

# Local Loop

## ISDN Test Solutions

### Access and Equipment





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<http://isdn.wg.com>



# Table of Contents

## ABOUT ISDN

ISDN Network Topology .....	4
ISDN Basics .....	5

## ISDN MEASUREMENTS

Test of S <sub>0</sub> bus/Cabling at Customer Premises .....	6
TE Simulation Mode .....	6
NT Simulation Mode .....	6
Bit Error Ratio Test (BERT) .....	6
Test of Bearer Services and Teleservices (BC, HLC, LLC) .....	7
Supplementary Services Test .....	7
X.25/D and X.25/B Test .....	7
D-Channel Trace .....	7
Monitoring .....	8
U Interface (BRA) .....	8
Equipment In Situ .....	9

## APPLICATIONS

Cabling at Customer Premises .....	10
ISDN BRA and PRA Installation .....	11
ISDN BRA and PRA Commissioning .....	12
ISDN BRA and PRA Maintenance .....	13
ISDN Equipment Installation and Maintenance .....	14

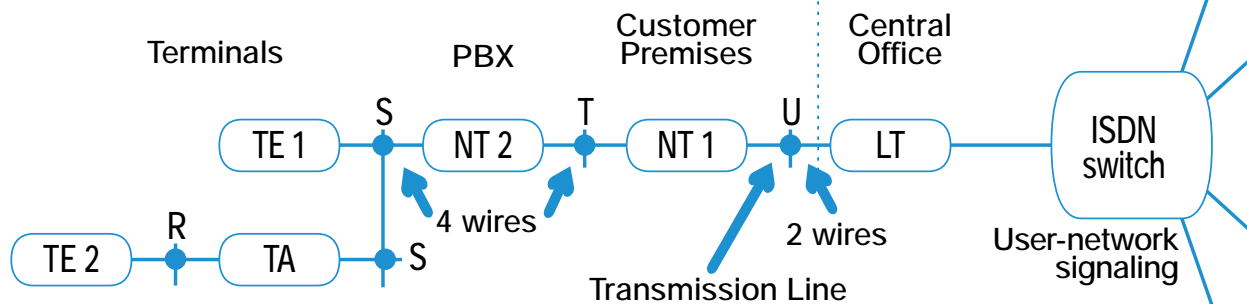
## PRODUCT LITERATURE

List of available documentation .....	15
IBT-5, ISDN Tester for the Basic Rate Access .....	16
IBT-10, ISDN Tester/Analyzer for the Basic Rate Access .....	17
IBT-20, ISDN Tester/Analyzer for the Primary Rate Access .....	18
IMK-30/-31/-32, ISDN Tester/Analyzer for the Basic and Primary Rate Accesses .....	19
Windows™ PC Detailed Decoder, Real-Time Analysis Software .....	20
IST-15, ISDN/LAN Cable Tester .....	21
IUM-10, ISDN U-Interface Monitor .....	22
DA-5, Multiport Protocol Analyzer .....	23
DominoWAN ISDN, ISDN Internetwork Analyzer .....	24
Examples of ISDN Collaterals .....	25
'Guide to ISDN Test Solutions' Poster .....	26



# About ISDN

## ISDN Network Topology



### ISDN Functional Groups Reference Points

LT: Line Termination

NT1: Network Termination 1 handles physical layer interface functions such as line termination, power transfer and timing

NT2: Network Termination 2 handles function of an NT1 plus layer 2 and layer 3 functions such as multiplexing, switching and concentration

TE1: End-user equipment such as ISDN phones or data terminals compliant with ISDN call set up procedures and capable of interfacing directly to the S bus

TE2: End-user equipment for non-ISDN environments (typically uses an R8232 interface)

TA: Terminal Adapter supports ISDN call set up and provides a way to connect TE2s

## Acronyms and definitions:

- BC: Bearer Capability
- HLC: High Layer Compatibility
- LLC: Low Layer Compatibility
- TEI: Terminal End Point Identifier
- SAPI: Service Access Point Identifier
- NEBE: Near End Block Error
- FEBE: Far End Block Error
- PSDN: Public Switched Data Network



# About ISDN

## ISDN Basics

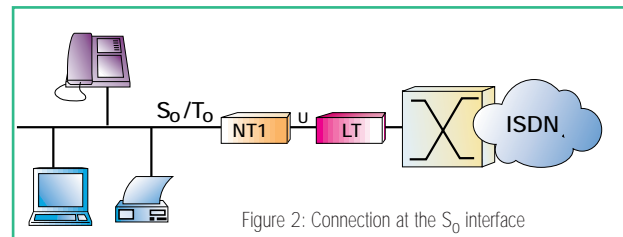
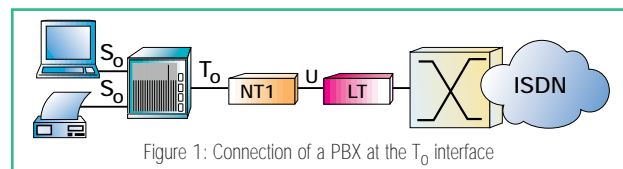
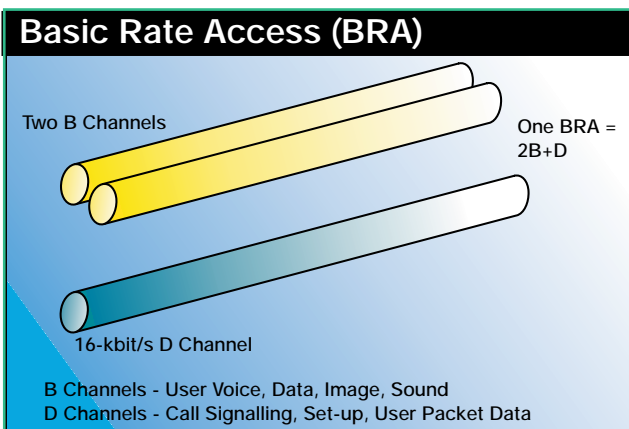
An end-user is connected to the local exchange over a twisted pair (the local loop). ISDN reuses this local loop to provide users with digital communications. ISDN offers bearer services (speech, data), teleservices (phone, Fax G4) and some facilities called Supplementary Services such as Call Forwarding, Three-way conference, Charging information, etc. In addition, ISDN offers a gateway to packet-switched data networks (X.25).

ISDN standards define the rules for this interface between the user and the network.

Two different types of access interfaces are offered: the Basic Rate Access (BRA) and the Primary Rate Access (PRA).

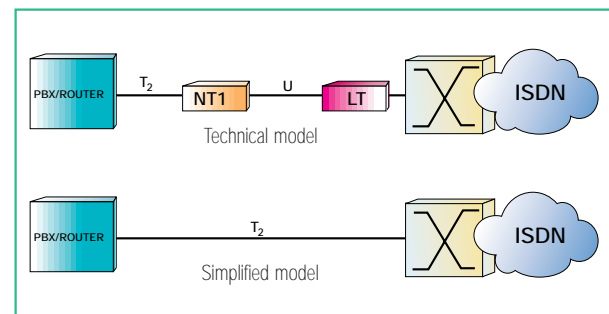
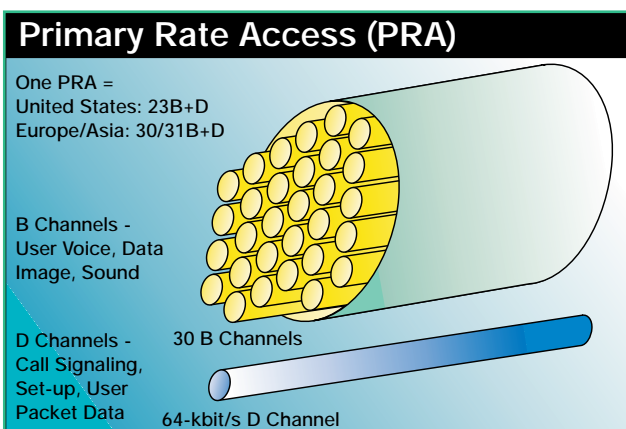
## The Basic Rate Access (BRA)

Two communication channels (64 kbit/s), called B channels, are available to provide up to 2 simultaneous communications thanks to a D channel (signaling with a rate of 16 kbit/s). The BRA provides the means to connect one (point-to-point) or several devices (point-to-multipoint) to the network. The U interface (2 wires) is owned by the network administrator. The line code on the U interface is 2B1Q in most countries but line code 4B3T can be found in Germany and Belgium. The S/T interface (4 wires) is used to connect a PBX/router at the  $T_0$  interface (see figure 1) or to connect one or several devices at the  $S_0$  interface (see figure 2).



## The Primary Rate Access (PRA)

The Primary Rate Access offers a higher bandwidth by providing 30 (Europe/Asia) or 23 (United States) B channels with a D-channel signaling of 64 kbit/s. The PRA is a point-to-point configuration with a data rate of 2.048 Mbit/s. ISDN reuses the PCM technology (G.703, G.704).





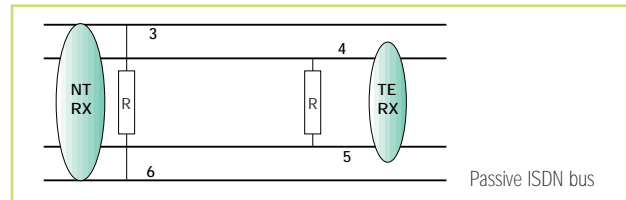
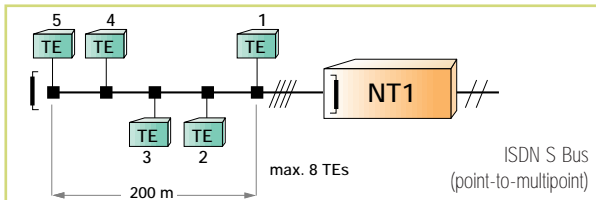
# ISDN Measurements

## Test of S<sub>0</sub> bus/Cabling at Customer Premises

For the BRA, a specific topology called the S bus is used to connect one or several devices to the NT1.

