction and information with the Call reference and ISDN access interface over which it was received, until:

a) the Timer MWI-T1 is exceeded; or

b) the MWI control attempt is successfully completed or is determined to be unsuccessful.

The network acknowledges a successful MWI control attempt with a Facility information element in a FACILITY message. The Facility information element contains a Return Result component. The Return Result contains an invoke identifier (to correlate with the Invoke Component).

6.2.4.1.7 Flow control

The network provider is allowed to define a limit on the number of outstanding (i.e., pending and unacknowledged) MWI control transactions that will be supported simultaneously for a particular user interface. If the network receives an MWI control request from an MSR System, and the network already has in process the maximum number of outstanding transactions that are allowed by the network for the requesting user interface, then the network is allowed to discard and reject the request with a Facility information element contained in a FACILITY message. The Facility information element contains a Return Error component indicating “resources unavailable” as the reason for failure.

If an MSR System receives a Return Error component with the Error Value corresponding to “resourcesUnavailable,” this is an indication that the MSR System has sent more than the number of MWI control requests than are allowed to be simultaneously unacknowledged for that user interface. The MSR System is expected not to send any more requests until it has received an acknowledgement of a previous request. After it has received an acknowledgement of a previous request, the MSR System may resubmit the failed MWI control request.

6.2.4.1.8 Overload conditions

If the network receives an MWI control request and cannot perform the requested action, e.g., due to a lack of switching or signaling resources, the network discards and, if possible, rejects the request with a Facility information element contained in a FACILITY message. The Facility information element contains a Reject component with the Problem Value “resourceLimitation.” The network may discard subsequent requests with or without acknowledgement until the local overload condition clears.

When the MSR System receives the “resourceLimitation” Problem Value in a Reject Component, then the MSR System is expected not to send any more requests until it has received an acknowledgement (either of success or failure) of a previous request. After it has received an acknowledgement of a previous request, the MSR System may resubmit the failed MWI control request. If the MSR System has not received any acknowledgement after a waiting period, the MSR System may attempt to send another request. This waiting period is determined by the MSR System. The MSR System continues to repeat this process of waiting and retrying (with a single request at a time) until the overload condition is cleared and it receives an acknowledgement of success (or failure other than “resourceLimitation”) for the requested MWI control attempt.

6.2.4.1.9 ASN.1 Description of Message Waiting Indicator Control

```
                messageWaitingIndicatorControl OPERATION
ARGUMENT SEQUENCE {
                        controlType [0] IMPLICIT ControlType
        destinationDN [1] IMPLICIT DestinationDN,
        mSRID [2] IMPLICIT MSRID OPTIONAL,
        bearerCapability [3] IMPLICIT BearerCapability OPTIONAL,

        callingNumber [4] IMPLICIT CallingNumber OPTIONAL,
        timestamp TimeStamp OPTIONAL,
                        mwiType [5] IMPLICIT MwiType
        displayText [6] IMPLICIT DisplayText OPTIONAL,
        numberOfMessages [7] IMPLICIT NumberOfMessages OPTIONAL
         }

RESULT
        --to indicate successful completion

ERRORS
                {
                userNotSubscribed,
                taskRefused,
                timerExpired,
                unauthorizedRequest,
                unassignedDN,
                missingCustomerRecord,
                notificationUnavailableToDestinationDN,
                mSRIDdidNotMatchUserProfile,
                invalidArgument,
                resourcesUnavailable,
                parameterNotSupported
                }

::=  {1 2 840 10005 0 1}
ControlType::= ENUMERATED {
        activate (0),

        deactivate (1)},

DestinationDN::=Digits

MSRID::=NumericString SIZE (10)

BearerCapability::=OCTET STRING

--coded as shown for octets 3 and 4 in the Bearer capability information element

--defined in T1.607

CallingNumber::=Digits

MwiType::=ENUMERATED {

      active1 (1), --normal

      active2 (2),

      active3 (3)}
```

DisplayText::=IA5String SIZE (0..20)

NumberOfMessages::=INTEGER (0..32,767)

Timestamp::=UTCTime

Digits::= OCTET STRING

-- coded as shown for octets 3 and following in the Called party number
-- information element defined in T1.607

-- UTCTime is coded as YYMMDDhhmm plus or minus hhmm
-- local time Time difference from
-- Greenwich Mean Time

--The following errors are of global significance.

taskRefused ERROR

::= **{1 2 840 10005 1 7}**
--used when the SS7 network is currently overloaded or
--cannot currently handle the request

unassignedDN ERROR
PARAMETER {DestinationDN}
::= **{1 2 840 10005 1 14}**
--used when the destination DN is not currently assigned
--to an active interface

missingCustomerRecord ERROR
PARAMETER {DestinationDN}
::= **{1 2 840 10005 1 4}**
--used when the destination DN/BC is not subscribed to the
--Message Waiting Notification feature

notificationUnavailableToDestinationDN ERROR
::= **{1 2 840 10005 1 16}**
--used when the notification cannot be provided to the
--destination DN for some short term reason (e.g., the
--line is temporarily out of service)

mSRIDdidNotMatchUserProfile ERROR
PARAMETER {MSRID}
::= **{1 2 840 10005 1 17}**
--used when the MSRID did not match the
--Authorized MSRID(s) in the client user's DN profile

--The following errors are of local significance on the switch which serves
--the ISDN MSR System.

userNotSubscribed ERROR
::= **0**
--used when the requesting user is not subscribed
--to MWI Control capability

invalidArgument ERROR
PARAMETER SET {controlType [0] IMPLICIT ControlType OPTIONAL,
destinationDN [1] IMPLICIT DestinationDN OPTIONAL,
mSRID [2] IMPLICIT MSRID OPTIONAL}
::= **{1 2 840 10005 1 101}**
--used when an argument provided by the requesting user in the
--messageWaitingIndicatorControl operation is not valid. The error
--PARAMETER SET contains the argument(s) that were determined to be
--invalid.

resourcesUnavailable ERROR
::= **11**
--used to provide flow control on the local access

timerExpired ERROR
::= **{1 2 840 10005 1 103}**
--used when timer MWI-T1 expires before an indication of
--successful or unsuccessful completion of attempt

unauthorizedRequest ERROR
::= **{1 2 840 10005 1 104}**
--used when the notification cannot be provided because
--service signaling is not available to destination DN

parameterNotSupported ERROR
PARAMETER SET {bearerCapability [3] IMPLICIT BearerCapability OPTIONAL,
callingNumber [4] IMPLICIT CallingNumber OPTIONAL,
Timestamp OPTIONAL,
displayText [6] IMPLICIT DisplayText OPTIONAL,
numberOfMessages [7] IMPLICIT NumberOfMessages OPTIONAL }
::= **{1 2 840 10005 1 105}**
--If optional arguments included in the messageWaitingIndicatorControl operation
--are not supported by the network, this error is used to identify the unsupported
--argument(s). The error PARAMETER SET is populated with the unsupported
--arguments(s).

6.2.4.2 Message Waiting Notification function

When the client user's serving switch receives an MWI control request, the switch determines if the destination DN (Directory Number, i.e., E.164 address) specified in the request has been assigned an MWI.

If the DN specified in the MWI control request is not assigned to an active line, the switch returns an error message to the MSR System indicating an "unassignedDN" failure.

If an MWI has not been assigned to the DN, the switch returns an error message to the MSR System indicating "missingCustomerRecord".

Each MWI is allowed to be correlated to a [set of] requested bearer capabilities. The client user's serving switch compares the requested bearer capability with parameters in the customer's profile to identify the appropriate MWI. If none is requested explicitly, the speech bearer capability is assumed. If there is no match, an error message is sent to the requesting MSR System indicating "missingCustomerRecord."

If an MWI is assigned to the DN, the switch compares the MSR System Identification (MSRID) included in the incoming MWI control request with parameters stored in the client user's profile for that DN.

– if the MSRID received exactly matches (one of) the stored identification parameter(s), then the MSRID in the MWI control request is authorized to proceed.

– if the MSRID parameter for a client user DN is **empty** (that is, no digits are specified), then the serving switch accepts **any** MSRID provided in an MWI control request (including no identification) as authorized for that DN and MWI.

Depending on whether or not the switch determines that the MSRID in the MWI control request matches the client user's profile, the switch takes one of the following actions:

– if the MSRID matches the client user's profile, then the switch updates the status of the MWI for that DN as specified in the incoming MWI control request. An MWI deactivation request results in the update of the MWI to the "inactive" state. An MWI activation request results in the update of the MWI to an "active" state. The MWI assigned to an ISDN client user DN may be updated to one of four defined states: **inactive, active(1), active(2),** and **active(3)**.

An ISDN client user may have more than one MWI assigned for each DN. If multiple MWI's are assigned, one MSRID parameter is assigned to each MWI (an empty parameter is allowed). When multiple MWI's are assigned, the MSRID provided in the authorized incoming MWI control request is used to determine which MWI status shall be updated. The bearer capability argument provided in the MWI control request may also be used to help determine which MWI status shall be updated.

An incoming MWI activation request may contain an optional parameter to indicate an MWI type. (This optional parameter may be provided by an ISDN MSR System to indicate message priorities, for example, as pre-arranged between the client user and the MSR System.) If this parameter is present in an authorized MWI activation request, then the value contained in the MWI type parameter can be mapped into one of the defined active MWI states as shown below.

Table 3 - Mapping from MWI type received in MWI control request to client user MWI state

MWI type	MWI state
1	active (1)
2	active (2)
3	active (3)
other	active (1)

If the MWI type parameter is not present in an incoming MWI activation request, then the MWI status is updated to the “active(1)” state.

An incoming MWI activation request may contain an optional argument containing display text to supplement the mwiType (or MWI Type in the SS7 TCAP operation). If the displayText argument (or Display_Text in TCAP) is included, the switch serving the client user’s interface shall attempt to deliver this information, if the client user is able to receive display information (e.g., an ISDN interface) or able to receive Detailed Notification as described in 6.2.4.2.3 and 6.2.4.2.4.

An incoming MWI activation request may contain an optional argument to indicate the number of messages. (This optional argument may be provided by an ISDN MSR System to indicate the number of messages waiting to be retrieved.) If the numberOfMessages argument is included, the switch serving the client user’s interface shall attempt to deliver this information, if the client user is able to receive display information (e.g., an ISDN interface) or able to receive Detailed Notification as described in 6.2.4.2.3 and 6.2.4.2.4.

