BLACK BOX®
NETWORK SERVICES

4-Port BRI-Hub (UK):
ISU2011-4-UK

4-Port BRI-Hub (Euro):
ISU2011-4-EURO

8-Port BRI-Hub (UK):
ISU2011-8-UK

8-Port BRI-Hub (Euro):
ISU2011-8-EURO

BRI-Hub

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Introduction

Within the data communications and LAN industry it is well known that a structured cabling concept using a star topology has significant advantages, such easier maintenance, unproblematic changes in the configuration and faster fault finding. Last but not least, a structured cabling concept may be used for all kinds of LAN-, WAN and telecommunications technologies.

Nevertheless, with ISDN a bus has to be formed to connect several users to one Basic Rate Interface (BRI), but a bus cannot be formed with a star topology. Alternatively a complete BRI must be dedicated to one user (point to point configuration), which is in many cases not feasible or too expensive.

By using the active star BRI-Hub it is now possible to use the structured star-cabling concept for ISDN. In addition the distance between the NT and the TEs may be extended because of the use of point-to-point links between the BRI-Hub and the TEs. It is also possible to use the "extended passive bus configuration" (distance up to 1000m) if all connections to the TEs are in the same range of distance (+/- 50m).

The Phantom Feed unit can be used with the BRI-Hub to provide power to all 4 or 8 ports on the BRI-Hub.

Description of functions

The BRI-Hub converts the ISDN BRI bus structure to a set of point-to-point connections, which are connected within the BRI-Hub to form a 'logical bus'. At this, the BRI-Hub makes it possible to hook up ISDN terminals via a maximum of 8 lines with the maximum length of 150 m each. Up to 1000 m is possible in a special configuration. Every port forms a separate electrical segment. Through this wiring faults don't affect other segments.

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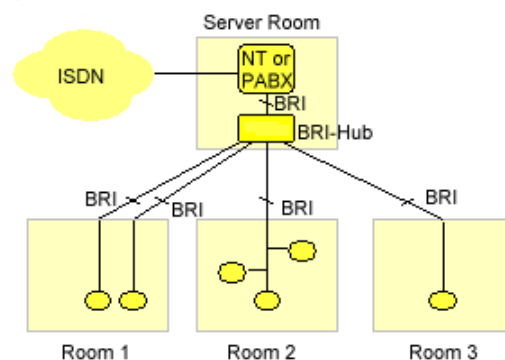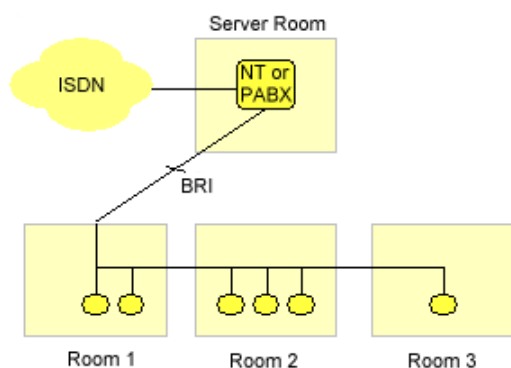
If a BRI needs to be made available in several rooms, it used to be necessary to install a bus from the server room through all rooms. (See picture 'old'). Now star wiring can be used with BRI-Hub, which comes to use also for telephone and local area networks (see picture 'with BRI-Hub').

Options

BRI-Hub

This option derives its power from the power supply provided.

BRI-Hub S

This option derives power from the S-Bus and uses an internal DC-DC converter to adapt the voltage to power itself – no external power supply is required. This option is available as a special request from Black Box.

Both of the above options can be used in conjunction with the Phantom Feed, a device used to provide power on each of the hub's S interfaces.

Key

 BRI-Hub

 NT with 2 RJ-45 jacks and termination resistors

 ISDN socket without termination resistors

 ISDN socket with termination resistors

 ISDN terminal equipment (e.g. ISDN telephone)

 Cable labeled 'x'

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Technical Specifications

SO Interface BRI

Number of interfaces……………………………………5 for BRI-Hub-4, 9 for BRI-Hub -8
Type and coding……………………………………I.430, Mod. AMI, 4-wire
Frame structure……………………………………I.430 (48 Bits per 250 µs)
Transmission rate…………………………………..192 kbps +/- 50 ppm
Interface connector…………………………………RJ-45

Common Features

Size (W x H x D)………………………………………..205 x 40 x 110 mm
Weight………………………………………………450g
Housing material……………………………………...ABS
Protection class……………………………………IP 21
Environmental temperature………………………….0° to 40° C
Storage temperature………………………………….-20° to 70° C
Humidity……………………………………………..max. 90% (non condens.)
Supply voltage………………………………………6 - 9V
Power consumption……………………………………. max. 2W

Power supply

Primary voltage……………………………………220V~ +/-10%, 50 Hz
Output voltage………………………………………..6V=
          Output current…………………………………………..max. 500mA

Environmental and Safety Notes

Power Supply

- The power adaptor is according to safety class II (VDE 0551) and my only be used indoor.

- Do not use the power adaptor when it was brought from a cold to a warm environment. In that case condensing water may damage the unit.

- There are no user serviceable part inside the power adaptor. Therefore it is not necessary to open the unit

Sound Emission

The unit does not emit any sound.

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Parts List

When opening your BRI-Hub the following parts should be present:

- BRI-Hub unit
- ISDN cable with two RJ45 plugs (Western plugs) to connect the BRI-Hub to the network termination (NT) or the PABX basic rate interface. The cable has a length of 2m.
- Power Supply adaptor (not with BRI-Hub-S)
- Users Manual
- Two 6mm dowels and two 6mm screws for wall mounting

The power feeding unit, The Phantom Feed, may be used to feed all TE ports with power (40V, 16W). This device is available as an option.