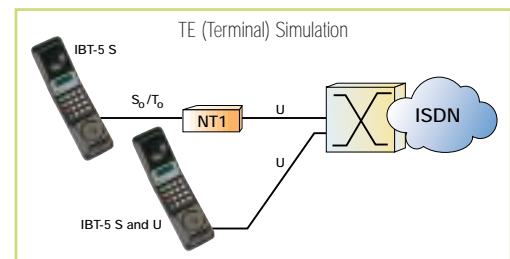
The topology used is either a point-to-point configuration (in that case the maximum distance between the NT1 and TE can be up to 1 km) or a point-to-multipoint configuration. In the case of a point-to-multipoint configuration, a passive bus configuration is used (see figure below): up to 8 TEs can be connected anywhere on a bus which is limited to a length of around 200 m.

There is one termination resistance of 100 (for each transmission pair). All devices on the S bus are powered by the NT1 providing the power (PS1 or PS2).



## TE Simulation mode

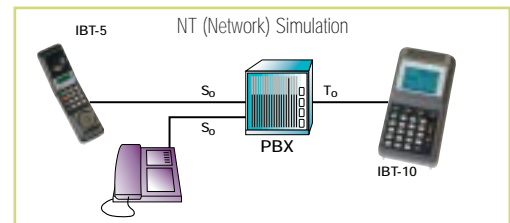
The TE simulation mode is used to replace a terminal. The tester can be connected on the S/T or U interface for a BRA and on the T<sub>2</sub> interface for a PRA. The equipment is used in the same way as an ISDN telephone to place phone calls to test the availability of the network. DTMF is needed to check facilities such as voice mail. The TE mode also enables testing of the quality of the access and the availability of bearer services, teleservices and supplementary services.



## NT Simulation mode

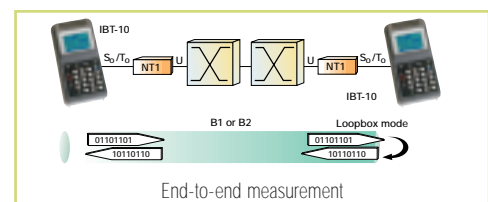
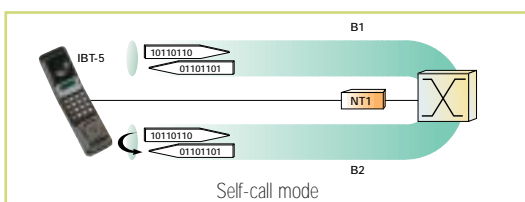
To test a user installation prior to connection to the network, the NT simulation mode is used to replace the network at the S/T interface (BRA) or T<sub>2</sub> interface (PRA). The NT simulation mode is the key-feature when installing a PBX or a router. The test equipment is used to verify and modify the equipment configuration (addressing plan) by calling terminals with various bearer services and teleservices.

Some supplementary services such as SUB-addressing (SUB), Advice Of Charge (AOC), Multiple Subscriber Number (MSN) or Direct-Dial-In (DDI) can be easily tested thanks to the NT simulation.



## Bit Error Ratio Test (BERT)

The quality is tested by first making a call and then sending a pseudo-random binary sequence (PRBS) within the B channel allocated for the call. The received sequence is evaluated according to the ITU-T standard G.821. The test is carried out in self-call mode to test the quality of the local access (test of the local loop between the user and the local exchange) or the test is an end-to-end measurement using another device in the network to measure the quality over a circuit.

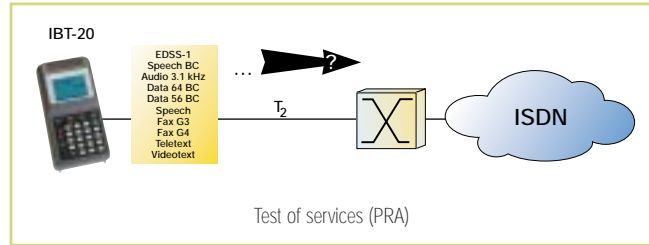




# ISDN Measurements

## Test of Bearer Services and Teleservices (BC, HLC, LLC)

ISDN provides users with a set of bearer services and teleservices (including an HLC and/or LLC). Teleservices are end-to-end services (Application Layer) while bearer services only offer a specific transmission capability (Network Layer). As ISDN applications rely on these services, the available services have to be tested during the installation or commissioning stages (especially for a PBX/router which could filter or modify the HLC/LLC information sent by the terminal). The tester provides an automatic test with a user-defined list of services.

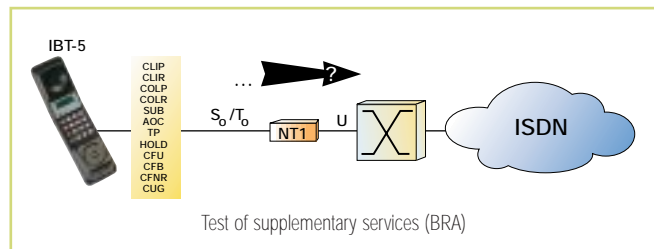


## Supplementary Services Test

ISDN offers a wide range of facilities called "Supplementary services": call diversion, call identification, conferencing etc. (Refer to our ISDN Pocket Guide No. 1 "ISDN Supplementary Services" for more information).

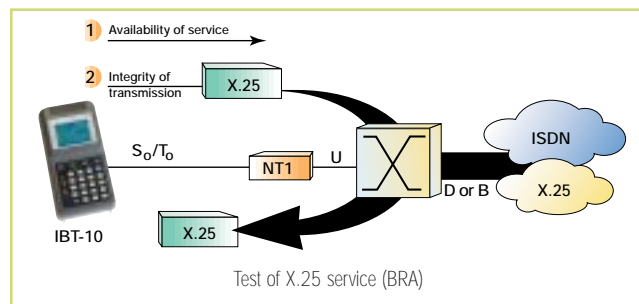
Supplementary services are optional and depend on the user subscription. Several protocols (Functional protocol, Keypad protocol and sometimes both) may be found on an ISDN

access, thus increasing the complexity of the test. The test equipment is used to easily and quickly determine which supplementary services are available on the access undergoing test and allows the user to activate/interrogate/deactivate a supplementary service: in that case the tester is used as an ISDN phone to perform a functional test on a specific supplementary service. Regarding the number of supplementary services which have to be tested, an automatic test based on a user-defined list (the supplementary services which should be available depending on the user subscription) is mandatory.



## X.25/D and X.25/B Tests

ISDN also provides the capacity to access a switched packet data network (X.25) using the D channel or the B channel. The tester sets up a real X.25 call (in self-call mode or using a loopbox), then sends some data packets (using a packet generator) which are sent back by the network. Thus the tester can measure X.25 parameters (throughput) and provides statistics on X.25 layer 2 (number of frames) and layer 3 (number of packets transmitted/received).



## D-Channel Trace

When a problem occurs in TE mode (unsuccessful call, unexpected call release etc.), a D-channel protocol trace is necessary to locate the problem. The trace gives all the messages sent by/received from the terminal. This is particularly useful when installing an ISDN access or equipment (PBX). Filters (per layer, SAPI, TEI) are available to easily display the relevant information.





# ISDN Measurements

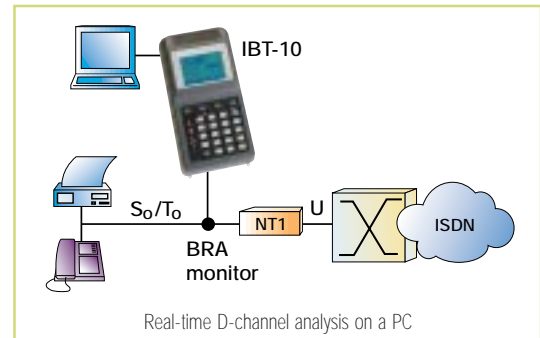
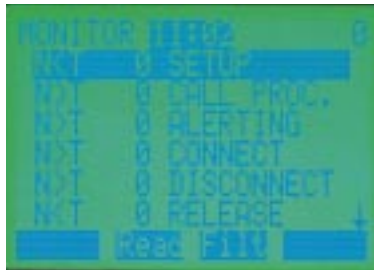
## Monitoring

Monitoring is the protocol analysis in high-impedance mode at S/T/U interfaces for BRA or T<sub>2</sub> interface for PRA (or on U interface when a PCM link is used).

This test is mainly used for maintenance applications

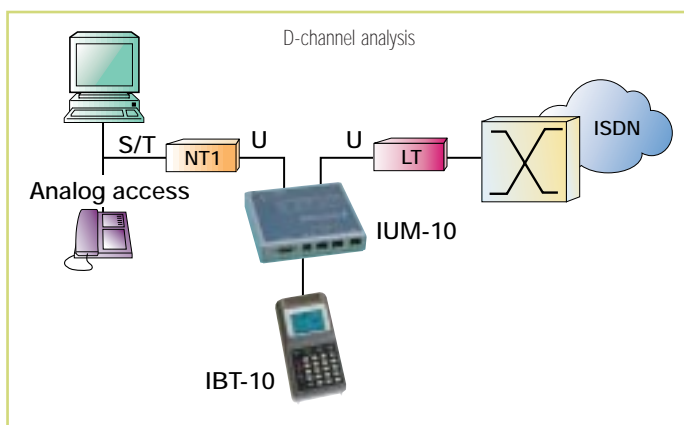
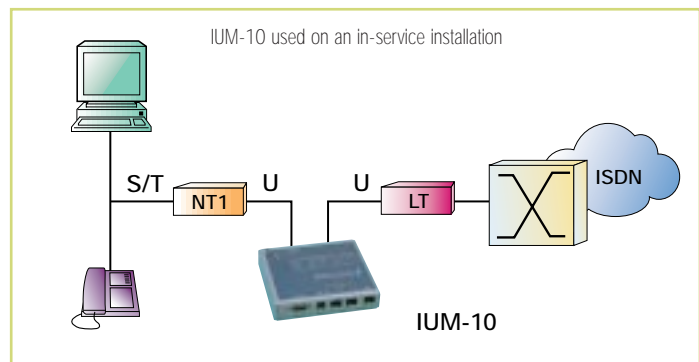
(troubleshooting). The D-channel signaling is displayed directly in real time either on the tester or on a PC (via a serial link) for long-term measurements.