The switch returns an indication of a successful activation or deactivation to the MSR System that originated the request.

If the client user’s MWI is assigned the Detailed Notification subscription option, the client user’s serving switch attempts to send Detailed Notification as described in 6.2.4.2.3. In the event of a successful notification, the serving switch returns an indication of a successful activation or deactivation to the MSR System that originated the request. If the notification attempt is unsuccessful, the client user’s serving switch returns the appropriate indication of an unsuccessful attempt as described in 6.2.4.2.3.

If the client user’s MWI is not assigned the Detailed Notification subscription option, the client user’s serving switch returns an indication of a successful activation or deactivation attempt to the MSR System that originated the request immediately after updating the status of the MWI in the switch.

– If the MSRID does not match the client user’s profile, then the serving switch does not change the status of the client user’s MWI(s) for that DN, and an error is returned to the MSR System that made the request, indicating that the “mSRIDDidNotMatchUserProfile” for the client user DN.

If an ISDN client user has multiple MWI’s defined for a DN, each MWI may be assigned to a Feature Indication identifier in the client user’s profile.

Message Waiting Notification is provided to the client user, depending on subscription options, as described in the following subclauses.

6.2.4.2.1 Stutter Dial Tone

If the client user is subscribed to the *stutter dial tone* form of Message Waiting Notification for a DN in the client user's profile, and the MWI for that DN is in an **active** state, then whenever the client user originates a call on that DN and it is appropriate for the switch to send inband dial tone the switch provides the special "interrupted dial tone" (defined below) instead of normal dial tone.

If the client user is subscribed to the *stutter dial tone* form of Message Waiting Notification for more than one MWI assigned to a DN, then the special "interrupted dial tone" is used whenever **at least one** of these MWI's is in an active state.

If all the MWIs for a DN that are subscribed to the *stutter dial tone* form of notification are in the **inactive** state, then normal dial tone is used on call originations, when appropriate.

The special *interrupted dial tone* provided upon call origination to support the stutter dial tone form of Message Waiting Notification is defined here as a 350 + 440 Hz tone. The tone is provided in bursts (0.1 sec on, 0.1 sec off) for at least 2.5 seconds, followed by steady on.

6.2.4.2.2 Feature Indication

When the switch updates the state of an MWI assigned to a client user DN, and the client user profile has a Feature Indication assigned to that MWI, then the switch updates the status of the Feature Indication. The switch sends a Feature Indication information element in an INFORMATION message. The INFORMATION message is sent point to point. A null Call Reference is used when this message is sent outside the context of a call. The Feature Indication information element contains the value of the feature identifier, and a status value corresponding to the appropriate defined MWI state, mapped as shown in table 4.

Table 4 - Mapping from MWI state to feature indication status value for ISDN client user

MWI state	Feature indication status value
inactive	0
active (1)	1
active (2)	1
active (3)	1

When an MWI state corresponds to active(2) or active(3), the network may provide an auxiliary display to indicate that urgent messages are waiting, for example.

If displayText (or TCAP Display_Text) is included, and if the MWI Type parameter is omitted, or is included and set to "active(3)", and if the client user is able to receive display information (e.g., an ISDN interface) the switch serving the client user may use the contents of the displayText to provide a display to the client user.

Whenever all the Feature Indications for a terminal are updated, then the Feature Indications assigned to MWI's are provided with the appropriate status value for the current MWI state as shown above.

If a client user has more than one MWI, each MWI can be assigned to the same or to different feature identifiers in the client user's profile. If more than one MWI is assigned to the same feature identifier, the client user's serving switch (or FE5) coordinates the information so as to always indicate an active status if any of these MWIs assigned to the feature identifier are in an active state.

6.2.4.2.3 Detailed Notification

When the client user's serving switch updates the state of an MWI assigned to a client user DN, and that MWI is assigned Detailed Message Waiting Notification, then the switch sends a detailed notification to each active terminal served by ISDN access interfaces associated with the destination DN specified in the incoming MWI control request. The detailed notification is sent in an Invoke Component contained in a Facility information element in a REGISTER message. The contents of the Invoke Component are described in 6.2.4.2.4.

The coding of the operation and error value in the ASN.1 description in 6.2.4.2.4 uses object identifiers. The national-specific operation value for the "messageWaitingNotification" (MWN) operation is defined with an OSI object identifier in number form as { 1 2 840 10005 0 2 }. In name form, this object identifier can also be written as {iso member-body us ansi-t1-610 operations 2}. The numbers (and names) in braces represent, in sequence, International Organization for Standardization [ISO], member body, United States of America, T1.610, operations, and the specific subidentifier for "messageWaitingNotification" (MWN).

The national-specific error value needed for the "messageWaitingNotification" (MWN) operation is defined with an OSI object identifier in number form as { 1 2 840 10005 1 16 }. In name form, this object identifier can be written as {iso member-body us ansi-t1-610 errors 16}. The numbers (and names) in braces represent, in sequence, the International Organization for Standardization [ISO], member body, United States of America, T1.610, errors, and the specific subidentifier for the error type "notificationUnavailableToDestinationDN."

After sending the Invoke component, the client user's switch starts timer MWI-T2. The client user indicates a successful notification by sending a Return Result component in a facility information element contained in a RELEASE COMPLETE message. Upon receiving this response, the client user's serving switch stops timer MWI-T2, and returns an indication of successful completion to the MSR System that originated the request.

The client user may reject the notification by sending a Return Error component with the error value corresponding to "notificationUnavailableToDestinationDN." If the Detailed Notification application is not supported by the client user, the client user may reject the notification using a Reject component with the Problem Value "unrecognizedOperation." The client user may reject notification that contains protocol errors using a Reject component with the appropriate Problem Value. These Return Error and Reject components are returned in a Facility information element contained in a RELEASE COMPLETE message.

When the serving switch receives a rejection of Detailed Notification from the client user, the switch stops timer MWI-T2 and sends an indication of an unsuccessful notification attempt corresponding to "notificationUnavailableToDestinationDN." Upon expiry of timer MWI-T2 before receiving any response, the serving switch sends a RELEASE COMPLETE to the client user terminal and returns an indication of an unsuccessful notification attempt, corresponding to "notificationUnavailableToDestinationDN."

If the network determines that the data link layer is lost between the network and the client user, the network shall return an indication of an unsuccessful attempt, corresponding to "notificationUnavailableToDestinationDN."

If Detailed Notification is provided to more than one user for the same client user DN and MWI, then an indication of success is returned to the requesting MSR System if notification is successfully provided to any of these users.

6.2.4.2.4 ASN.1 Description of Message Waiting Notification - Detailed notification

```
messageWaitingNotification OPERATION
ARGUMENT SEQUENCE {
        controlType [0] IMPLICIT ENUMERATED {
                        activate (0),
                        deactivate (1)},
        destinationDN [1] IMPLICIT Digits,
        mwiNo [2] IMPLICIT NumericString SIZE (2) OPTIONAL,
        bearerCapability [3] IMPLICIT OCTET STRING OPTIONAL,
                        --coded as shown for octets 3 and following in the bearer
                        --capabilities information element defined in T1.607
        callingNumber [4] IMPLICIT Digits OPTIONAL,
        timestamp UTCTime OPTIONAL,
        mwiType [5] IMPLICIT ENUMERATED {
                        active1 (1), --      normal
                        active2 (2),
                        active3 (3)}   OPTIONAL,
        displayText [6] IMPLICIT IA5String SIZE (0..20) OPTIONAL,
        numberOfMessages [7] IMPLICIT INTEGER (0..32767) OPTIONAL
        }
RESULT
        --to indicate successful completion
ERRORS
                {
                notificationUnavailableToDestinationDN
                }
::= {1 2 840 10005 0 2}

Digits::= OCTET STRING

        --coded as shown for octets 3 and following in the called party number
        --information element defined in T1.610

--UTCTime is coded as YYMMDDhhmm plus or minus  hhmm
-- local time Time difference from
-- Greenwich Mean Time

--The following error is of local significance on the switch which serves the
--ISDN client user.

notificationUnavailableToDestinationDN     ERROR
        ::= {1 2 840 10005 1 16}
                --sent by the user to refuse detailed notification
                --or to indicate an error in the request; for example,
                --a protocol error or a missing or invalid argument
```

6.2.4.3 Message Waiting Notification to an NT2

This clause includes the protocol and procedures for sending a detailed notification to an NT2.

6.2.4.3.1 Sending a Message Waiting Notification to an NT2

When the network receives and accepts a request from a MSR System to send an MWI control request to an NT2, and the interface to the NT2 is permitted to receive such a notification, the network shall send a detailed notification using the NCICS procedures. The detailed notification shall be sent in an Invoke component contained in a Facility information element in either an NCICS SETUP message (which also initiates a new NCICS connection) or in a FACILITY message (if an appropriate NCICS connection already exists between the network and the NT2). The contents of the Invoke component are described in 6.2.4.3.2. If a new NCICS connection is established for the sending of the MWI control request, the network may code the Called Party Number information element to indicate a local NCICS connection or a networked connection, as appropriate. Whether or not to establish and clear an NCICS connection for each notification, or to keep the NCICS connection up for long term is a network option.

The coding of the operation and error value in the ASN.1 description in 6.2.4.3.2 uses object identifiers. The national-specific operation value for the "messageWaitingNotificationNT2" operation is defined with an ISO object identifier in number form as { 1 2 840 10005 0 7}. In name form, this object identifier can also be written as {iso member-body us ansi-t1-610 operations messageWaitingNotificationNT2}. The numbers (and names) in braces represent, in sequence, International Organization for Standardization [ISO], member body, United States of America, T1.610, operations, and the specific subidentifier for "messageWaitingNotificationNT2."

After sending the Invoke component, the network shall start timer MWI-T3. The NT2 shall indicate a successful notification by sending a Return Result component in a Facility information element contained in a FACILITY or CONNect message, as appropriate. Upon receiving this response, the network switch serving the NT2 shall stop timer MWI-T3, and return an indication of successful completion to the MSR System that originated the request.

The NT2 may reject the notification by sending a Return Error component with an appropriate Error value, for example, "notificationUnavailableToDestinationDN" (see 6.2.5.3 for more information). If the Detailed Notification application is not supported by the NT2, the NT2 should reject the notification using a Reject component with the Problem value "unrecognizedOperation." The NT2 should reject a notification which contains protocol errors using a Reject component with the appropriate Problem value (see T1.610). These Return Error and Reject components shall be returned in a Facility information element contained in a FACILITY or CONNect message, as appropriate.

