Note - The digital system used between the LT and NT1 may contain regenerators, which may also contain a loopback.

FIGURE 13/I.601

Location of loopbacks

Reference:

[1] CCITT Recommendation Reference model of open system interconnection for CCITT Applications Vol.VIII Recommendation X.200.

avoid interference with looped signal

FIGURE 11/I.601

Transparent loopback

ii) A non-transparent loopback is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated is not the same as the received signal at the loopback point. The forward signal may be a defined signal or unspecified.

Non-transparent, complete loopback
(Complete loopback of full bit stream, non-transparent with regard to bit stream in forward direction.)

X = signal inhibited in order to avoid interference with looped signal

L1 - Device which changes or inhibits the transferred signal

FIGURE 12/I.601

Non-transparent loopback

Note - Whether or not a transparent loopback is used, the loopback should not be affected by facilities connected beyond the point at which the loop is provided, e.g. by the presence of short circuits, open circuits or foreign voltages.

5.3 Loopback locations in the subscriber access and subscriber installation

Figure 13/I.601 shows the numbering and location of loopbacks described in the I-Series of Recommendations.

The characteristics and implementation status of these loopbacks are given in the appropriate I.600-Series Recommendation.

Note 1 - The generation of the test pattern used over the loopback may or may not take place at the control point.

Note 2 - Loopback requests should be subject to identification and authorization.

Note 3 - Possible locations of loopback requesting points are:
The network, or a TMN, or a maintenance service providers (MSP).

The following three types of loopback mechanisms are defined:

a) Complete loopback - a complete loopback is a physical layer [1] mechanism which operates on the full bit stream. At the loopback point, the received bit stream shall be transmitted back towards the transmitting station without modification.

Note - The use of the term "complete loopback" is not related to implementation since such a loopback may be provided by means of active logic elements or controlled unbalance of hybrid transformer, etc. At the control point only the information channels may be available.

b) Partial loopback - a partial loopback is a physical layer [1] mechanism which operates on one or more specified channels multiplexed within the full bit stream. At the loopback point, the received bit stream associated with the specified channel(s) shall be transmitted back towards the transmitting station without modification.

c) Logical loopback - a logical loopback acts selectively on certain information within a specified channel or channels and may result in some specified modification of the looped information. Logical at any layer 2 loopbacks may be defined to apply at any layer [1], depending on the detailed maintenance procedures specified.

For each of the above three types of loopback mechanisms, the loopback may be further categorized as either transparent or non-transparent. (See Figures 11 and 12/I.601.)

i) A transparent loopback is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated, is the same as the received signal at the loopback point.

Transparent, complete loopback
(Complete loopback of full bit
stream, transparent with regard to
bit stream in forward direction.)

X = signal inhibited in order to

Note: In some countries certain NT1 functions are within the control domain of the SIME.

FIGURE 10/I.601

Control Domain of SIME

Since the SIME supervises the correct functioning of the peer-to- peer communication between protocol layer entities, failures outside its control domain will be recognized by the layer 2 and 3 processes on the subscriber equipment and reported by them to the SIME (i.e. layers 2 and 3 failures in the D Channel entities of the exchange (ET), and layer 1 failures beyond the T reference point, as seen by the subscriber). Automatic additional failure localization may be necessary to have clear differentiation between failures in the subscriber installation and the subscriber access.

5. Loopbacks

5.1 Use of loopbacks

In general loopbacks are used for failure localization and verification as defined in M.20.

The use of loopbacks should not result in unnecessary activity in the terminal layer 2 functions, resulting in possible error reporting by the terminal management function to the user or his MSP.

5.2 Digital loopback mechanism definitions

A digital loopback is a mechanism incorporated into a piece of equipment whereby a bidirectional communication path may be connected back upon itself so that some or all of the information contained in bit stream sent on the transmit path is returned on the receive path.

The loopback point is the location of the loopback.

The loopback control point is the point which has the ability to directly control loopbacks and should be located as close as possible to the loopback point.

The loopback control point may receive requests for loopback operation from several loopback requesting points.

The loopback requesting point is the point which requests the loopback control point to operate loopbacks.

4.2.1 The control domain of the SAME

The control domain of the SAME is shown in Figure 9/I.601.

Note - In some countries certain NT1 functions are within the control domain of theSIME.

FIGURE 9/I.601

Control Domain of SAME

Since the SAME supervises the correct functioning of the peer-to-peer communication between protocol layer entities, failures outside its control domain will be recognized by the layer 2 and 3 processes in the ET and reported by it to the SAME (i.e. layers 2 and 3 failures in the B Channel entities of the subscriber installation, and layer 1 failures on the T reference point). Automatic additional failure localization may be necessary to have clear differentiation between failures in the subscriber installation and the subscriber access.