The connection of a device at the U interface (BRA) in high-impedance mode to monitor the signaling is not possible, due to the transmission technology used: echo cancellation. To make this test possible at the U interface, a U repeater has to be inserted on the line to extract/regenerate an S interface (See description above).



## U Interface (BRA)

The analysis of layer 1 events (activation or deactivation, loops requested by the local exchange) or quality problems (NEBE, FEBE) are possible thanks to a U-monitoring device (U repeater). For more information refer to the Application Note 63 (Supervision and analysis at the U interface).

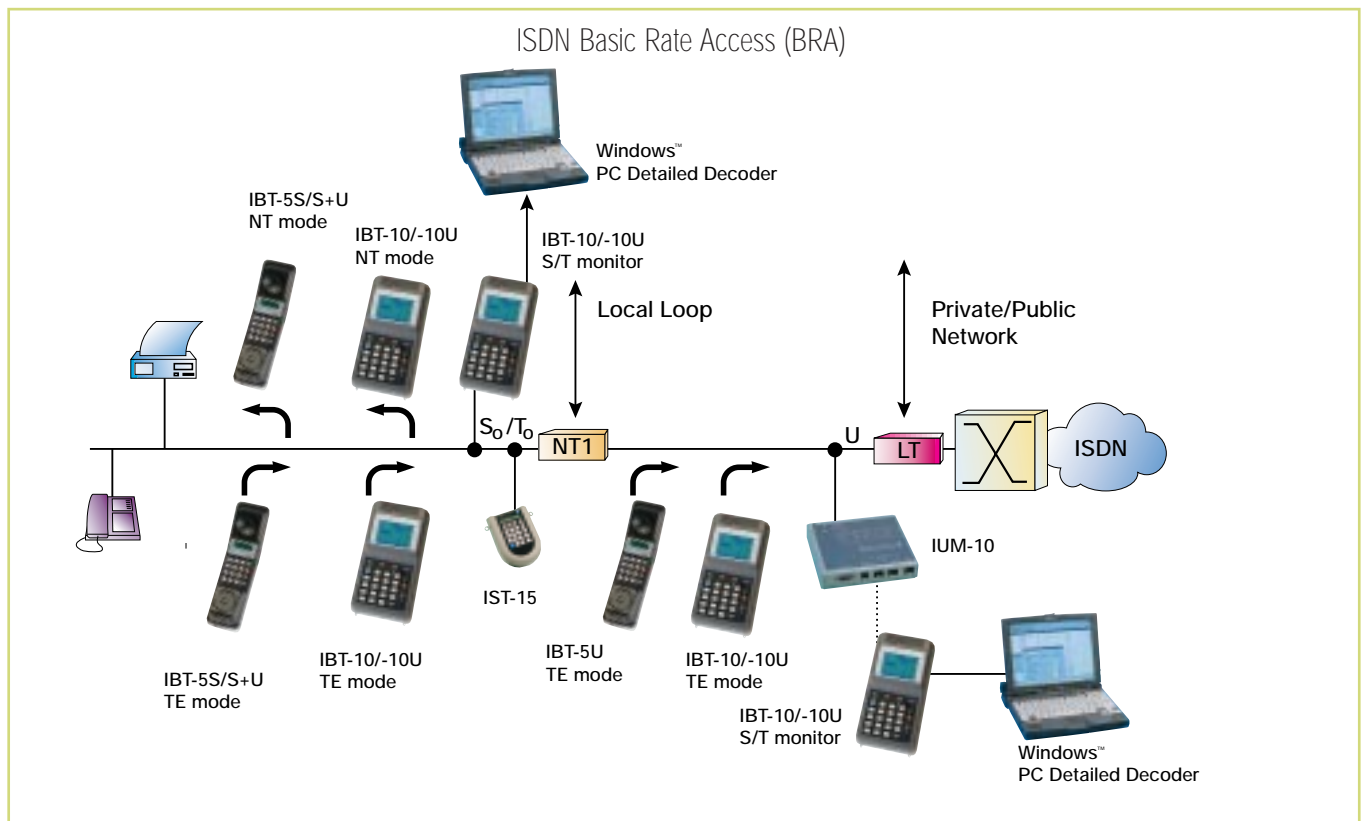


Certain ISDN routers include the NT1 function and are therefore connected directly to the U interface. Others are more traditionally connected to the S/T interface behind an NT1. As the U repeater extracts an S interface, the analysis of the D-channel signaling is possible.

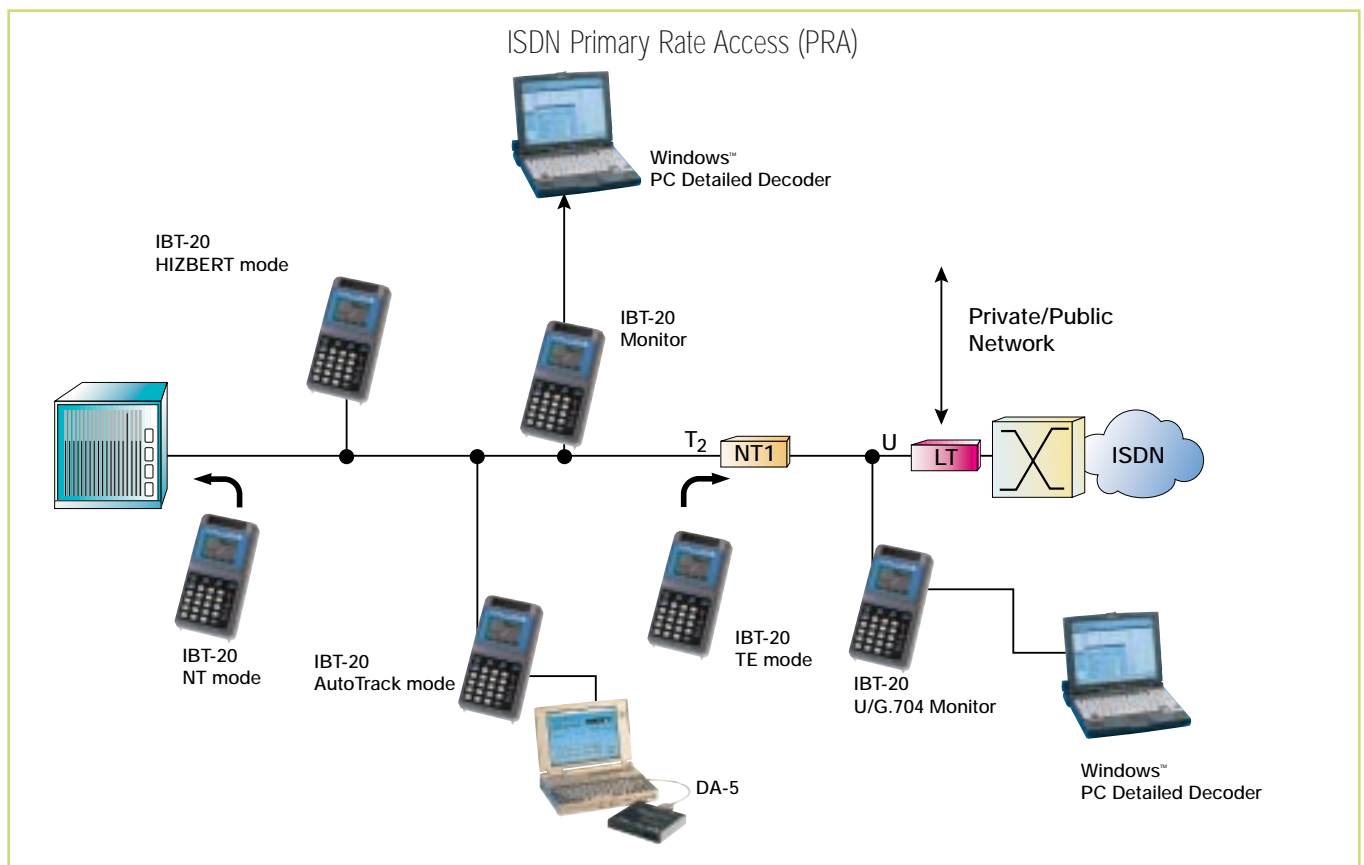


# ISDN Measurements

## Equipment In Situ



9





# Applications

## Cabling at Customer Premises

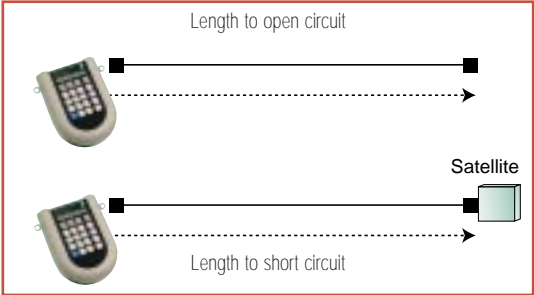
When installing ISDN cabling at customer premises, the wiring is checked by carrying out simple cabling measurements e.g. open wires, short circuits. In order to verify that the topology of the ISDN installation meets the standards (maximum length of the installation), it is necessary to be able to measure the length.



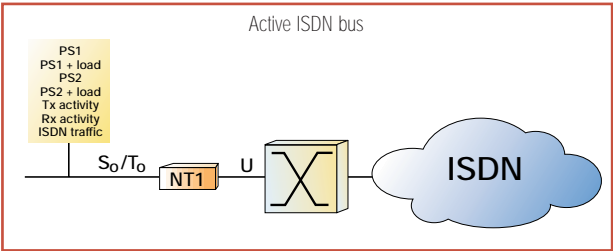
Cable testing



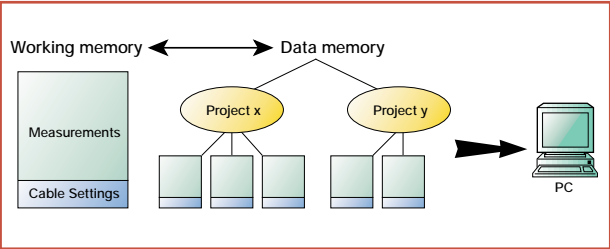
Satellite



The power provided by the NT1 should then to be checked. Measuring the voltage is not sufficient. The tester should place a specific load on the bus to detect if some power is present.