When the serving switch receives a rejection of Detailed Notification from the NT2, the switch shall stop timer MWI-T3 and send an indication of an unsuccessful notification attempt corresponding to the received indication, for example, "notificationUnavailableToDestinationDN," to the requesting MSR System. Upon expiry of timer MWI-T3, the network shall send a RELEASE COMPLETE to the NT2 and return an indication of an unsuccessful notification attempt, corresponding to "notification UnavailableToDestinationDN," to the requesting MSR System.

In the case of data link layer failure between the network and the NT2, the network shall return an indication of the unsuccessful attempt, corresponding to "notificationUnavailableToDestinationDN," to the requesting MSR System.

6.2.4.3.2 ASN.1 Description of Message Waiting Notification - Detailed Notification to an NT2

```
messageWaitingNotificationNT2 OPERATION
ARGUMENT SEQUENCE {
        controlType [0] IMPLICIT ControlType,
        destinationDN [1] IMPLICIT DestinationDN ,
        mSRID [2] IMPLICIT MSRID  OPTIONAL,
        bearerCapability [3] IMPLICIT BearerCapability  OPTIONAL,
        callingNumber [4] IMPLICIT CallingNumber  OPTIONAL,
        timestamp Timestamp  OPTIONAL,
        mwiType [5] IMPLICIT MwiType  OPTIONAL,
        displayText [6] IMPLICIT DisplayText  OPTIONAL,
        numberOfMessages [7] IMPLICIT NumberOfMessages  OPTIONAL

        }

RESULT
        --to indicate successful completion

ERRORS
                {
                unassignedDN,
                missingCustomerRecord,
                notificationUnavailableToDestinationDN,
                mSRIDdidNotMatchUserProfile,
                resourcesUnavailable
                }

::=  {1 2 840 10005 0 7}

ControlType::= ENUMERATED {
        activate (0),

        deactivate (1)},

DestinationDN::=Digits

MSRID::=NumericString SIZE (10)

BearerCapability::=OCTET STRING

--coded as shown for octets 3 and 4 in the Bearer capability information element

--defined in T1.607

CallingNumber::=Digits

MwiType::=ENUMERATED {

      active1 (1), --normal

      active2 (2),

      active3 (3)}

DisplayText::=IA5String SIZE (0..20)

NumberOfMessages::=INTEGER (0..32,767)
```

```
Timestamp::=UTCTime

Digits::= OCTET STRING

        -- coded as shown for octets 3 and following in the Called party number
        -- information element defined in T1.607

-- UTCTime is coded as YYMMDDhhmm  plus or minus  hhmm
--  local time  Time difference from
--  Greenwich Mean Time

--The following errors are of global significance.


unassignedDN ERROR
        PARAMETER {DestinationDN}
        ::= {1 2 840 10005 1 14}
                        --used when the destination DN is not currently assigned
                        --to an active interface


missingCustomerRecord ERROR

        PARAMETER {DestinationDN}
        ::= {1 2 840 10005 1 4}
                        --used when the destination DN/BC is not subscribed to the
                        --Message Waiting Notification feature

notificationUnavailableToDestinationDN ERROR
        ::= {1 2 840 10005 1 16}
                        --used when the notification cannot be provided to the
                        --destination DN for some short term reason (e.g., the
                        --line is temporarily out of service)

mSRIDdidNotMatchUserProfile ERROR
        PARAMETER {MSRID}
        ::= {1 2 840 10005 1 17}
                        --used when the MSRID did not match the
                        --Authorized MSRID(s) in the client user's DN profile
                        --The following error is of local significance on the switch which serves
                        --the ISDN User equipment receiving this detailed notification.


resourcesUnavailable ERROR
        ::= 11
                        --used to provide flow control on the local access
```

6.2.5 Error handling

6.2.5.1 Message Waiting Indicator Control request function

6.2.5.1.1 Invalid Message Waiting Indicator Control requests

If the network receives an MWI control request from an ISDN access interface that is not subscribed to the capability, the network rejects the request with a Facility information element contained in a FACILITY or RELEASE COMPLETE message. The Facility information element contains a Return Error component with the error “userNotSubscribed.”

If the "controlType" argument is not valid, then the MWI control request shall be rejected with a Facility information element contained in a FACILITY message. The Facility information element shall contain a Return Error component with the error “invalidArgument,” containing the “controlType” argument received in the “messageWaitingIndicatorControl” operation in the Error PARAMETER SET.

The “destinationDN” is the DN of the client user for which the MWI control request is being made. If the “destinationDN” argument is not present, the request is rejected with a Facility information element in a FACILITY message. The Facility information element contains a Reject component with the problem value corresponding to “badlyStructuredComponent.”

If the “destinationDN” argument is present, but the network determines that the argument does not contain a valid DN, and that a valid DN cannot be derived, the network rejects the MWI control request with a Facility information element in a FACILITY message. The Facility information element contains a Return Error component with the error “invalidArgument,” and containing the "destinationDN" argument received in the “messageWaitingIndicatorControl” operation in the Error PARAMETER SET.

If the “mSRID” argument does not pass screening, then the MWI control request is rejected with a Facility information element contained in a FACILITY message. The Facility information element contains a Return Error component with the error “invalidArgument,” containing the “mSRID” argument received in the “messageWaitingIndicatorControl” operation in the Error PARAMETER SET.

6.2.5.1.2 Unsuccessful MWI control attempts

If timer MWI-T1 is exceeded, or if the MWI control attempt is determined to be unsuccessful, the network reports the failure in a Facility information element contained in a FACILITY message sent from the network to the MSR System. The Facility information element contains a Return Error component. The Return Error component contains the invoke identifier value of the Invoke Component that contained the MWI control request.

The defined error conditions for valid but unsuccessful attempts include:

a) *task refused* - used when network signaling is currently overloaded or cannot currently handle the request;

b) *timer expired* - used when timer MWI-T1 expires before an indication of a successful or unsuccessful completion of attempt;

c) *unauthorized request* - used when the notification cannot be provided because SS7 service signaling is not available to the switch serving the destination DN;

d) *unassigned DN* - used when the destination DN (provided in the “destination DN” argument, or derived from it) is not currently assigned to an active interface;

e) *missing customer record* - used when the client user identified by the destination DN is not subscribed to Message Waiting Notification;

f) *notification unavailable to destination DN* - used when the MWN cannot be provided to the destination DN for some short-term reason (e.g., the line is temporarily out of service) or when Detailed Notification cannot be provided;

g) *MSRID did not match user profile* - used when the MSRID did not match information in the client user's profile.

6.2.5.1.3 Abnormal error conditions

If the network receives a RELEASE COMPLETE message (which clears the Call reference of an outstanding MWI control request), before it can acknowledge the request, then the network completes the MWI control request and clears the transaction information associated with the ISDN access interface. If the MWI control request has already been completed for the client user, but a result or error has not yet been returned to the MSR System, then the network clears the transaction information associated with the Call reference and ISDN access interface.

If the network determines that the data link layer is lost, over which an outstanding MWI control request was received, then the network completes the MWI control request and clears the transaction information associated with the Call reference and ISDN access interface. If the MWI control request has already been completed for the client user, but a result or error has not yet been returned to the MSR System, then the network clears the transaction information associated with the Call reference and ISDN access interface.

6.2.5.1.4 Unsupported Optional Parameters

If the network does not support one or more of the optional arguments defined for the messageWaitingIndicatorControl operation (except for the mSRID argument), then if the network receives a messageWaitingIndicatorControl operation containing an unsupported optional argument, at the network provider's option, the network may either discard the argument(s) and process the request, or reject the messageWaitingIndicatorControl operation with a Return Error component coded with the Error value corresponding to parameterNotSupported, and include identifiers of the unsupported argument(s) in the PARAMETER SET of the error (i.e., echo the argument back to the requesting MSR System). Optional arguments that may be discarded, or returned with an indication that they are not supported, include: bearerCapability, callingNumber, timeStamp, mwiType, numberOfMessages, and displayText. An invalid mSRID is handled as indicated in 6.2.5.1.1. No indication is provided back to the MSR System if the argument is not supported at the destination.

6.2.5.2 Message Waiting Notification function

If the client user's network loses the status of an MWI, because of a network failure for example, the MWI is placed in the active(1) state.

6.2.5.3 Message Waiting Notification function to an NT2

If timer MWI-T3 expires, or if the MWI notification attempt is determined to be unsuccessful, the network shall report the failure in a Facility information element contained in a FACILITY message sent from the network to the MSR System as described in 6.2.5.1.1. As described in 6.2.4.3, the error indications received by the network that consitute a valid but unsuccessful notification attempt include:

1. unassigned DN - used when the destination DN (provided in the "destination DN" argument, or derived from it) is not currently assigned to an active interface;
2. missing customer record - used when the client user identified by the destination DN is not subscribed to Message Waiting Notification;
3. notification unavailable to destination DN - used when the MWN cannot be provided to the destination DN for some short-term reason (e.g., the line is temporarily out of service) or when Detailed Notification cannot be provided;
4. MSRID did not match user profile - used when the MSRID did not match information in the client user's profile.

Under normal conditions, the network shall clear the NCICS connection. However, under exceptional conditions (e.g., system recovery), the NT2 may clear the NCICS connection.

6.3 Interactions

6.3.1 Basic call

No interactions with basic call procedures.

6.3.2 Other services

6.3.2.1 CLIP/CLIR

None required.

6.3.2.2 Call hold

None required.

6.3.2.3 Call waiting

None required.

6.3.2.4 MLPP

None required.

6.3.2.5 User to user

None required.