4.2.2 The control domain of the SIME

The control domain of the SIME is given in Figure 10/I.601.

An administration may wish to mark an access "out of service due to operational reasons" for example, due to payment deficiencies by the customer.

Call offering (either originating and/or terminating) may be rejected.

Note - In any of the conditions testing (and/or measurements) may be in progress. The availability of the access call offering will be dependent on the specific test in progress. Whether the test or the call attempt is rejected (in the case of a collision) is dependent on the specific test and/or the administration. Further study is required.

4. Control domain on the ISDN subscriber basic access

4.1 General

In Figure 8/I.601 the layered communication configuration is shown for the ISDN subscriber access showing also the SIME, SAMC and the OAMC.

Note 1 - The SAME will communicate with the OAMC, however, this is outside the scope of this Recommendation.

Note 2 - Some functions of the SAME and OAMC may be distributed.

FIGURE 8/I.601

Layered Communication Configuration

4.2 Control domains

The control domain is defined as the grouping of those protocol layer entities which are under the supervision and control of a management entity (e.g. SAME or SIME).

3.5.1.1Correct functioning

An access which is fully equipped has been allocated an ISDN number(s) and is correctly functioning (meeting all the network performance and operational requirements) is considered to be "in service". The access can be either busy or free in this condition.

3.5.1.2Degraded transmission

An access is said to be in the "degraded transmission" condition when the transmission of the digital section has degraded sufficiently to cause the initiation of further maintenance activity. The amount of degradation at which the maintenance activity is initiated is service dependent.

In this condition call offering is not changed (i.e. the same as for the "in service" condition). The levels at which an access enters the degraded transmission condition may be dependent on the quality of service provided to the customer.

These levels are found in other Recommendations.

3.5.2Out of service

3.5.2.1Out of service due to failure (unavailability state)

When a failure exists and has been detected such that the network performance is below an acceptable limit the access is considered to be "out of service due to failure". In such a condition call offering may be rejected or attempted as normal. In the latter case, the call offering may not be successful and normal clearing with cause may not be possible.

Examples of failure conditions are:

- unacceptable transmission performance;
- access in a failure condition;
- failure of subscriber installation;
- failure of the digital transmission section;
- failure within individual exchange subscriber equipment;
- local exchange failure.

3.5.2.2Out of service due to operational reasons

This condition is included for information but is not considered further in this Recommendation.

Note 3 - The OAMC acts as the communication agent for the SAME.

FIGURE 7/I.601

Communication Relationships

The connections shown in Figure 7/I.601 represent the allowed communication paths that use the protocol architecture defined in Recommendation Q.940. These communications are subject to security procedures implemented by the receiver of the message.

The subscriber access maintenance entity (SAME) controls the subscriber access maintenance functions and provides communications for such activities. The SAMC functions might be distributed.

The operations Administration and Maintenance Centre (OAMC) consists of a group of functions and staff. In the context of this Recommendation the OAMC is responsible for the communication with, and the controlling of, the subscriber access maintenance functions, as provided by the SAME.

The OAMC may also be responsible for the communication with and the controlling of other maintenance functions, as provided by other management entities. Such functions are outside the scope of this Recommendation. Therefore, the SAMC can be considered as the grouping of the SAME, communication path and part of the OAMC.

3.4.2Security provisions

To facilitate maintenance procedures and failure localization, management entities responsible for different control domains may communicate. However, since management and maintenance information is of critical importance to system integrity, access to management functions and information is subject to prior authorization and security restrictions upon access.

The security restrictions are enforced by the recipient of the maintenance request and may include requirement for user authentication (identification), the use of passwords and/or limited access based on originating line.

The use of adequate security mechanisms is especially important in the case of the OAMC since maintenance functions for many users may be affected by unauthorized access.

3.5Maintenance conditions for an ISDN subscriber access

In general, a subscriber access can be considered to be in one of the following conditions for the purpose or explanation of the relationship between maintenance and trafficability in this Recommendation.

3.5.1In service

MSP: Maintenance Service Provider

Note - In some countries the subscriber installation is allowed to control certain maintenance functions in the subscriber access without authorization of an SAMC.

FIGURE 6/I.601

Communication configuration for maintenance
as a subscriber installation by an MSD
connected to the ISDN via an S or T
reference point

3.4 Management configurations

3.4.1 Relationships

In Figure 7/I.601 the communication relationships between the management entities required to support the functions in this series of Recommendations are given. It does not imply any network physical model.