10



All test results have to be printed or transferred to a PC, thus a documentary proof can be delivered and archived.

Installation, maintenance and commissioning of structured cabling at customer premises	IST-15	
	IST-15	(BN 7533/40)
	IMK-1X	
	IMK-10 (IST-15 + IBT-10)	(BN 7533/80)
	IMK-11 (IST-15 + IBT-10U 2B1Q)	(BN 7533/81)
	IMK-12 (IST-15 + IBT-10U 4B3T)	(BN 7533/82)

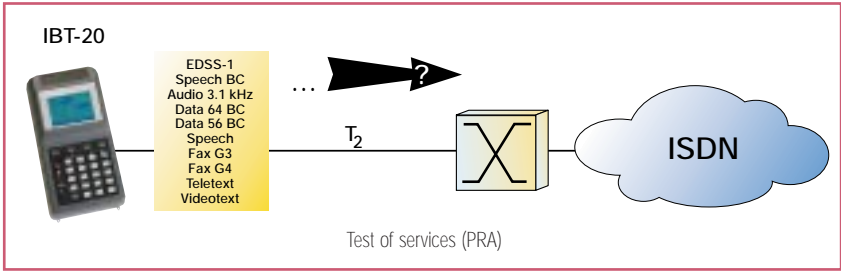
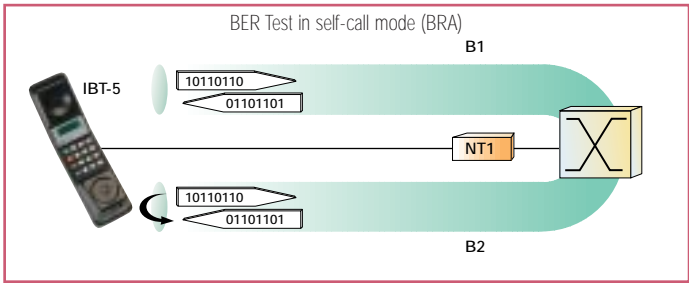
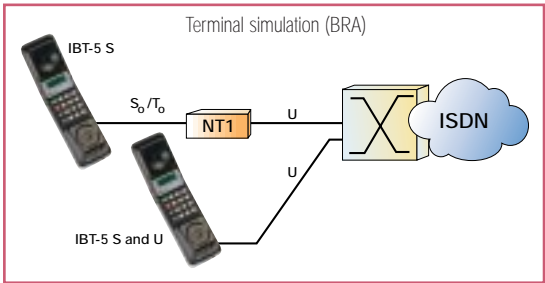


# Applications

## ISDN BRA and PRA Installation

The installation of an ISDN access (BRA or PRA) mainly consists in testing the availability of the network by making a simple phone call, carrying out a quick quality check of the access (BER Test) and verifying the availability of services and teleservices (the subscriber is expecting not only the ability to make only speech phone calls but also data communications or specific teleservices such as Fax G4).

All these tests can be carried out on the S interface or directly on the U interface if the NT1 has not yet been installed.



In case of problems, the D-channel tracer allows the user to examine signaling messages to easily locate the problem (Layer 1, Layer 2 or Layer 3 problem).



IBT-10 Tracer (BRA)

Installation of an ISDN Basic Rate Access	IBT-5	
	IBT-5 S	(BN 7522/20)
	IBT-5 S+U (2B1Q)	(BN 7522/10)
	IBT-5 S+U (4B3T)	(BN 7522/70)
	IBT-10	Basic Package (BN 7510/40)
	IBT-10U (2B1Q)	Basic Package (BN 7530/40)
	IBT-10U (4B3T)	Basic Package (BN 7532/40)
Installation of an ISDN Primary Rate Access	IBT-20	
	IBT-20	Basic Package (BN 7531/40)



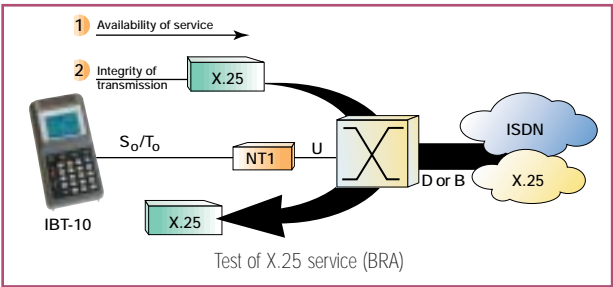
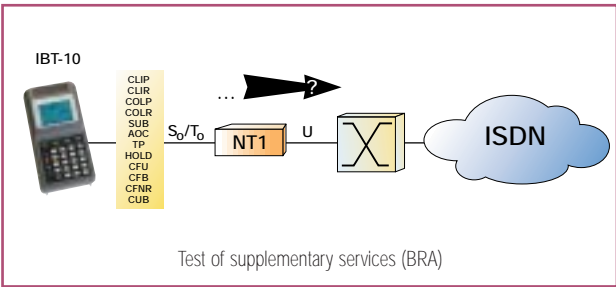
ISDN BRA and PRA Commissioning

The commissioning of ISDN Basic Rate Accesses (BRAs) or Primary Rate Accesses (PRAs) implies more test activities with regard to the installation in order to verify that the access provides all the services (supplementary services, X.25 over the D or B channel) that should be available on the access undergoing test.

Basic tests are carried out in exactly the same way as for the installation step:

- Network availability,
- Quality testing,
- Test of services/teleservices.

The availability of supplementary services is then tested with the possibility of performing functional testing (activate/interrogate/deactivate a specific supplementary service). The check of the access to a switched data packet network and the evaluation of the X.25 transmission quality are carried out over either the D or B channel.

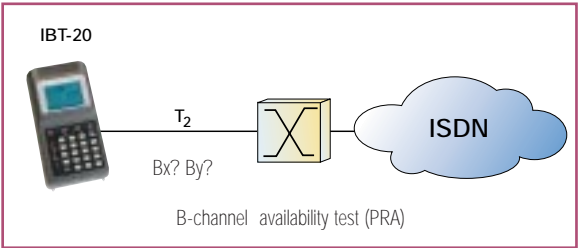


At the end of the commissioning, all the results can be printed to deliver a documentary proof or be exported to the Windows™ PC Detailed Decoder application for traceability. The Windows™ PC Detailed Decoder is also used to decode trace files (D-channel signaling messages) for a more detailed analysis (complete decoding of layer 2 and layer 3 messages).

In the case of an ISDN Primary Rate Access, one additional test is required to check the availability of B channels. The PRA can provide the user with 30 B channels, but the user often subscribes for a restricted bandwidth (10 or 15 B channels for instance). Therefore the availability of each B channel has to be tested individually (in turn) but also a multiple-call test is needed to determine the number of B channels which can be used simultaneously.

Wandel & GoltermannIBT-10 V08.02C	
Hardware number: R-0079	
ISDN BER G821 Test result	
Test configuration:	
Pattern :	2E11-1
Word :	
Insert. Error :	none
Tx mode :	pattern
HRX % :	100
Phone:	
Address :	0299602770
Sub-address :	
Service :	speech
Channel :	B1
SelfCall :	No
UII :	none
Test result:	
Start :	26/01/99 - 19:05:52
Stop :	26/01/99 - 19:20:52
Duration :	00:15:00
Normal	
Rate: Count:	
EFS :	100.00% 900
ES :	0.00% 0
SES :	0.00% 0
US :	0.00% 0
DM :	0.00% 0
Bit Error :	0.0E+000 0
G821 CONFORMED	

Commissioning of an ISDN Basic Rate Access	IBT-5 for a first level of commissioning
	IBT-5 S (BN 7522/20) IBT-5 S+U (2B1Q) (BN 7522/10) IBT-5 S+U (4B3T) (BN 7522/70) + Commissioning option (BN 7522/92.13)
Commissioning of an ISDN Primary Rate Access	IBT-10
	IBT-10 Complete Package (BN 7510/41) IBT-10U (2B1Q) Complete Package (BN 7530/41) IBT-10U (4B3T) Complete Package (BN 7532/41)
	IBT-20
	IBT-20 Complete Package (BN 7531/41)





# Applications

## ISDN BRA and PRA Maintenance

The Monitoring mode is a high-impedance analysis in real time for the D-channel signaling. This measurement allows troubleshooting on the access. A text display and filter functions make it easy to locate the problem.

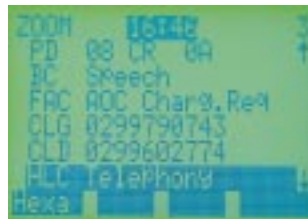
All capture files can be transferred to the Windows™ PC Detailed Decoder for an off-line analysis with a full decoding of the D protocol. The Windows™ PC Detailed Decoder offers all facilities to export data to office software, so the user can reprocess data to compile high-quality customized reports.

Real-time D-channel analysis on PC provides an efficient solution for random problems when a long-term measurement is required. The D-channel signaling is stored in real time on the hard disk and displayed with an exhaustive decoding.