6.4 Flow diagrams

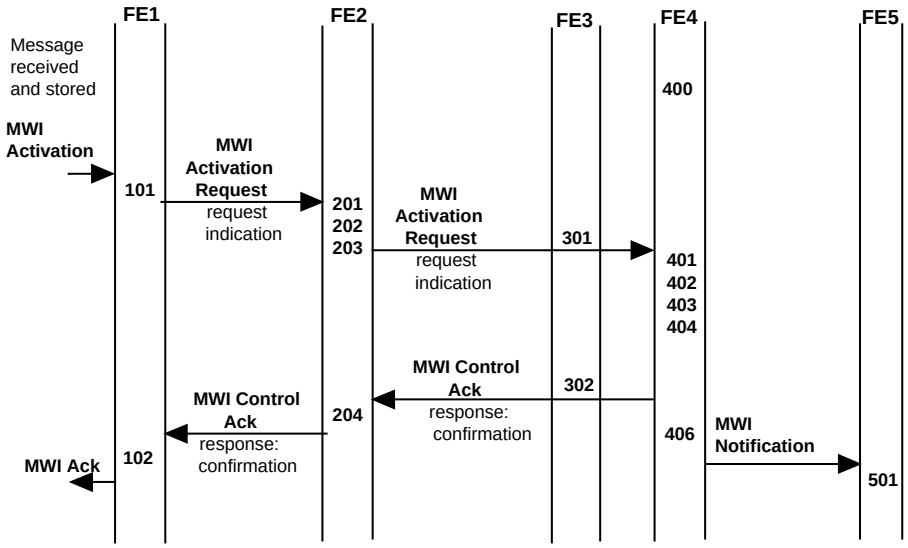
Figure 7 shows the message flows for a successful attempt to control (activate/deactivate) an MWI, when the Stutter Dial Tone form of MWN is subscribed.

Figure 8 shows the message flows for a successful attempt to control (activate/deactivate) an MWI when the Feature Indication form of MWN is subscribed.

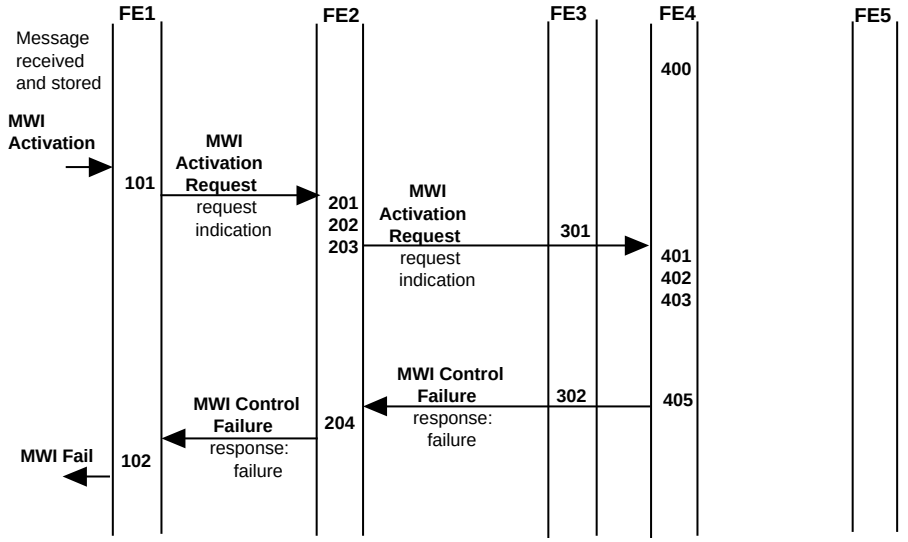
Figure 9 shows the message flows for a successful attempt to control (activate/deactivate) an MWI when the Detailed Notification form of MWN is subscribed.

Figure 10 shows the message flows for an unsuccessful attempt to control (activate/ deactivate) an MWI. Figures 10(a), 10(b), and 10(c) show the message flows for an unsuccessful attempt to control (activate/deactivate) an MWI. Figure 10(a) shows the general case, figure 10(b) shows the case when Detailed Notification to a Terminal Equipment (TE) fails, and figure 10(c) shows the case when Detailed Notification to an NT2 fails.

Figure 10(d) shows the message flows for a successful attempt to control (activate/deactivate) an MWI at an NT2.

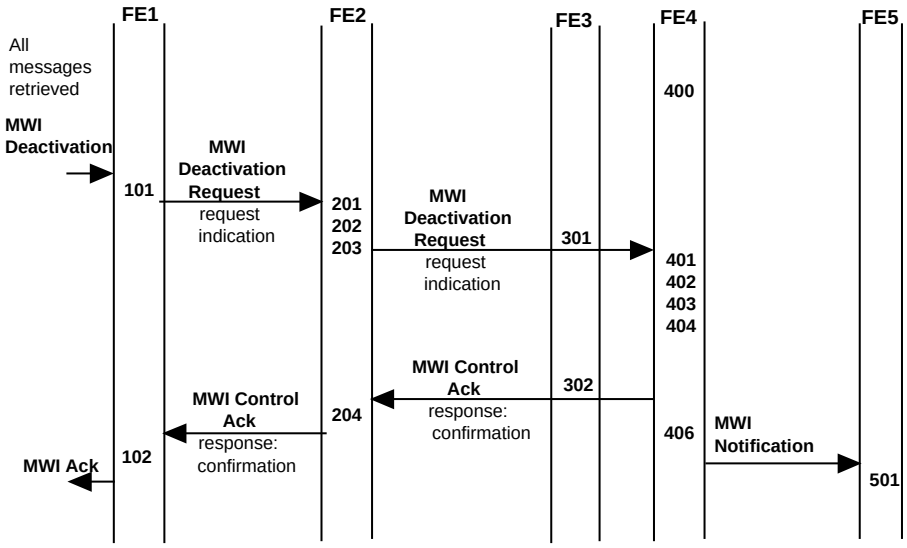


(a) Successful activation of MWI
(applies to Stutter Dial Tone and Feature Indication MWN subscription options only)

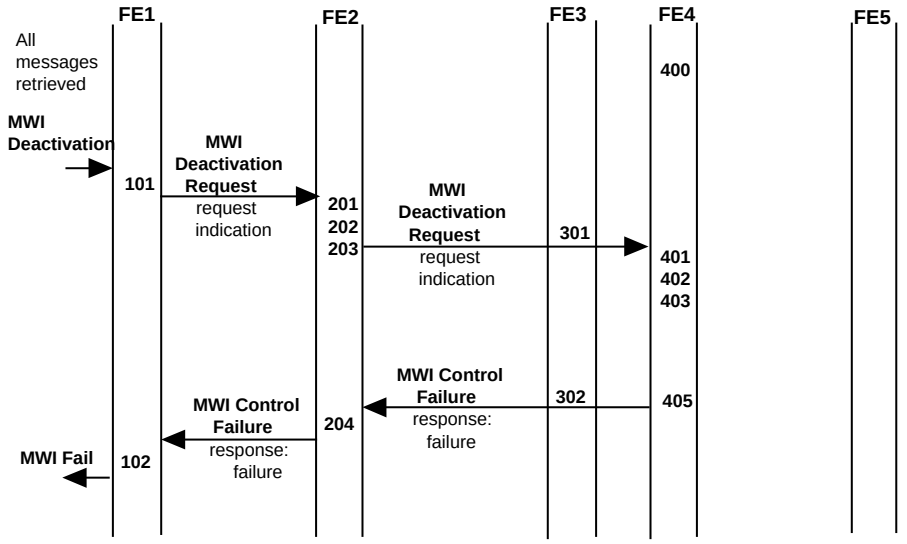


(b) Unsuccessful attempt to activate MWI
(applies to all MWN subscription options)

Figure 3 - MWI activation attempts

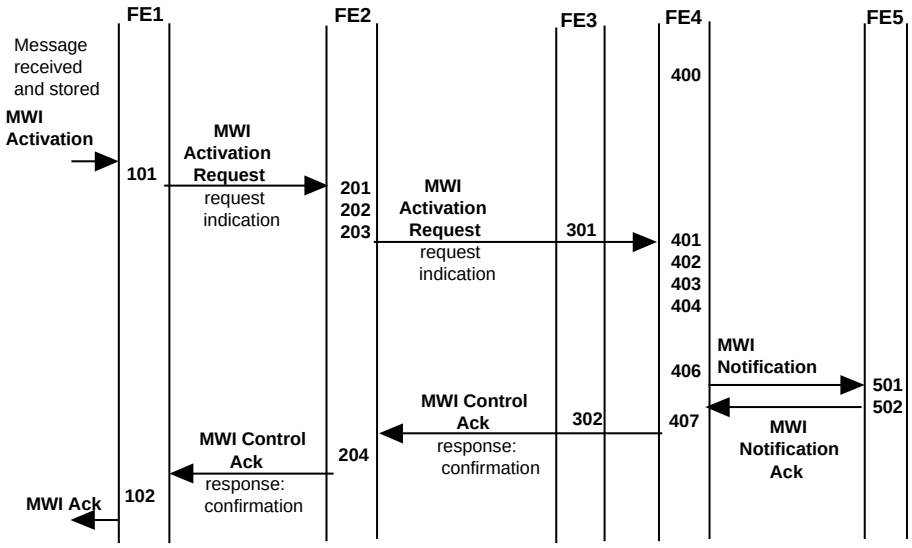


(a) Successful deactivation of MWI
(applies to Stutter Dial Tone and Feature Indication MWN subscription options only)

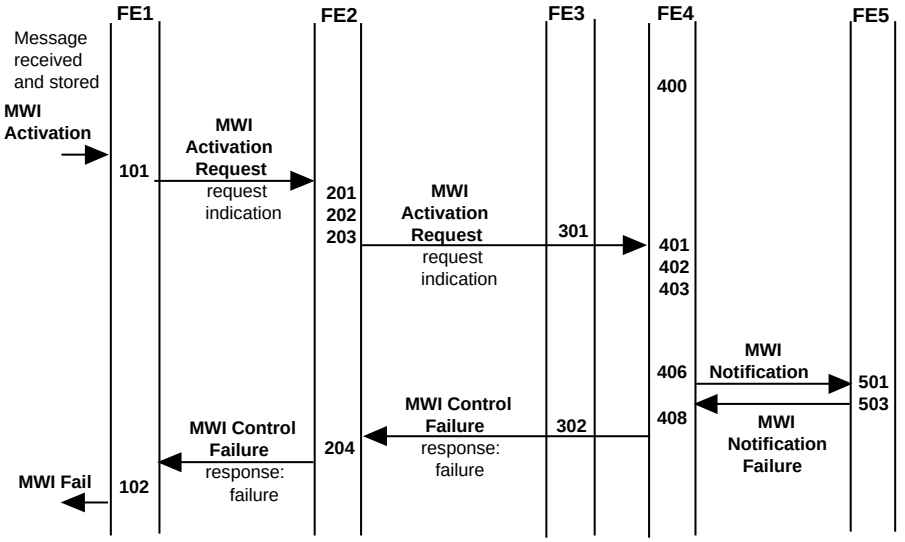


(b) Unsuccessful attempt to deactivate MWI
(applies to all MWN subscriptions options)