Note 1 - As shown here, only the relationships are indicated since the interface are outside the scope of this Recommendation.

Note 2 - In this case the subscriber is acting as his own MSP.

SAMC: Subscriber Access Maintenance Centre
SIME: Subscriber Installation Maintenance Entity
MSP: Maintenance Service Provider

Note - In some countries the subscriber installation is allowed to control certain maintenance functions in the subscriber access without authorization of an SAMC.

FIGURE 5/I.601

Communication configuration for maintenance of a subscriber installation by an MSP with the ISDN

3.3.5 Communication configuration for maintenance of a subscriber installation by an MSP connected to the ISDN via an S or T reference point

Figure 6/I.601 shows the communication configuration between an MSD at reference point S or T and the subscriber installation.

SAMC: Subscriber Access Maintenance Centre
SIME: Subscriber Installation Maintenance Entity

SAMC: Subscriber Access Maintenance Centre
SIME: Subscriber Installation Maintenance Entity
MSP: Maintenance Service Provider

Note 1 - Test request and/or response are made by normal calls or automatic procedures after authorization. Protocols for the automatic procedure are to be defined. The MSP has no direct control over subscriber access maintenance.

The SAMC tests the subscriber access according to other sections of this Recommendation.

Note 2 - A subscriber may act as his own MSP, requesting the SAMC to perform tests on his own subscriber access.

FIGURE 4/I.601

Communication configuration for maintenance of a subscriber access by an SAMC requested by an MSP

3.3.4 Communication configuration for maintenance of a subscriber installation by an MSP within the ISDN

Figure 5/I.601 shows the communication configuration between an MSP within the ISDN and the subscriber installation.

The communication paths are shown by bold lines within the following figures.

3.3.2 Communication configuration for maintenance of a subscriber access by the SAMC

Figure 3/I.601 shows the communication configuration between the subscriber access and the SAMC.

SAMC: Subscriber Access Maintenance Centre
SIME: Subscriber Installation Maintenance Entity
MSP: Maintenance Service Provider

FIGURE 3/I.601

Communication configuration for the maintenance of a subscriber access by the SAMC

3.3.3 Communication configuration for maintenance of a subscriber access by a SAMC requested by a MSP

Figure 4/I.601 shows the communication configuration between an MSP and a SAMC that allows the MSP to request maintenance information and actions related to the subscriber access.

- control of internal testing and maintenance mechanisms.

It is considered that the functions of the SIME may be distributed throughout layers 1-3 and management/maintenance entities, including NT1 functions in some applications, but the precise architecture and protocol of the SIME is not a subject of this Recommendation.

3.2.2.3MSP - Maintenance Service Provider

i) The MSP represents a group of functions, equipment and maintenance staff, which together have the responsibility for maintaining a subscriber installation or a part of the subscriber installation. A MSP cannot control the maintenance functions of the subscriber access. If authorized, it can request an SAMC to perform these functions.

ii) Agreement and responsibility for maintenance between the subscriber and the MSP for each part or parts of the subscriber installation should be made at the time of subscription to the maintenance service (this may take the form of a commercial contract). In any case, provision to allow a customer to change the maintenance service provider(s) is recommended. The subscriber may choose not to make such an agreement with MSP.

iii) Maintenance service providers can be:

- private providers;
- the Administration.

Note - A subscriber can act as his own MSP.

iv) A private maintenance service provider external to ISDN is connected to the ISDN via a recommended T reference point. An administration's maintenance service provider may be connected to the ISDN via a recommended T reference point or via an interface which is internal (out of the scope of this Recommendation) to the ISDN. More than one MSP may have the responsibility to maintain one subscriber installation. The responsibility for maintaining each equipment shall be unique. Other interfaces are for further study.

v) If authorized the MSP can invoke maintenance function in SIME. It is the sole responsibility of a subscriber installation and not of the network to ensure that an unauthorized MSP cannot get access to maintenance functions in the subscriber installation.

3.3Communication configurations

3.3.1General

The presentation of the relationships between the functional blocks SAMC, SIME and MSP and the configurations to be maintained has been completed by figures showing the various communication paths.

SAMC: Subscriber Access Maintenance Centre
SIME: Subscriber Installation Maintenance Entity
MSP: Maintenance Service Provider

Note - In the case where the subscriber installation does not contain a NT2 the S and T reference points are coincident.

FIGURE 2/I.601

Reference configuration for maintenance activities

3.2.2Definitions

3.2.2.1SAMC - Subscriber Access Maintenance Centre

A SAMC represents a group of functions, network equipment elements and staff controlled by the Administration, which together have the responsibility and capability for maintenance functions and maintenance actions within the subscriber access, such as defined in Figure 2/I.602.