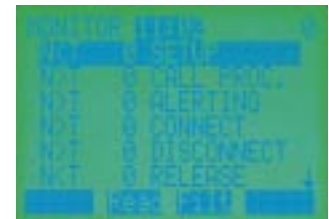
### U-Interface monitoring (BRA)

The IUM-10 (available for line code 2B1Q) enables the ISDN line status to be checked at a glance:

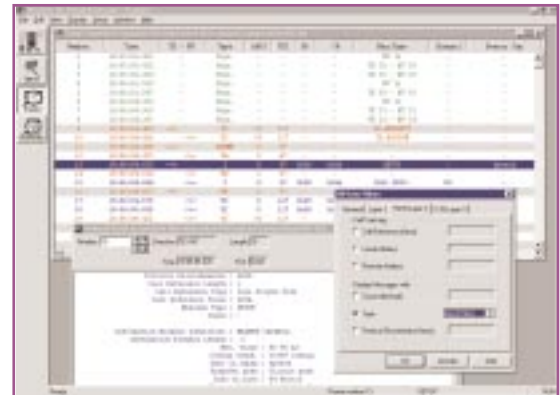
- Presence of the power feeding or sealing current,
- Activation as regards NT1 and LT,
- Traffic on the B and D channels,
- CRC errors for each direction of transmission (FEBE/NEBE),
- Loopback commands transmitted by the LT and responses from the NT1.



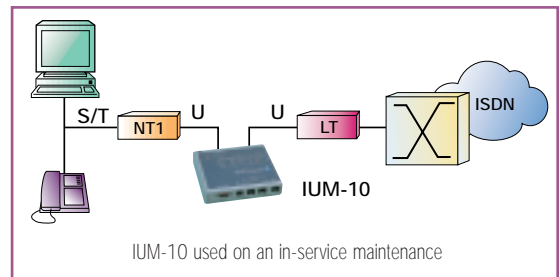
IBT-10 detailed monitoring



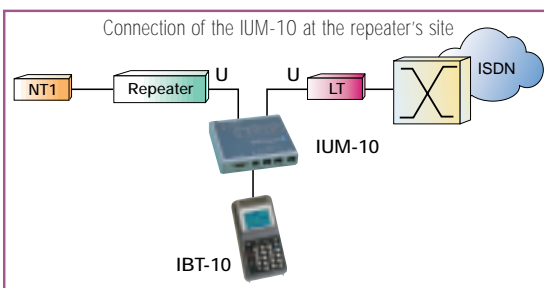
IBT-20 monitoring (PRA)



Real-time D-channel analysis on PC



IUM-10 used on an in-service maintenance



### Maintenance from a remote Site (BRA)

Troubleshooting on BRA accesses can be carried out from any point along the line fitted with a U interface (repeater, LT) with the use of a U repeater providing an S/T interface point to analyze the D-channel signaling using an ISDN BRA tester (IBT-10).

<b>Maintenance on the U interface</b>	<b>IUM-10</b> (BN 7534/10)
<b>Maintenance of an ISDN Basic Rate Access from a remote site</b>	<b>IMK-13</b> IUM-10+IBT-10 (BN 7534/80) <b>IMK-14</b> IUM-10+IBT10U (2B1Q) (BN 7534/81)
<b>Maintenance of an ISDN Basic Rate Access</b>	<b>IBT-10</b> IBT-10 Complete Package (BN 7510/41) IBT-10U (2B1Q) Complete Package (BN 7530/41) IBT-10U (4B3T) Complete Package (BN 7532/41)
<b>Maintenance of an ISDN Primary Rate Access</b>	<b>IBT-20</b> IBT-20 Complete Package (BN 7531/41)



## ISDN Equipment Installation and Maintenance

Installation of ISDN equipment concerns PBXs and routers. PBXs are connected to the network or to another PBX (corporate networks) using one or several BRA accesses (small or medium configuration) while PRA accesses are used when a higher bandwidth is required. Routers could also have one BRA or a PRA access, but the main difference is that the NT1 function can be included in the router.

### Installation of PBXs

For a PBX connected to the network via a Primary Rate Access ( $T_2$ ) or a Basic Rate Access ( $T_0$ ), the simulation of the network (NT simulation) allows tests to be carried out prior to connecting the PBX to the network. If the PBX is connected with a  $T_2$  link, the simultaneous use of both testers (IBT-10 and IBT-20) makes it possible to carry out a complete test.

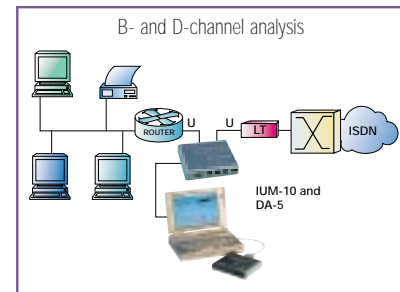
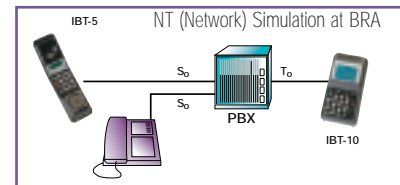
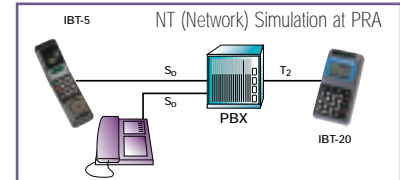
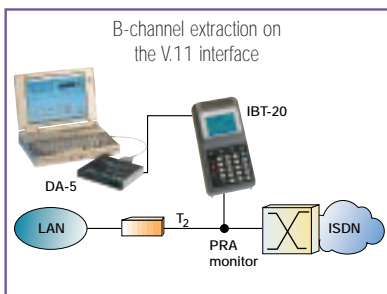
### Maintenance of PBXs ( $T_2/S_0$ )

It is often impossible to interrupt a  $T_2$  (PRA) link in order to carry out maintenance operations or quality tests. The IMK-3X solution (IBT-10 + IBT-20) offers an in-service quality measurement solution.

### Maintenance of routers (D- and B-channel analysis)

Routers connected to a Basic Rate Access may include the NT and are therefore connected directly to the U interface. The DA-5 can be used to analyze the contents of the D channel (ISDN signaling and X.25) and the contents of the B channels. The DA-5 provides decoding up to the IP and IPX levels. For full decoding up to the application level, the DA-5 can be replaced by a DominoWAN ISDN.

For a router connected to a Primary Rate Access, the automatic extraction on the IBT-20 (AutoTrack\*) of the B channel to a V.11 offers a unique maintenance solution for datacom-Internet applications (Refer to Application Note 58, Maintenance of the CPE Primary Rate Interface with IBT-20 and DA-5).



<b>Installation of PBXs (<math>T_0/S_0</math>) connected with one or more Basic Rate Accesses</b>	IBT-5	IBT-5 S+U (2B1Q) (BN 7522/11)
	IBT-5	IBT-5 S+U (4B3T) (BN 7522/71)
<b>Installation of PBXs (<math>T_2/S_0</math>) connected with one or more Primary Rate Accesses</b>	IBT-10	Basic BRA Package (BN 7510/40)
	IBT-10U (2B1Q)	Basic BRA Package (BN 7530/40)
	IBT-10U (4B3T)	Basic BRA Package (BN 7532/40)
<b>Maintenance of PBXs (<math>T_0/S_0</math>) connected with one or more Basic Rate Accesses</b>	IMK-3X**	
	IMK-30	Basic BRA and PRA Package (BN 7531/90)
	IMK-31	Basic BRA and PRA Package (BN 7531/91)
<b>Maintenance of PBXs (<math>T_2/S_0</math>) connected with one or more Primary Rate Accesses</b>	IMK-32	Basic BRA and PRA Package (BN 7531/92)
	IBT-10	Complete BRA Package (BN 7510/41)
	IBT-10U (2B1Q)	Complete BRA Package (BN 7530/41)
	IBT-10U (4B3T)	Complete BRA Package (BN 7532/41)
<b>Maintenance of ISDN routers</b>	IMK-3X**	
	IMK-30	Complete BRA and PRA Package (BN 7531/80)
	IMK-31	Complete BRA and PRA Package (BN 7531/81)
	IMK-32	Complete BRA and PRA Package (BN 7531/82)
<b>Maintenance of ISDN routers</b>	IMK-50	
	IUM-10 + DA-5	(first level) (BN 7534/82)
	DominoWAN	
<b>Maintenance of ISDN routers</b>	DominoWAN ISDN	(BN 7514/40)

\*AutoTrack: mode based on the D-channel signaling.

\*\*IMK-30 = IBT-10 + IBT-20  
IMK-31 = IBT-10U (2B1Q) + IBT-20  
IMK-32 = IBT-10U (4B3T) + IBT-20



# Product Literature

## List of Available Documentation

You will find below a list of all the documents relating to our ISDN test solutions together with the languages in which they are available. If you wish to receive any of this literature, please contact your local sales office (see the list of Wavetek Wandel Goltermann addresses at the back of the brochure).

Datasheets	
IBT-5	ISDN Tester for the Basic Rate Access (E, G, F, SP)
IBT-10/-10U	ISDN Tester/Analyzer for the Basic Rate Access (E, G, F, SP)
IBT-20	ISDN Tester/Analyzer for the Primary Rate Access (E, G, F, SP)
IMK-30/-31/-32	ISDN Tester/Analyzer for the Basic and Primary Rate Accesses (E, G, F, SP)
Windows™ PC Detailed Decoder	Real-Time Analysis Software (E, G, F, SP)
IST-15	ISDN/LAN Cable Tester (E, G, F, SP)
IUM-10	ISDN U-Interface Monitor (E, G, F, SP)
DA-5	Multiport Protocol Analyzer (E, G, F, SP)
DominoWAN ISDN	ISDN Internetwork Analyzer (E, G, F, SP)
Flyers	
IBT Range	'Nature always finds ways to equip man with the best tools' (E, G, F, SP)
IBT-10/-10U and IBT-20	'Real-time analysis on PC' (E, G, F, SP)
Poster	
ISDN poster	'Guide to ISDN Test Solutions' (E)
Other ISDN Collaterals	
ISDN Pocket Guide No. 1	'ISDN Supplementary Services' (E)
ISDN Pocket Guide No. 2	'PPP Troubleshooting' (E)
Application Note 58	'Maintenance of the CPE Primary Rate Interface with IBT-20 and DA-5' (E, G, F, SP)
Application Note 63	'Supervision and analysis at the U interface' (E, G, F, SP)

E: English - G: German - F: French - SP: Spanish

The cover page of the above-mentioned datasheets is shown on pages 16 to 24.