Figure 4 - MWI deactivation attempts

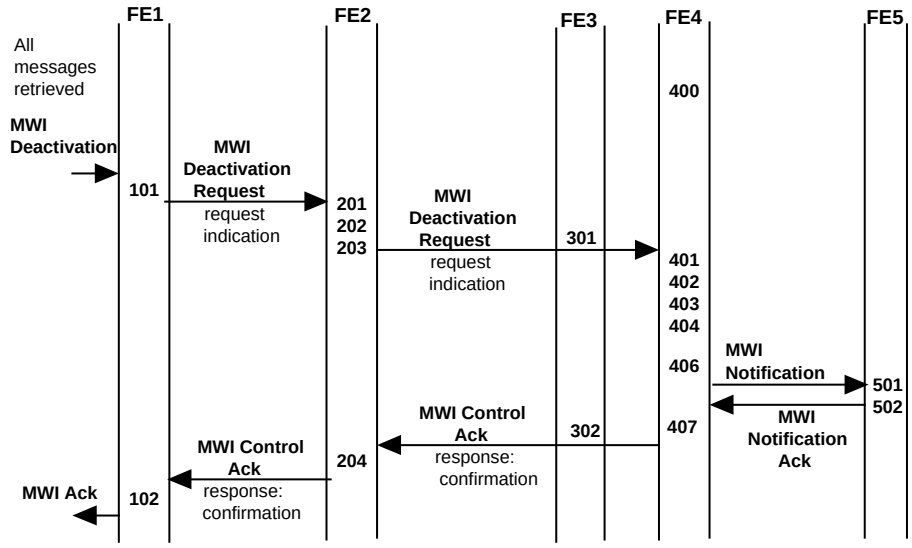


(a) Successful activation of MWI - Detailed Notification option only

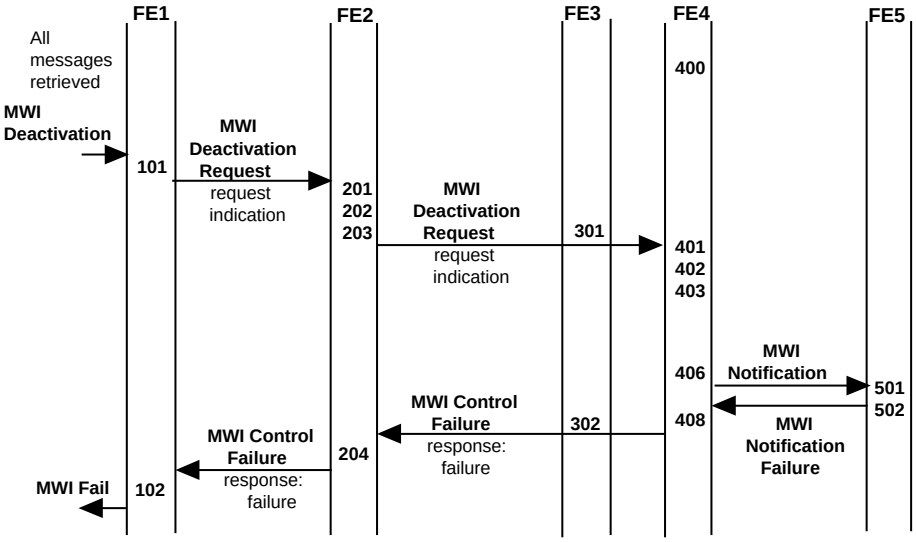


(b) Unsuccessful attempt to activate MWI - Detailed Notification option only

Figure 5 - MWI activation attempts for Detailed Notification



(a) Successful deactivation of MWI - Detailed Notification option only



(b) Unsuccessful attempt to deactivate MWI - Detailed Notification option only

Figure 6 - MWI deactivation attempts for Detailed Notification

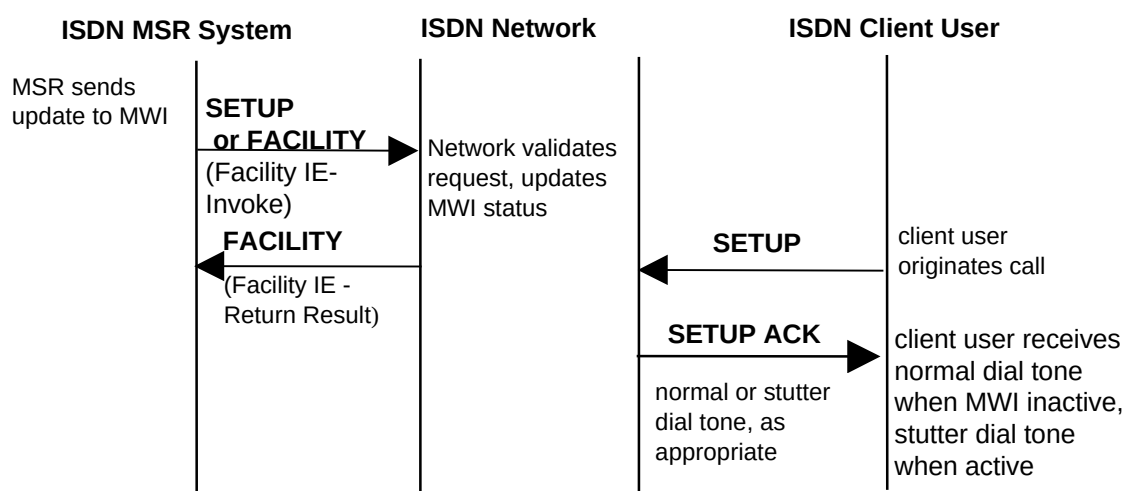


Figure 7 - Successful activation/deactivation of MWI at TE
(Stutter Dial Tone subscription option of MWN)

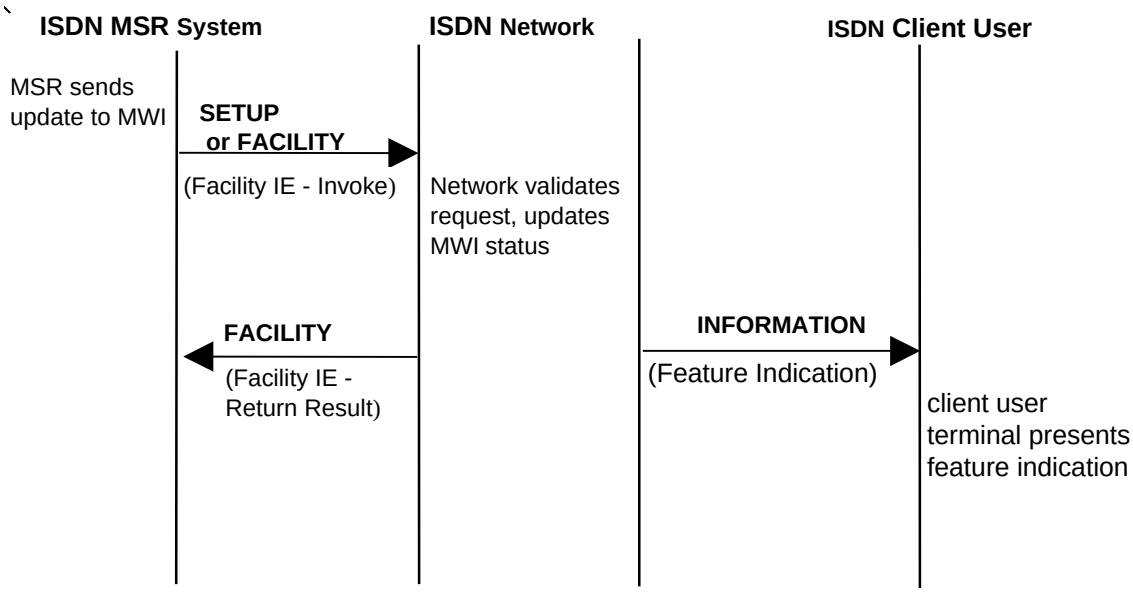


Figure 8 - Successful activation/deactivation of MWI at TE
(Feature Indication subscription option of MWN)