The equipment and functions may be centralized or distributed in the network, local exchange and subscriber access. The architecture of the SAMC and its internal interface(s) between SAMC staff equipment(s) is presented in section 3.4 of this Recommendation. Conceptually, the SAMC is considered to be a single functional entity within an ISDN, as seen by the subscriber.

3.2.2.2SIME - Subscriber Installation Maintenance Entity

An SIME represents a group of dedicated functions contained within the functional groups (as specified in Recommendation I.411) of the subscriber installation which have the following purposes, e.g.:

- interaction with the (human) user:

- handling of maintenance protocol from the subscriber installation and/or maintenance service provider;

The definitions contained in this figure are the ones used in the I.600-Series Recommendations.

Note 1 - The NT2 functional grouping may be null. In this case the S and T reference points are coincident.

Note 2 - The ISDN subscriber access contains a digital section which can use a variety of transmission techniques and may also include a regenerator.

Note 3 - A digital section could be a basic rate section, a primary rate section, or a multiplexed basic rate section.

FIGURE 1/I.601

Simplified ISDN subscriber access and installation
configuration (based on CCITT Recommendations I.411 and Q.512)

3.2 Network configuration and definition for maintenance activities

3.2.1 Network configuration

Figure 2/I.601 is the basis for the general maintenance principles of the ISDN access and subscriber installation.

Recommendation I.601).

1.4Recommendation I.604 describes maintenance of the network portion of the ISDN Primary Access (2048 and 1544 kbit/s) following the same principles as Recommendation I.603.

The functions by the digital transmission section and the exchange termination (ET) are identified.

The functions are supervised and/or controlled by the network or administration.

1.5Recommendation I.605 describes the maintenance of a multiplexed Basic Rate System. Reference is made to Recommendations I.603 and I.604 when common mechanisms are applied.

These functions performed by the digital section of the ISDN basic rate access, the basic access multiplexer, the digital link, and the exchange (ET) are identified.

These functions are supervised and/or controlled by the network or administration.

2.Objectives

In order to try and meet overall objectives, a number of points have been identified for Administrations, Recognized Private Operating Agencies and Maintenance Service Providers (see § 3.2.2.3):

i) to detect fault conditions, identify the failed maintenance entity, take system protection actions, inform the maintenance staff of administrations and Recognized Private Operating Agencies.

ii) to incorporate facilities to enable the failure to be located by the maintenance staff so that failure correction is achievable by a single attendance to the failed location;

iii) to provide an appropriate maintenance organization and levels of staffing such as to achieve goals for out of service repair times;

iv) to incorporate facilities to allow clear differentiation of failures between subscriber installation and the network;

v) to incorporate facilities to allow clear differentiation between failures and normal subscriber activities.

3.The network reference model

3.1ISDN subscriber access and installation configuration

Figure 1/I.601 shows the simplified ISDN subscriber access and installation configuration (based on CCITT Recommendations I.411 and Q.512).

CONTENTS

I.601: General maintenance principles of ISDN subscriber access and subscriber installation

I.602: Application of maintenance principles to ISDN subscriber installation

I.603: Application of maintenance principles to ISDN basic accesses

I.604: Application of maintenance principles to ISDN primary rate accesses

I.605: Application of maintenance principles to static multiplexed ISDN basic accesses

Recommendation I.601

GENERAL MAINTENANCE PRINCIPLES OF ISDN SUBSCRIBER ACCESS AND SUBSCRIBER INSTALLATION

1.Scope of application

1.1This Recommendation outlines the general aspects and principles relating to the Reference Configurations and general architecture for each kind of subscriber access (basic, primary, multiplexed, higher rate) and associated subscriber installations. This is given in terms of the function groupings and the interconnecting communication parties.

Also loopback definitions and their locations used in this Recommendation are given.

1.2Recommendation I.602 is concerned with the maintenance of the ISDN subscriber installation. It is given in a general way for functions which are NT2 and TE design dependent and more precisely where it impacts directly on the S or T interface (i.e. in relation to Recommendations I.430, I.431).

These functions are supervised and/or controlled by the subscriber installation.

The ISDN management protocols which provide this activity are contained in Recommendation Q.940 on ISDN user-network management and maintenance protocols.

1.3Recommendation I.603 describes maintenance for the network portion of the ISDN Basic Access (144 kbit/s). They are presented in a common format with other similar CCITT Recommendations in conformance with Recommendation M.20.

The functions performed by the digital transmission section and the exchange termination (ET) are identified.

These functions are supervised and/or controlled by the network or administration (see § 3.3 of