New:  
**NT simulation**  
for the installation of  
ISDN equipment

### IBT-5

for quick installation  
of ISDN lines and PBXs

- Powerful
- Easy to use
- Robust and compact
- Future-proof



### Applications

- Installation of basic rate accesses
- Commissioning of ISDN accesses
- Installation of ISDN equipment

The IBT-5 has been designed to reduce the time required for ISDN line and equipment installation. Efficiency during these various stages is becoming increasingly crucial. This is why the IBT-5 is as easy to use as a telephone. Moreover, thanks to clearly displayed results, it enables rapid diagnostics of the access and the configuration tested.

- During basic rate access installation, a number of tests have to be carried out to check access to the ISDN network, the availability of services and teleservices and subsequent transmission quality. The IBT-5 provides a simple means of carrying out all these tests and obtaining reliable results.
- Operators and users seeking a quick, easy means of defining the full extent of the ISDN service provided will find, in the Commissioning option, tests designed to check supplementary services and perform the X.25 in the D channel test.
- When providing full installation of ISDN equipment (e.g. a PBX), the configuration of the equipment has to be checked before connection to the network. The NT simulation available on the IBT-5 provides an easy means of simulating the ISDN network before connecting up the equipment.

### Functions

- TE and NT Simulation
- Test of services and teleservices
- Bit Error Rate Test
- Supplementary services test
- X.25 in the D channel test
- Loopbox mode
- S<sub>0</sub> and U Interfaces (2B1Q or 4B3T)

The basic version of the IBT-5 software provides the tests and functions required for the installation of basic rate accesses i.e. terminal simulation, BER measurement, service testing and loopback function.

There are two types of unit, one equipped with S and U interfaces and one equipped with only the S interface. Both are robust, compact and designed for intensive daily use.

The IBT-5 can be powered from the voltage supplied by the access being tested or from a long-life NiMH battery pack available on option. This battery pack is particularly necessary when the user wants to connect up to ISDN equipment in order to simulate the network (NT Simulation option).

The second software option (Commissioning) is more especially designed for the commissioning of accesses. It provides all the supplementary services tests and the test for the X.25 service in the D channel.

The total availability of the IBT-5 is guaranteed by software updates which can be easily implemented by the user in just a few minutes.



# ISDN Tester/Analyzer for the Basic Rate Access

WG IBT-10/-10U



**New**  
PC-based, real-time  
D-channel analysis  
Dual Call function

## IBT-10/-10U

For testing the basic rate  
access (2B+D)



IMK-31 package

### Applications

- Installation of ISDN basic rate accesses
- Commissioning of ISDN basic rate accesses
- Installation of PBXs
- Maintenance of ISDN basic rate accesses and PBXs

When **installing an ISDN basic rate access**, it is necessary to test the accessibility of the ISDN network, verify the availability of the basic services and check the quality of transmission.

When **commissioning ISDN basic rate accesses**, operators and end users need to quickly qualify the X.25 service or the supplementary services.

When **installing a PBX**, the basic services must be tested in order to verify that the PBX is configured properly prior to connection to the network.

Teams in charge of **maintaining ISDN equipment or basic rate accesses** need an analyzer that can perform detailed decoding of the D-channel protocol in high-impedance mode.

In order to keep track of any problems that are detected, it is useful to have PC-based software for exhaustive decoding and simplified archiving of measurement results.

### Functions

- TE and NT simulation
- Built-in tracer
- Test of services, BER measurement (G.821)
- Test of supplementary services
- Dual Call
- Results storage
- High-impedance protocol analysis
- Windows™ PC Detailed Decoder
- X.25 test in D and B channels
- PC-based, real-time D-channel analysis

The IBT-10's basic version covers all essential tests, such as BERTs (bit error ratio tests) and tests of services and supplementary services. The instrument also offers a built-in tracer mode. Software options are available, allowing powerful, high-impedance protocol analysis with detailed results analysis on a PC, and a test of the X.25 service in the B and D channels (as specified in ITU-T Rec. X.31).

The "Results storage" software option lets you manage all of your test result files.

Users can easily add on these software options.



# ISDN Tester/Analyzer for the Primary Rate Access

WG IBT-20



**New**  
PC-based, real-time  
D-channel analysis  
AutoTrack function

## IBT-20

For testing the primary rate  
access (30B+D)



AutoTrack with the WG DA-5

### Applications

- Installation of ISDN primary rate accesses
- Commissioning of ISDN primary rate accesses
- Installation of PBXs
- Maintenance of ISDN primary rate accesses and PBXs
- Maintenance of primary rate access routers

When **installing a primary rate access**, it is necessary to test the accessibility of the ISDN network, verify the availability of the basic services and check the quality of transmission.

When **commissioning ISDN primary rate accesses**, operators and end users need to quickly qualify the X.25 service or the supplementary services.

When **installing a PBX**, the basic services must be tested in order to verify that the PBX is configured properly prior to connection to the network.

Teams in charge of **maintaining ISDN equipment or primary rate accesses** need an analyzer that can perform detailed decoding of the D-channel protocol in high-impedance mode. In order to keep track of any problems that are detected, it is useful to have PC-based software for exhaustive decoding and simplified archiving of measurement results.

For **maintaining routers on the primary rate access**, it is necessary to analyze the signalling in the B channel in order to detect configuration problems between routers.

### Functions

- TE and NT simulation
- Built-in tracer
- Test of services, BER measurement (G.821)
- Test of supplementary services
- ISDN Multiple Calls
- AutoTrack function
- Results storage
- High-impedance protocol analysis
- Windows™ PC Detailed Decoder
- X.25 test in D and B channels
- PC-based, real-time D-channel analysis

The IBT-20's basic version covers all essential tests, such as BERTs (bit error ratio tests) and tests of services and supplementary services. The instrument also offers a built-in tracer mode. Other functions in the basic version include automatic dropping of a B channel to an interface of type V.11 (for analysis by the DA-5) and high-impedance BERT.

Software options are available, allowing powerful, high-impedance protocol analysis with detailed results analysis on a PC, and a test of the X.25 service in the B and D channels (as specified in ITU-T Rec. X.31).

Users can easily add on these software options.



# Tester/Analyzer for the Basic and Primary Rate Accesses

WG IMK-30/-31/-32



PC-based, real-time  
D-channel analysis  
AutoTrack function

## IMK-30/-31/-32

For testing the ISDN Basic and Primary Rate Accesses



### Applications

- Installation of ISDN accesses
- Commissioning of ISDN accesses
- Installation of ISDN PBXs
- Maintenance of ISDN accesses and PBXs

Whatever your activity in the field of ISDN, whether it be installation, maintenance or commissioning, the IMK-30/-31/-32 are designed to meet your needs. For BRA and PRA, for lines or equipment, the IMK test bags is the all-round tool for ISDN tests.

For the **Basic Rate Access (2B+D)**, a tester, equipped with terminal (TE) or network (NT) simulation functions, may be used for installation or commissioning. In TE simulation mode, it enables the testing of services and teleservices, supplementary services and the X.25 service in the D and B channels. The tester should offer a high-quality BER test measurement. For maintenance purposes, protocol analysis of the D channel and X.25 analysis are required not only on the equipment, but also in real time on a PC for long-duration analysis.

All measurement results can be recorded and processed using a high-performance PC-based analysis software.

For the **Primary Rate Access (30B+D)**, specific functions are required for testing B channels, i.e. automatic testing of B channels to determine the configuration of the access, extraction of a B channel for analyzing the user traffic, and finally, automatic search/extraction of a B channel during setup of a selected call corresponding to certain criteria (calling number, called number, etc.).

### Functions

- TE and NT simulation, built-in tracer
- High-impedance protocol analysis
- Test of services and supplementary services
- BER measurement (G.821)
- ISDN Multiple Calls, AutoTrack function
- X.25 test in D and B channels
- PC-based real-time D-channel analysis
- Results storage
- Windows™ PC Detailed Decoder software

### Advantages

- Simultaneous  $S_0$  and  $S_2$  tests
- End-to-end tests
- Compact, lightweight carrying bag

The user will find numerous advantages in the IMK-30/-31/-32. The compact, sturdy and lightweight carrying bag contains a twin set of fully independent tools: the IBT-10 for the BRA test and the IBT-20 for the PRA test. The user can thus implement tests requiring two independent instruments set up in different places. The most frequent situations are:

- Commissioning of PBXs ( $T_2/S_0$ ),
- Maintenance of PBXs ( $T_2/S_0$ ),
- End-to-end testing.

Both products have the same user interface, which makes them very easy to operate. This solution is all the more flexible, in that if one of the instruments is not in service, it may be made available to another user. This modularity also allows you to optimize investments, given the constant fluctuation in the relation between basic and primary rate accesses.



# Windows™ PC Detailed Decoder

For the IBT-10/-10U, IBT-20 and IST-15



One software  
for all your ISDN tests  
Real-time analysis

## Windows™ PC Detailed Decoder

Analysis and report editing  
software for test results.  
Delivered together with  
IBT-10/-10U, IBT-20 and  
IST-15

The screenshot shows the Windows PC Detailed Decoder software interface. The main window displays a table of captured frames with columns: Number, TE - NT, Type, TEI, N(S), N(R), PD, CR, and Msg. Type. The table contains several frames, including physical layer frames (Phys.) and user interface frames (UI). Below the table, there is a section for 'Protocol Detail & Hexa Trace' showing details for a specific frame (ID: 4) and a hexa trace of the data. To the right of the main window, there is a sidebar with various icons and a list of protocols. Below the main window, there is a diagram illustrating the ISDN network setup, showing a laptop connected to a PC (Windows PC Detailed Decoder) via a serial link. The PC is connected to an IBT-10/-10U or IBT-20 tester, which is connected to an IST-15 terminal. The IST-15 is connected to an IUM-10 interface unit, which is connected to an ISDN network. The ISDN network is connected to a PBX (Private Branch Exchange) and a S/T (Subscriber Terminal) unit. The diagram also shows a cloud representing the ISDN network and a PBX unit connected to a S/T unit.