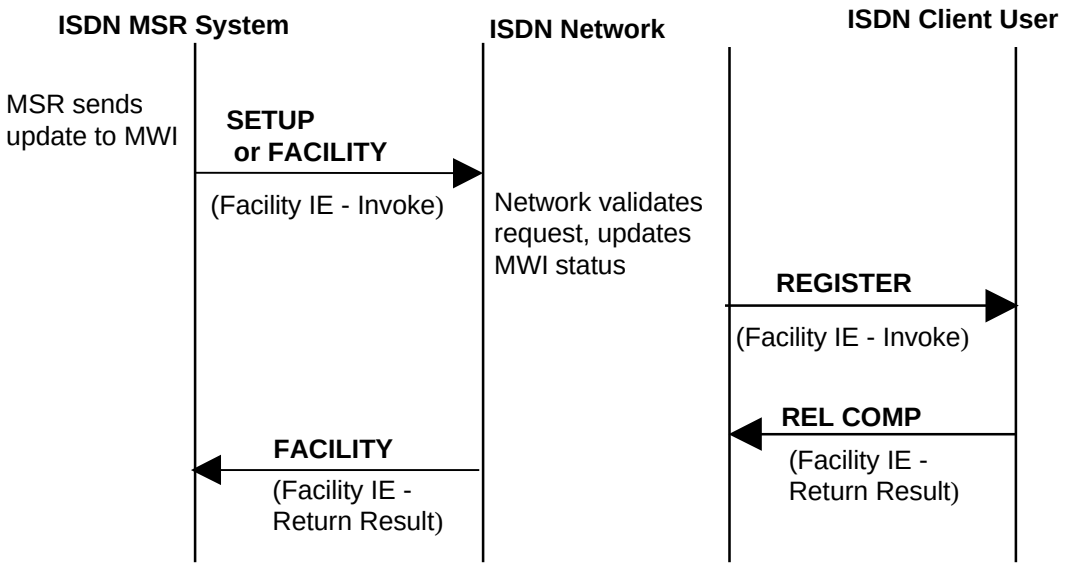
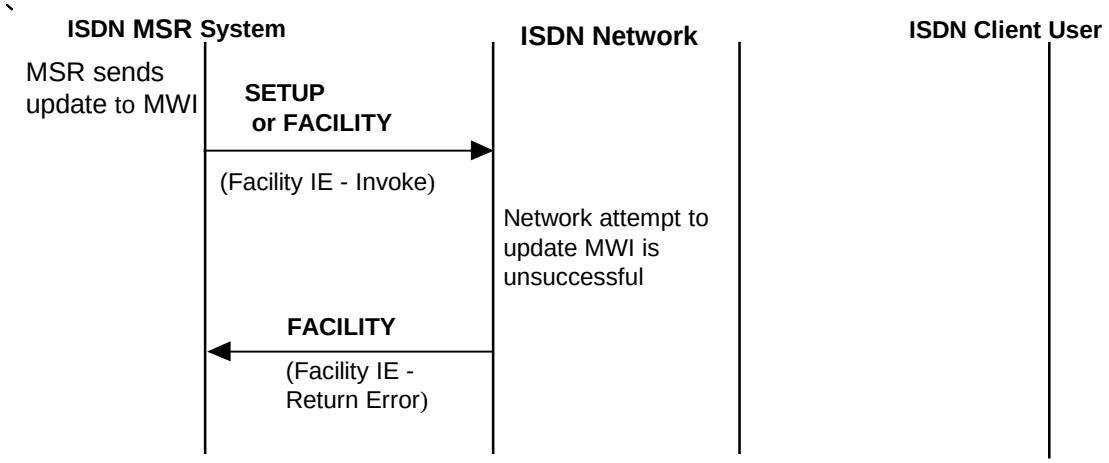
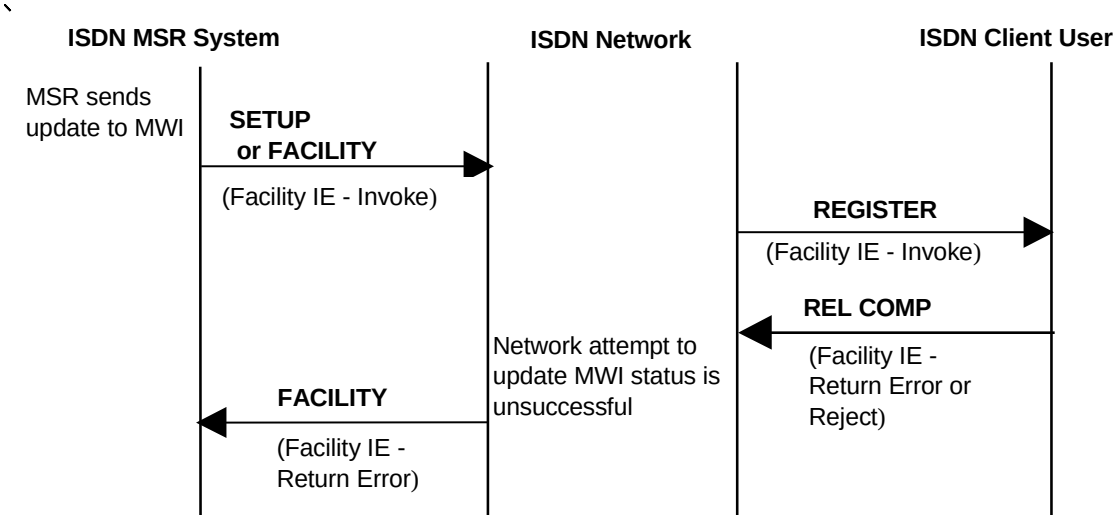


Figure 9 - Successful activation/deactivation of MWI at TE
(Detailed Notification subscription option of MWN)

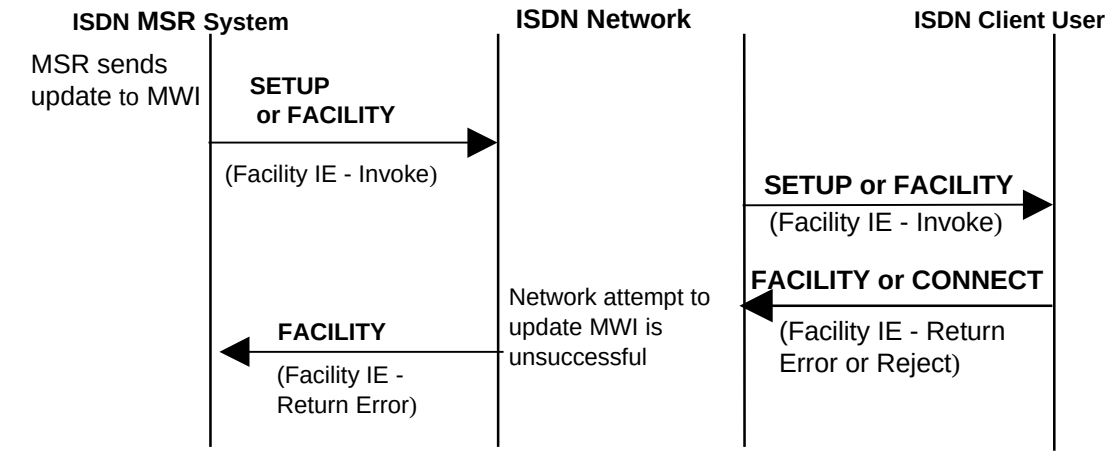


(a) Unsuccessful activation/deactivation of MWI

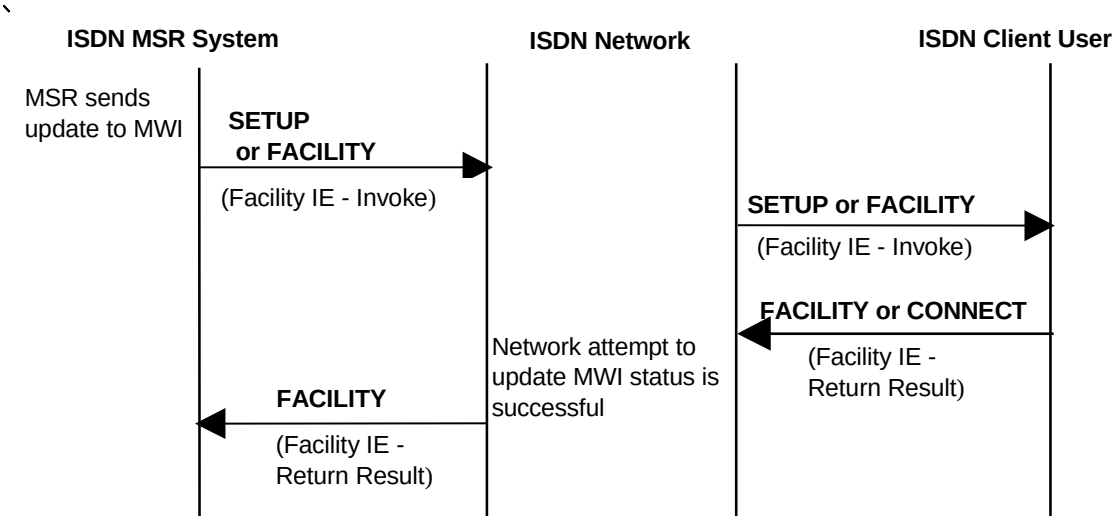


(b) Unsuccessful activation/deactivation of MWI to a TE
(Detailed notification subscription option of MWN)

Figure 10 - Unsuccessful MWI activation/deactivation attempts



(c) Unsuccessful activation/deactivation of MWI at an NT2
(Provision of MWI to an NT2)



(d) Successful activation/deactivation of MWI at an NT2
(Provision of MWI to an NT2)

Figure 10 *(concluded)*

7 Switching and signaling specifications for Message Waiting Indicator Control and Notification at interswitch interfaces

7.1 Format and coding for Message Waiting Indicator Control and Notification services

This subclause describes the messages, parameter sets within these messages, and coding required for the support of invocation and control (activation and deactivation) of MWI Control and Notification services on an interswitch basis. While additional protocol may be needed to support inter-network operation, this standard does not preclude such operation.

7.1.1 Transactions capabilities application part (TCAP) formats and parameter codings

For a general description of TCAP formats and parameter codings refer to Chapter 3 of T1.114.

7.1.1.1 Messages

The SS7 TCAP Query, Response, and Unidirectional family of messages that will be used for MWI Control request are defined in Chapter 2 of T1.114.

7.1.1.2 Parameters

For general descriptions, formats and coding of the TCAP parameters that are referred to in the text refer to Chapter 5 of T1.114.

7.1.1.2.1 Digits

This parameter indicates a set of digits and provides information on the number of digits, the type of digits, nature of number, numbering plan, and encoding method for the digits (Refer to 4.5 and figure 8 of Chapter 5, T1.114.).

MWI Control and Notification service recognizes ISDN and Unknown Numbering Plans and BCD coding.

Numbering plan	H	G	F	E
Unknown	0	0	0	0
ISDN numbering	0	0	0	1

If the “calling number” received from the access side is coded in a private numbering plan, it should be mapped to “Unknown” numbering plan (0000).

The following parameters are coded in the Type of Digits field and are used in the MWI Control and Notification service:

ANI (Calling party number)	0	0	0	0	0	0	1	0
Destination number	0	0	0	0	0	1	1	0
VMSR Identifier	0	0	0	0	1	1	0	0

7.1.1.2.2 Error codes

This field identifies the reason an operation failed (refer to clause 3 and table 2 of chapter 5, T1.114). Error types used in the MWI Control and Notification service are coded as follows:

Task Refused	0	0	0	0	0	1	1	1
Unassigned DN	0	0	0	0	1	1	1	0
Notification unavailable to destination DN	0	0	0	1	0	0	0	0
VMSR ID did not match user profile	0	0	0	1	0	0	0	1
Unavailable resource	0	0	0	0	0	0	1	1
Missing customer record	0	0	0	0	0	1	0	0

7.1.1.2.3 Bearer capability requested

This parameter indicates which bearer capabilities are identified in the request. The content of the Bearer Capability Requested is coded according to 4.19 and figure 17 of Chapter 5, T1.114.

The Information Transfer Capability field is coded as follows:

speech	0	0	0	0	0
unrestricted digital information	0	1	0	0	0
3.1 kHz audio	1	0	0	0	0
Multi-use service	1	0	0	0	1

All other values are not applicable to this service.

The coding standard recognizes ITU-T (00 in the coding standard field) for this service.

The Information Transfer Rate field is coded as follows:

channel size	0	0	0	0	0
64-kbit/s (This rate is used for voiceband analog circuits)	1	0	0	0	0

All other values are not applicable for this service. The definition of throughput rates for packet mode bearer capabilities is for further study; 00000 shall be used for packet mode calls.

The Transfer Mode field is coded as follows (see T1.114, Chapter 5):

circuit mode	(00)
packet mode	(10)

The Multiplier or Layer Identification field is coded as follows:

	G F
Multiple or layer identification (see note)	
user information layer 1 protocol	0 1

NOTE - When this subfield indicates a user information protocol, bits 5-1 of the same octet represent the corresponding identification in accordance with User Information Layer 1 Protocol Identification, User Information Layer 2 Protocol Identification, and User Information Layer 3 Protocol Identification. For this application, the only applicable value is User Information Layer 1 Protocol Identification.

The User Information Layer 1 Protocol Identification field is coded as follows:

User information layer 1 protocol identification	E D C B A
Rate adaption (see note)	0 0 0 0 1
ITU-T Recommendation G.711 u-law	0 0 0 1 0
ITU-T Recommendation G.722 and G.725/p (7 kHz audio)	0 0 1 0 1

All other values are reserved for further study or are not applicable (see T1.114, chapter 5).

NOTE - The extension bit in this octet is set to 0 and octet 3a rate subfield is coded:

01111	56.0 kbit/s	(Recommendation I.463)

7.1.1.2.4 Message Waiting Indicator type

This parameter indicates a notification of a waiting message. It is used to provide additional information about the waiting message priorities.

The contents of the parameter can be translated by the receiving switch to mean specific action. (Refer to 4.24 and figure 21 of Chapter 5, T1.114).

7.1.1.2.5 Timestamp

This parameter identifies what time a voice message was received by indicating a local time along with the difference between the local time and Greenwich Mean Time (GMT) (Refer to 4.1 and figure 4 of Chapter 5, T1.114).

7.1.1.2.6 Display Text

This parameter contains display text to supplement the MWI type and is coded with an IA5STRING character string obtained from the displayText argument if this argument is included in the message-WaitingIndicatorControl operation used to request the MWI control request.

7.1.1.2.7 Number of Messages

This parameter identifies the number of messages waiting and is coded with an Integer value obtained from the numberOfMessages argument if this argument is included in the messageWaitingIndicator-Control operation used to request the MWI control request.

7.2 Procedures

7.2.1 Transactions capabilities application part (TCAP) procedures

For general TCAP procedures refer to Chapter 4 of T1.114.

The procedures described in the following subclauses specify how the Transaction Capabilities Application Part (TCAP) is used to support ISDN MSR service. These procedures are for MWI Control (Activation and Deactivation) and MWN services.

7.2.1.1 MSR System switch initiates MWI control request

If a network switch, serving an MSR System, receives an MWI control request from an ISDN MSR System, then based on the information derived from the DN indicated in the “destination DN” argument in the FACILITY message, the switch should decide whether to attempt to update an MWI by sending a TCAP message to the switch serving the client user. If the request was unauthorized, the switch should inform the MSR System by sending a FACILITY message with a Facility information element containing a Return Error component.

If the switch determines that a TCAP message should be sent to the switch serving the client user, the TCAP message should have a package type of query with permission and contain a single Invoke component. The content of the Invoke component depends on the content of the MWI control request received from the ISDN MSR System. The operation code of the Invoke component should be set according to the received operation value in the Facility information element described in T1.610 and the related control type argument.

If the received operation value is “Message Waiting Indicator Control” and the related control type argument is “activate,” the SS7 operation code for the component should be set to “Report Event - Voice Message Available.” If the received operation value is “Message Waiting Indicator Control” and the related control type argument is “deactivate,” the SS7 operation code for the component should be set to “Report Event - Voice Message(s) Retrieved.”

The Invoke component should contain a parameter set with at least two Digits parameters, one with Type of Digits coded “Destination Number” (identifies the served user), the second with Type of Digits coded “VMSR Identifier” (a ten-digit number that identifies the MSR System making the message waiting control request). The SS7 Digits parameter with the Type of Digits coded “Destination Number” should be set according to the E.164 destination number argument in or derived from the “destination DN” argument in the Facility information element described in T1.610. If a valid “MSRID” argument is contained in the received MWI control request, the SS7 Digits parameter with the Type of Digits coded “VMSR Identifier” should be set according to this “MSRID” argument. If the received MWI control request did not contain an “MSRID” argument, the SS7 Digits parameter with the Type of Digits coded “VMSR Identifier” should be set according to the **Default MSRID** subscription parameter value.

Other optional parameters, like Bearer Capability Requested, may be included in the Parameter Set, depending on the contents of the received Facility information element. If the MWI control request is for activation, and any of the following arguments are received in the Facility information element:

“mwi type,” “bearer capability,” “calling number,” “display text”, “number of messages”, or “timestamp,” a corresponding SS7 parameter should be included in the Parameter Set and coded according to the contents of the Facility information argument. The corresponding SS7 parameters are: “MWI Type,” “Bearer Capability Requested,” “Digits [ANI(Calling Party Number)],” “Display Text”, “Number of Messages”, and “Timestamp,” respectively.

When the switch sends a TCAP Query to the switch serving the client user to attempt to update an MWI, a timer MWI-T1 should be started.

The description of a generic TCAP message in ASN.1 is contained in annex A in chapter 3 of T1.114. This can be applied to Query, Response, Unidirectional, and Abort messages.

7.2.1.1.1 Report event-voice message available operation

The Report Event family of operations is used to indicate that there has been an event occurrence at a remote location. It is used when a message arrives for an MSR subscriber at a remote ISDN MSR System. The operation is used to notify the MSR client user that a message is available. Subclause 7.2.1.1.2 contains the ASN.1 notation description of “Report Event Voice Message Available” Operation. The names of operations, parameters, and errors in the text have been expanded from the names noted in ASN.1 description to enhance readability.

7.2.1.1.2 ASN.1 Description of report event - Voice message available operation

```
TCAPMSGAVAIL DEFINITIONS
IMPLICIT TAGS                   ::=
BEGIN

   --TCAP Package is defined in Chapter 3 of T1.114.
   --package type identifier value is [11100010] for Query With Permission
   --Transaction ID identifier is coded national, primitive, value 7 [11000111]
   --Transaction ID length 4 [00000100]
   --component sequence identifier is coded national, constructor value 8  [11101000]
   --Invoke component type identifier is coded national, constructor, value 9  [11101001]
   --component ID identifier is coded national, primitive, value 15 [11001111]
   --operation code identifier value is 16 [11010000], defined in national TCAP
   --operation code length is 2 [00000010]

reportEventVoiceMessageAvailable                OPERATION

        --this operation is defined in TCAP specification, T1.114.
        --It is used to indicate that a message has arrived for an MSR subscriber
        --at a remote ISDN MSR System.

PARAMETER SET           {serviceKey  ServiceKey,
                        callingPartyNumber     Digits  OPTIONAL,
                        numberOfMessages  NumberOfMessages OPTIONAL,
                        displayText  DisplayText  OPTIONAL,
                        timestamp  UTCTime   OPTIONAL}

   -- Parameter Set identifier is coded national constructor, value is 18 [11110010]

RESULT SET              {}

   --to indicate successful completion

ERRORS          {taskRefused, unassignedDN,
                notificationUnavailableToDestinationDN,
                vMSRIdDidNotMatchUserProfile,    missingCustomerRecord, unavailableResource}

 ::= 35329
```

-- FAMILY := 138 [10001010], SPECIFIER = 1 [00000001]

ServiceKey::= [10] SET {
destinationNumber Digits,
vMSRidentifier Digits,
bearerCapabilityRequested [18] OCTET STRING OPTIONAL,
mwiType [24] ENUMERATED OPTIONAL}

--coded contextual, constructor, identifier code 10 [10101010]
--the Destination Number is provided by the MSR System

Digits ::= [4] OCTET STRING
--coded contextual, primitive (see 4.5, Chapter 5 of T1.114), identifier code 4 [10000100]
NumberOfMessages ::=[32] INTEGER (0..32767)
--coded contextual, primitive (see 4.34, Chapter 5 of T1.114), identifier code 32 [10011111
--00100000]
DisplayText ::=[33] IA5STRING SIZE (0..20)
--coded contextual, primitive (see 4.35, Chapter 5 of T1.114), identifier code 33 [10011111
--00100001]

UTCTime ::= [UNI 23] VisibleString[2)]

-- The visible string is coded as YYMMDDhhmm + or - hhmm
-- local time Time difference
-- from Greenwich
-- Mean Time

taskRefused ERROR
PARAMETER SET {}
::= 7
--value = [00000111], used when the SS7 network is currently
--overloaded or cannot currently handle the request. Parameter
--set is empty.

unassignedDN ERROR
PARAMETER SET {}
::= 14
--value = [00001110], used when the destination DN is not
--currently assigned to an active interface. Parameter set is
--empty.

notificationUnavailableToDestinationDN ERROR
PARAMETER SET {}
::= 16
--value = [00010000], used when Notification cannot be provided
--to the destination DN for some short term reason (e.g., the line
--is temporarily out of service, or a potential protocol
--(temporary) problem with the far end. Parameter set is empty.

vMSRIdDidNotMatchUserProfile ERROR
PARAMETER {}
::= 17
--value = [00010001], used when the MWI Control request is not
--authorized (i.e., the destination DN is not a customer of the
--identified MSR System.)

[2)] The definition for UTCTime and VisibleString types are universally defined in ITU-T Recommendation X.680.

```
unavailableResource ERROR
        PARAMETER SET {}
        ::= 3
                --value = [00000011], used when the MWN feature is not
                --implemented at the client user switch.  Parameter set is empty.

missingCustomerRecord ERROR
        PARAMETER SET {}
        ::= 4
                --value= [00000100], used when the destination DN is not
                --subscribed to the MWN feature.  Parameter set is empty.

END
```

7.2.1.1.3 Report event - Voice message retrieved operation

The Report Event family of operations is used to indicate that there has been an event occurrence at a remote location. It is used when all MSR client user messages have been picked up at a remote MSR System. The operation is used to remove the voice message waiting indication. Subclause 7.2.1.1.4 contains the ASN.1 notation description of “Report Event - Voice Message Retrieved” Operation. The names of operations, parameters and errors in the text have been expanded from the names noted in ASN.1 description to enhance readability.