### Applications

- Commissioning of ISDN installations
- Maintenance of ISDN installations on site
- Off-line problem analysis by experts

The Windows™ PC Detailed Decoder software is specially designed for quick and easy troubleshooting on ISDN installations. Used with the Wandel & Goltermann ISDN testers IBT-10/-10U, IBT-20 and IST-15, the software can analyze all types of problems related to cabling, transmission or offered services. It also allows the user to edit detailed test reports to trace the tests carried out. The Windows™ PC Detailed Decoder software covers the following fields of application:

#### – Commissioning of ISDN installations

There is an increasing demand by end customers for a “measurement slip” giving details of the tests carried out, in addition to the list of services actually available. The service provider should be able to file the results and print them in a customizable format.

#### – Maintenance of ISDN installations on site

The sources of ISDN problems can be wide-ranging. Problems may occur at the cabling level of the S bus, or result from transmission errors or incorrect configuration of equipment such as PBXs, switches or terminals.

### Functions

- Real-time detailed analysis of the ISDN signalling and X.25 in the D channel
- Detailed report for tests on ISDN cabling
- Detailed report for tests on the Basic or Primary Rate Access (test of services and supplementary services, BERT, etc.)

#### – Off-line problem analysis by experts

The on-site maintenance technician does not always have the time or skills required to locate the source of a malfunction. He should thus be able to store test or protocol analysis results on a PC, in order to submit them to an expert equipped with the same analysis tools.

The test results can be transferred to a PC using a serial link connected to the testers. The user may then edit, print test files or export them to standard office software for further processing. The software can be used in standalone mode (without a tester connected to the PC) from files stored on the disk.

The protocol analysis can be performed in real time with a possible storage on disk for long-duration captures.

The user interface is user-friendly and intuitive. The commands are the same whatever the type of tester used.



Length measurement  
using TDR

## IST-15

ISDN S bus and structured  
cabling tester

## IMK-10/-11/-12

Carrying bag with an  
IST-15 and an IBT-10 or  
IBT-10U (2B1Q or 4B3T)



### Applications

- Installation of structured cabling
- Maintenance of ISDN installation with IBT-10
- Commissioning of ISDN and LAN cabling

The IST-15 is a cable tester designed for structured cabling testing with additional test features for measuring a passive or active ISDN S bus. Predefined cable settings as well as user-defined test sequences make this tester really easy to use. The IST-15 covers the main application cases:

#### – Installation of structured cabling

Before bringing a data network into service, a basic cable test has to be carried out. In the case of the ISDN S bus, length measurement is mandatory to make sure that the cabling matches the specifications provided by the standards.

#### – Maintenance of ISDN installations with IBT-10

In ISDN, errors in cabling may be very difficult to detect without a complete tool which can also perform active measurement such as power supply voltage measurement or Tx/Rx activity.

#### – Commissioning of ISDN and LAN cabling

During commissioning, several tests have to be carried out per outlet and all results have to be recorded to deliver proof at the end of the commissioning stage.

### Functions

- Fault finding (short, open, crossed wires)
- Detection of split pairs
- Wire resistance measurement
- Length measurement TDR (open or short circuit)
- Passive ISDN measurement (termination resistance)
- Active ISDN measurement (power supply, Tx/Rx activity)
- Predefined settings (CAT5UTP, CAT5STP, ICS, Flat etc.)
- Compatible with the Windows™ PC Detailed Decoder software for managing test results

The tester comprises a master unit and a satellite acting as a remote device which is needed to perform some of the measurements (such as open or crossed wires). The IST-15 master unit is powered from a battery or from the access when testing on an ISDN S bus (no power supply is necessary for the satellite). An LCD screen allows a clear display of results. The ability to store and handle test results is provided by the IST-15 with its large memory (up to 450 measurements can be stored). The tester provides two external RJ-45 interfaces: one is dedicated to passive cable testing (screened or unshielded cables with a choice of the most common cable types) while the other is used to test an active ISDN bus.



## IUM-10

ISDN U-interface monitor  
(2B1Q)

## IMK-13, IMK-14

An IUM-10 and an  
IBT-10/-10U in the same  
carrying bag

## IMK-50

An IUM-10 with a DA-5:  
a combined S- and U-inter-  
face protocol analyzer



### Applications

- Maintenance of ISDN installations
- Installation/Maintenance of ISDN equipment
- Troubleshooting from a remote site
- Voice quality checking

When connected to the U interface, the IUM-10 monitor provides a means of analyzing the causes of ISDN installation malfunction (lines, equipment, repeaters, etc.). It can be used in stand-alone mode for a first level of troubleshooting or combined with the IBT-10, DA-5 or DominoWAN ISDN analyzers to perform full decoding of the contents of the D and B channels.

The IUM-10 covers the following applications:

- **Maintenance of ISDN installations**  
Protocol analysis at the S/T interface is sometimes insufficient to solve problems on the network side. Likewise, connecting to the U interface a tester that emulates both the NT1 and a terminal changes installation behavior (because of the replacement of the NT1) and prevents observation of the problem in an operational situation.
- **Installation/Maintenance of ISDN equipment**  
Numerous routers and PBX's are connected directly to the U interface.
- **Troubleshooting from a remote site**  
Analyzing problems from a concentrator or from the central office avoids costly travel to the access site.
- **Voice quality checking**  
The quality of voice transmission sometimes requires monitoring in an operational situation (using the user's telephone).

### Functions

- Connection of any WG ISDN analyzer to the U interface (2B1Q)
- Direct indication using LEDs of the main layer 1 events: CRC errors, loop requests (EOC commands), U and S activation, remote power feeding and sealing current, traffic in the D and B channels for each direction of transmission
- Monitoring of layer 1 events from the V.24 interface
- Listening of the B channels using an external handset
- Transparency as regards remote power supply and EOC commands
- Software updates through downloading from a PC

The IUM-10 is connected in line by means of two U interfaces. The device provides an S/T interface to which it redirects the traffic observed on the line and to which an ISDN analyzer can be connected.

A telephone handset can also be connected in order to listen to either of the B channels. LED's provide instantaneous diagnosis of loop problems or errors relating to transmission, activation or power supply. The IUM-10 can be used in stand-alone mode or in combination with the following Wandel & Goltermann analyzers: IBT-10, DA-5, DominoWAN ISDN and DA-30 ISDN.

Layer 1 events, transmitted via the serial link in ASCII, can be displayed in real-time using any commercially available asynchronous terminal or PC.

The software installed in the IUM-10 can be updated by downloading new software from a PC.



### DA-5

Troubleshooting and maintenance on WAN and ISDN networks

- Multi-technology: ISDN BRA and WAN V.xx
- Remote power supply via PC
- Efficient: analysis up to 2 Mbit/s



### Applications

- Maintenance of WAN and ISDN equipment: routers, PBX's, X.25 and Frame Relay switches, terminal adapters etc.
- WAN and ISDN access maintenance: SOHO and Internet access, Frame Relay, X.25 etc.

The DA-5 has been designed to reduce technician time during the maintenance of ISDN and WAN (Wide Area Network) accesses and equipment. Its multi-technology and multi-protocol design enables it to be used with most configurations: the DA-5 optimizes the equipment used by maintenance technicians.

The DA-5 is the ideal solution for the following applications:

- Maintenance of ISDN or WAN networks and accesses, when service availability problems have to be determined.
- Maintenance of ISDN or WAN equipment, with definition of the equipment configuration parameters and their consequences on the network, in order to diagnose inter-working problems.

The DA-5 provides a solution to each type of problem for operators or users wishing to restore the service quickly.

### Functions

- Multiprotocol: ISDN, Frame Relay, X.25, PPP, SDLC etc.
- Multitechnology: ISDN BRA, serial link V.xx etc.
- Multiprotocol: simultaneous analysis on 2 interfaces
- Long-duration measurements
- Diagnosis of network service availability problems thanks to detailed analysis of the ISDN and WAN protocols, including:
  - Detailed decoding of ISDN signaling protocols,
  - Detailed decoding of X.25, Frame Relay, PPP/MLP and SDLC protocols etc.
- Diagnosis of equipment configuration faults through precise detailed definition of ISDN and WAN parameters, including:
  - Simultaneous decoding of the D, B1 and B2 channels in the ISDN Basic Rate Access to enable complete analysis of equipment configuration (signaling parameters, negotiations and protocols encapsulated in the B channels);
  - Detailed decoding of the protocols (IP/IPX, TCP/UDP, ICMP etc.) encapsulated in the ISDN B channels and on the WAN protocols;
  - Detailed decoding of the PPP (Point-to-Point Protocol) and PPP Multilink negotiations for Internet and SOHO (Small Office Home Office) applications;
  - Decoding of the asynchronous and V.120 PPP protocol for applications including terminal adapters and modems;
  - Simultaneous analysis of a serial link and ISDN Basic Rate Access (V.xx+D+B1+B2) for leased line applications with ISDN back-up.
- Diagnosis of problems that are random and difficult to reproduce, thanks to long-duration analysis capabilities (real-time capture on the PC hard disk) and filtering or triggering functions.



# WG DominoWAN ISDN

ISDN Line Interface Modules for the basic rate and primary rate accesses



**New**  
Protocol analysis  
on the U interface  
with the IUM-10 option

## DominoWAN ISDN

Internetwork Analyzer



### Telecom applications

- Maintaining ISDN PBXs
- Maintaining ISDN networks
- Managing and optimizing enterprise networks

### Datcom and Internet applications

- Maintaining ISDN routers
- Managing and optimizing enterprise networks
- Maintaining points of concentration (enterprise networks)
- Maintaining points of presence (Internet operators)

When equipped with the ISDN interfaces (basic rate access 2B+D, primary rate access E1 30B+D or T1 23B+D), the DominoWAN ISDN analysis platform enables efficient maintenance, management and optimization of enterprise networks.

### Telecom applications

DominoWAN ISDN allows verification of:

- Availability of the ISDN service, specialization of incoming lines
- Configuration of supplementary services, facilities allocated to a group of terminals, numbering plan
- Optimization of an installation (cost/performance).