7.2.1.1.4 ASN.1 Description of report event - Voice message retrieved operation

```
TCAPMSGRET DEFINITIONS
IMPLICIT TAGS                ::=
BEGIN

   --TCAP Package is defined in Chapter 3 of T1.114.
   --package type identifier value is [11100010] for Query With Permission
   --Transaction ID identifier is coded national, primitive, value 7 [11000111]
   --Transaction ID length 4 [00000100]
   --component sequence identifier is coded national, constructor value 8 [11101000]
   --component type identifier is coded national, constructor, value 9 [11101001]
   --Invoke component ID identifier is coded national, primitive, value 15 [11001111]
   --operation code identifier value is 16 [11010000], defined in national TCAP
   --operation code length is 2 [00000010]

reportEventVoiceMessage(s)Retrieved          OPERATION

        --this operation is defined in TCAP specification, T1.114.
        --It is used when an MSR client user has picked up all his messages
        --at a remote MSR System.

PARAMETER SET                    {serviceKey ServiceKey,
                                 timestamp UTCTime OPTIONAL}

   --Parameter Set identifier is coded, national constructor, value 18  [11110010]

RESULT SET                   {}

        --to indicate successful completion

ERRORS              {taskRefused, unassignedDN,
                     notificationUnavailableToDestinationDN,
                     vMSRIdDidNotMatchUserProfile,   missingCustomerRecord,
                     unavailableResource}

::= 35330

              --FAMILY := 138 [10001010], SPECIFIER := 2 [00000010]

ServiceKey::= [10] SET {
                     destinationNumber Digits,
                     vMSRidentifier Digits,
                     bearerCapabilityRequested [18] OCTET STRING OPTIONAL}

              --coded contextual, constructor, Identifier code 10  [10101010]
```

```
        --the Destination Number is provided by the MSR System

Digits ::= [4]  OCTET STRING

    --coded contextual, primitive (see 4.5 of chapter 5, T1.114), Identifier code 4  [10000100].

UTCTime ::= [UNI 23] VisibleString[2)]

    --The visible string is coded as YYMMDDhhmm  + or -        hhmm
    --                              local time                Time difference from
    --                                                        Greenwich Mean Time

taskRefused ERROR
        PARAMETER SET {}
        ::= 7
                --value = [00000111], used when the SS7 network is currently
                --overloaded or cannot currently handle the request.  Parameter
                --set is empty.

unassignedDN ERROR
        PARAMETER SET {}
        ::= 14
                --value = [00001110], used when the destination DN is not
                --currently assigned to an active interface.  Parameter set is
                --empty.

notificationUnavailableToDestinationDN ERROR
        PARAMETER SET {}
        ::= 16
                --value = [00010000], used when Notification cannot be provided
                --to the destination DN for some short term reason (e.g., the line
                --is temporarily out of service,or a potential protocol
                --(temporary) problem with the far end.  Parameter set is empty.

vMSRIdDidNotMatchUserProfile ERROR
        PARAMETER {}
        ::= 17
                --value = [00010001]. used when the MWI Control request is not
                --authorized (i.e., the destination DN is not a customer of the
                --identified MSR System.)

unavailableResource ERROR
        PARAMETER SET {}
        ::= 3
                --value = [00000011], used when the MWN feature is not
                --implemented at the client user switch.  Parameter set is empty.

missingCustomerRecord ERROR
        PARAMETER SET {}
        ::= 4
                --value= [00000100], used when the destination DN is not
                --subscribed to the MWN feature.  Parameter set is empty.

END
```

7.2.1.2 Receiving results of an MWI control request

After sending the TCAP Query to request MWI control, if the switch serving the ISDN MSR System receives a TCAP message with a Response Package Type and a Responding Transaction ID corresponding to the Query's Originating Transaction ID, it should cancel timer MWI-T1. In addition, the switch should check the type of component in the message and react accordingly:

– if the received TCAP message contains a Return Result component, the switch should determine that an MWI update attempt has been successfully completed and send an acknowledgement of this to the MSR System.

– if the received TCAP message contains a Return Error component, the switch should determine that an MWI update attempt has been unsuccessful and report the failure to the MSR System by sending a Facility information element in a FACILITY message. The Facility information element should contain a Return Error component. The error value in the T1.610 Facility information element should be set according to the error code in the SS7 Return Error component as shown in figure 12. If the SS7 error code is unexpected or unrecognized (i.e, Unexpected Data Value, Unexpected Component Sequence or any other error as defined in Chapter 5 of T1.114), the error value described in T1.610 should be set to "task refused."

– if the received TCAP message contains a Reject component, the switch should determine that an MWI update attempt has been unsuccessful and report the failure to the MSR System by sending a Facility information element in a FACILITY message. The Facility information element should contain a Return Error component. The error value described in the Facility information element described in T1.610 should be set to "task refused."

– if the received TCAP message abnormally terminates the transaction (Abort package type), the switch should determine that an MWI update attempt has been unsuccessful and report the failure to the MSR System by sending a Facility information element in a FACILITY message. The Facility information element should contain a Return Error component. The error value in the Facility information element described in T1.610 should be set to "task refused."

If the timer MWI-T1 expires before the switch receives a TCAP response, the switch should determine that an MWI update attempt has been unsuccessful and report the failure to the MSR System by sending a Facility information element in a FACILITY message. The Facility information element should contain a Return Error component. The error value in the Facility information element described in T1.610 should be "timer expired."

If the switch receives a Unitdata Service message, the switch should determine that an MWI update attempt has been unsuccessful and report the failure to the MSR System switch by sending a Facility information element in a FACILITY message. The Facility information element should contain a Return Error component with an error value in information element of "Task Refused."

7.2.1.3 Notification of waiting messages to the client user

This subclause describes how a switch serving a client user processes a TCAP Query containing an MWI control request. If the switch determines that a TCAP message is to be sent, the switch sends an indication of either success or failure to the switch serving the MSR System.

If the switch serving the client user receives a TCAP message with

– a package type of Query with Permission, and

– a single Invoke component with a parameter set with at least two Digits parameters, one with the Type of Digits field coded "Destination Number," the second with the Type of Digits field coded "VMSR Identifier," the switch should interpret this message as an MWI control request.

If the operation code of the Invoke component is set to “Report Event-Voice Message Available,” the switch should interpret this message as an MWI activation request. The parameter set in an MWI activation request may also contain optional parameters, including an “MWI Type” parameter indicating an MWI type, a Digits parameter with Type of Digits coded “ANI (Calling Party Number)” indicating the number of the party who left the message, and a Timestamp parameter indicating the time a message was received by the MSR System. If the switch determines that the activation request is authorized, the switch should use any received MWI Type parameter value to update the MWI state.

If the operation code of the component is set to “Report Event-Voice Message(s) Retrieved,” the switch should interpret this message as an MWI deactivation request. If the switch determines that the MWI deactivation request is authorized, the switch should update the MWI state.

The switch serving the client user should send a TCAP Response to the switch serving the MSR System, indicating if the attempt to update the MWI is successful. If the attempt is unsuccessful, the TCAP Response should also report the appropriate error condition.

– if the DN specified in the Digits Parameter with Type of Digits coded “Destination Number” is not assigned to an interface or line, the TCAP Response should contain a Return Error component with the error code set to “Unassigned DN.”

– if the Message Waiting Notification feature has not been assigned to the DN specified in the Digits parameter with the Type of Digits coded “Destination Number,” the TCAP Response should contain a Return Error component with the error code set to “Missing Customer Record.”

– if the notification cannot be provided to the destination DN for some short-term reason (e.g., the line is temporarily out of service), TCAP Response should contain a Return Error component with the error code set to “Notification Unavailable to Destination DN.”

– if the client user switch attempts to send detailed notification and the notification attempt is unsuccessful, TCAP Response should contain a Return Error component with the error code set to “Notification Unavailable to Destination DN.”

– if the switch determines that the MWI request is not authorized, the TCAP Response should contain a Return Error component with the error code set to “VMSR ID Did Not Match User Profile.”

– if the switch is currently overloaded and cannot handle the request, the TCAP Response should contain a Return Error component with the error code set to “Task Refused.”

– if the switch determines that the MWN feature is not implemented at the client user switch, the TCAP response should contain a Return Error component with the error code set to “Unavailable Resource.”

– if the switch determines that the MWI request is authorized and if the request is completed successfully, the TCAP Response should contain a Return Result (Last) component. This procedure should also be followed if the MWI is already in the requested state when the MWI request is received.

8 Specifications for protocol interworking

8.1 SS7/DSS1

8.1.1 Message mapping

8.1.2 Parameter/information element mapping

Figure 11 illustrates the mapping between the contents of the ISDN access Invoke Component and the contents of the SS7 TCAP Invoke component for MWI control.

Figure 11 - Invoke component: ISDN access -> SS7

ISDN access invoke component contents	SS7 invoke component contents
Message Waiting Indicator Control +control type = activate	Report Event - Voice Message Available
Message Waiting Indicator Control +control type = deactivate	Report Event - Voice Message(s) Retrieved
Destinations DN (or derived DN if destination DN contains abbreviated number)	Digits -- destination number
mSRID	Digits - VMSR Identifier
bearerCapability	Bearer Capability Requested
callingNumber	Digits - ANI (calling party number)
timestamp	Timestamp
mwiType	MWI Type
displayText	Display_Text
numberOfMessages	Number Of Messages

8.1.3 Error codes/error types mapping

Figure 12 illustrates the error codes used in SS7 and the corresponding error type used in the ISDN access Facility Information element Return Error Component.

Figure 12 - Error codes: SS7 -> ISDN access

SS7 Error	ISDN access error type
Task Refused or other unrecognized or unexpected error codes	task refused
Unassigned DN	unassigned DN
Notification Unavailable to Destination DN	notification unavailable to destination DN
VMSR ID did Not Match User Profile	MSRID did not match user profile
Unavailable Resource	task refused
Missing Customer Record	missing customer record
Protocol errors	task refused

8.2 ISDN/non-ISDN

If a switch serving a non-ISDN client user receives a Query Message for MWI Control from an MSR System which includes:

a) “Bearer Capability Requested”: The switch may discard this parameter.

b) “MWI Type”: The switch may discard this parameter.

c) “Display Text”: The switch may discard this parameter.

d) “Number of Messages”: The switch may discard this parameter.

8.3 Interworking with the Previous Version of this Standard (T1.622-1992)

The introduction of new, optional parameters (i.e., DisplayText and NumberOfMessages) in the TCAP query for MWN causes a compatibility problem when the parameters are included in a query message sent to a node using the previous version of the standard. The new parameters would not be understood, and the whole message would be rejected. The MWI service is based on an established relation between the MSR System and the local exchange serving the Client user. Because such an established relation exists, the MSR system can keep a data element indicating if new parameters would be understood by the local exchange serving the Client user. In the absence of such data, the MSR system should not include the new parameters.