### Datcom and Internet applications

When working with installations where LANs are interconnected via ISDN or the Internet, the following tests are required:

- Verification of the service availability or of the configuration of the ISDN equipment parameters
- Verification of the configuration of LAN parameters on routers and stations served
- Localization and capture of traffic from a remote site for points of concentration and presence
- Optimization of an installation in terms of cost and performance (spoofing of routers)
- Qualification of ISDN accesses (traffic prioritization).

### Features

- AutoTrack function
- Detailed analysis of the ISDN D channel
- Detailed analysis of B-channel protocols (more than 350!)
- Access usage and loading statistics
- Statistics on access performance and cost
- ISDN terminal and network simulation
- Remote control

To enable efficient maintenance, DominoWAN ISDN offers the following:

#### AutoTrack function

Automatic detection and decoding of the allocated B channel. Selection criteria: Calling/called address, bearer capability. Capture of target traffic less than 500  $\mu$ s after connection, starting with the first exchanges in the B channel, enabling efficient isolation of faults on the primary rate access.

#### Protocol analysis

Simultaneous analysis of the D channel and B channels. Analysis of signalling protocols in the D channel and detailed decoding of national variants in layer 3. Analysis of protocols encapsulated in the B channels and detailed decoding of LAN traffic in the B channels up to OSI layer 7 (more than 350 LAN and proprietary protocols available).

#### LANLink Monitor application

B-channel usage and payload statistics for LAN protocols encapsulated in the B channels.

#### Cost Control application

Statistics on events in the ISDN D channel for optimizing an installation (cost, performance, quality of service).

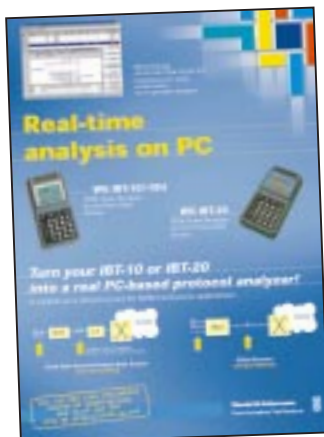
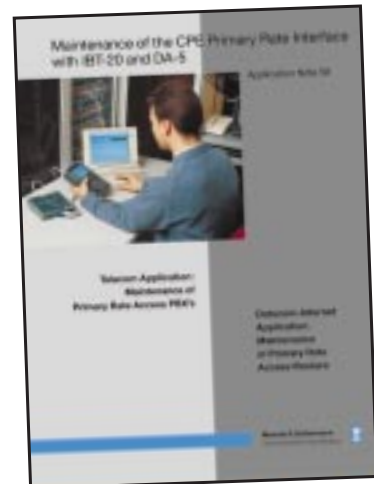
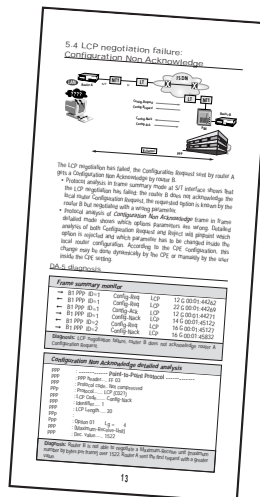
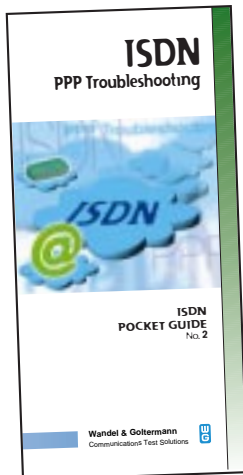
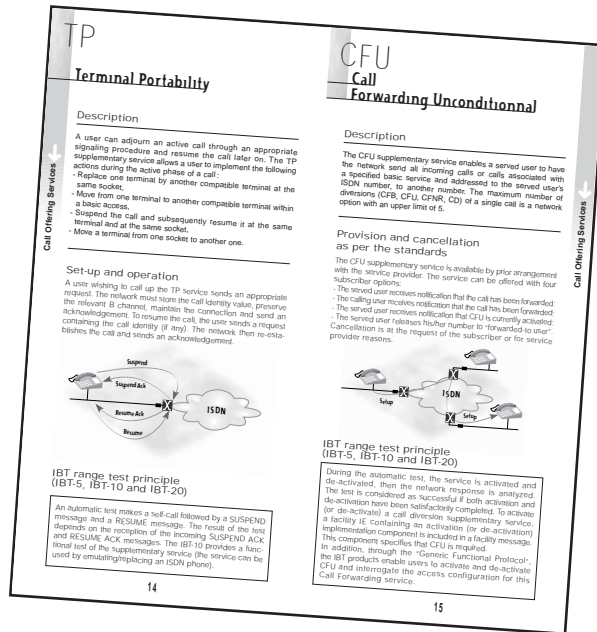
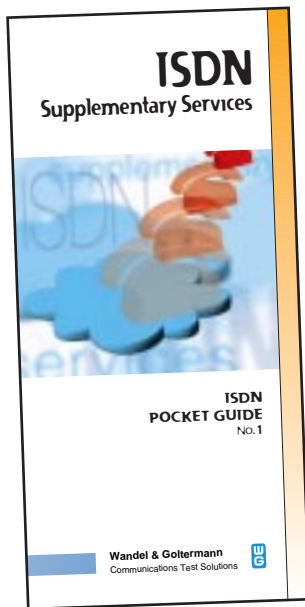
#### TE and NT Simulation application

Simulation of ISDN terminals (TE) and networks (NT). Simulation of ISDN services, multiple calls, traffic generation (Fox, PPP or X.25) in a B channel. Evaluation and counting of received frames (Rx, Tx, FCS error, etc.).



# Product Literature

## Examples of ISDN Collaterals





# Product Literature

## 'Guide to ISDN Test Solutions' Poster

### Testers



**WG IBT-10/-10U**

ISDN Tester/Analyzer for Basic Rate Access. For installation, commissioning and maintenance.



**WG IBT-5**

ISDN Tester for Basic Rate Access. For installation, first level of commissioning and maintenance.



**WG IBT-20**

ISDN Tester/Analyzer for Primary Rate Access. For installation, commissioning and maintenance.

**NEW**

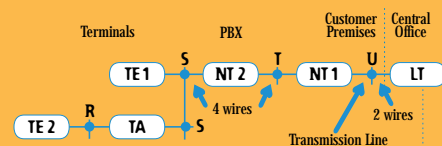
**WG IST-15**

ISDN/IAN Cable Tester. For installation, commissioning and maintenance of structured cabling at customer premises.

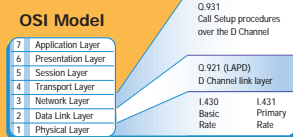
### Guide to

# ISDN Test Solutions

## ISDN architecture



### ISDN Implementation



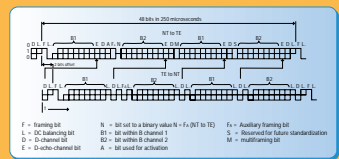
## ISDN protocols

### Layer 1

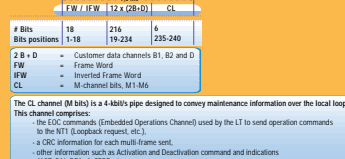
#### Physical

Handles the physical, electrical, and procedural specifications required to transmit data across the physical medium or cables. Defines connectors, pinouts and electrical voltage and current levels. Works in units of bits.

#### Frame Structure at S and T Reference Points



#### Frame Structure at U Reference Point

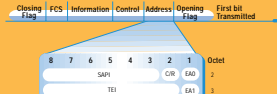


### Layer 2

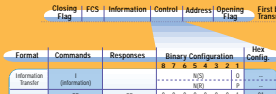
#### Data link

Frames and Addresses Packets. Provides error-free node-to-node connections and flow control. Provides mapping between Network Layer addresses. Works in units of frames.

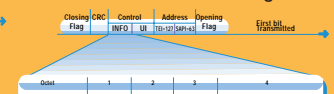
#### Q.921 Address Field



#### Q.921 Control Field



#### Frame Structure for TEI Management

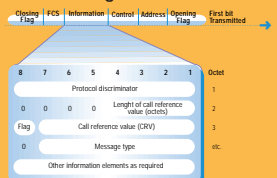


### Layer 3

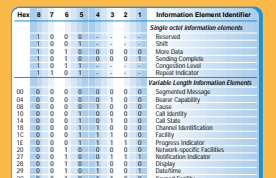
#### Network

Addresses, switches and routes packets between hosts. Fragments and reassembles packets. Works in units of packets.

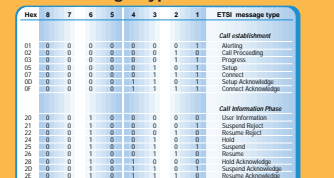
#### ETSI Message Structure



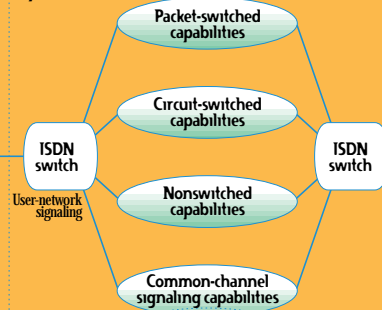
#### ETSI Information Element Identifier



#### ETSI Message Type



### Bearer capabilities



### User-user signaling

#### ISDN Functional Groups and Reference Points

**Line Termination (LT)**  
Network Termination 1 (NT1): handles physical layer interface functions such as line termination, power transfer and timing.  
**Network Termination 2 (NT2)**: handles function of an NT1 plus layer 2 and layer 3 functions such as multiplexing, switching and concentration.  
**Terminal Equipment 1 (TE1)**: end-user equipment such as ISDN telephones or data terminals compliant with ISDN call set up procedures and capable of interfacing directly to the S-bus.  
**Terminal Equipment 2 (TE2)**: end-user equipment for non-ISDN environments (typically uses an RS232 interface).  
**Terminal Adapter (TA)**: equipment that supports ISDN call set up and provides an interface for connecting to TE2s.







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