Installation

For proper operation the device must be placed in a suitable location. It should be a clean and dry environment without direct sun light. Sufficient cooling must be possible. Do not pack or cover the unit or set other warm equipment on top of it.

Tabletop

Just place the unit on a clean and dry place. Multiple BRI-Hub units may be stacked. The rubber stands give enough space for proper cooling.

Wall mount

The wall assembly works as follows:

- Drill two holes vertically, one above the other with a separation of 95 mm, into the wall where you want to place the BRI-Hub.

- Completely put the dowels into the drilled holes.

- Turn the BRI-Hub screws into the dowels; with a separation of approx. 7 mm still left between wall and screw head.

- Now place the BRI-Hub so that the screws fit into the holes in the floor plate. The power LED is in the upper right corner.

- Carefully shift the BRI-Hub downward, so that the screws move into the slots inside the floor plate.

Caution! Don't use any excessive force. If the screws are turned too far into the dowels, the screws may not move into the slots. Turn the screws out a little and try again.

Rack Mount

For the assembly into a rack an optional 19" front panel is needed. This may hold one or two BRI-Hub devices. This 19"rackmount panel is available as a special from Black Box. Please call technical support for further information. The front panel is fixed to the BRI-Hub devices by two engine screws.

- To do this the panel is set onto the front of the BRI-Hub.

- The two screws are put into the holes of the panel provided for this. (Left from the NT port and right besides the power LED.

- The screws must be put into the holes of the BRI-Hub. The screws slide approximately 25 mm into the case.

- The screws can be screwed in tight.
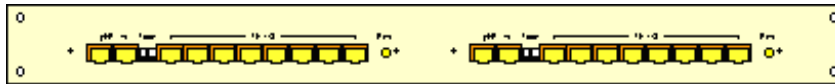
Power Supply

BRI-Hub

The standard BRI-Hub is supplied with a wall mount power adapter. There is no power switch at the device. The BRI-Hub is active when the power adaptor is plugged into an outlet and the DC connector of the power adaptor is connected to the BRI-Hub.

BRI-Hub-S

Besides the operation with a power adaptor it is possible for a BRI-Hub-8S or BRI-Hub-4S to get its power through the power feeding of the NT or PABX via the NT port. Please note that the BRI-Hub needs approximately twice the power as an ISDN telephone. Therefore it is not possible to operate the BRI-Hub from the 'restricted mode' power feeding.

If the DC connector of the power adaptor is plugged into the BRI-Hub DC socket, the BRI-Hub will switch to the power adaptor automatically even if the power supply doesn't deliver any electrical power. Therefore it is necessary to unplug the DC connector from the BRI-Hub when the power feeding of the BRI or 'Phantom Feed' is used.

If power is detected at the 'Phantom Feed' connector on the rear side of the BRI-Hub (40VDC), a relay will disconnect the NT port BRI phantom power feeding from the internal DC-DC converter and TE port phantom feed. The external power supplied through the 'Phantom Feed' will be used instead.

Please note the polarity of the connector (inner side +, outer side -).##

Connecting the Hub
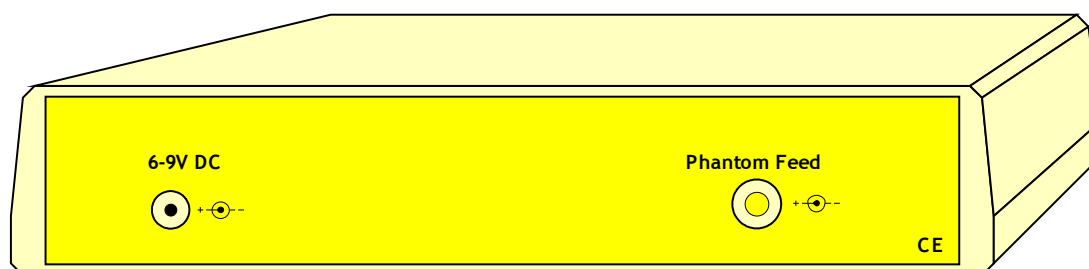
The DC connector of the power adapter is inserted into the left jack on the rear panel (Jack "6-9V DC"). If 'power feeding' via the S-interface or if the Phantom Feed connector is used with the BRI-Hub 4-S or the BRI-Hub-8-S, it is not necessary to insert the DC connector.

Do not use other power adaptors than the original one. In any case notice the polarity of the connector. Inner tip +, outer ring -.

The "Phantom Feed" connector is used to optionally connect a 40VDC voltage to feed all TE-ports and, with option "-S" only, also the BRI-Hub itself. Use the Phantom Feed product for this function. In any case notice the polarity of the connector. Inner tip +, outer ring -.
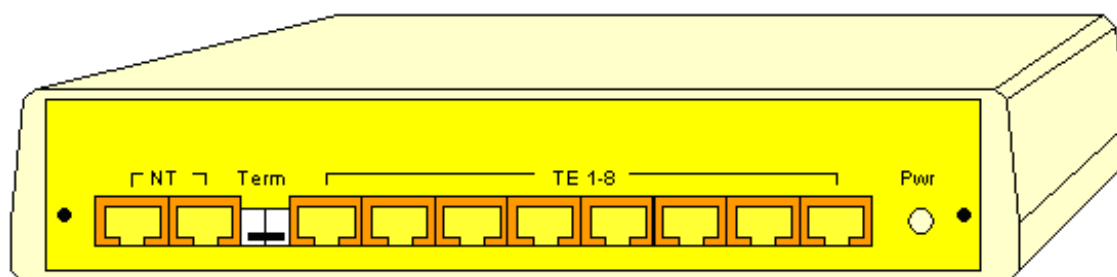
To connect the BRI-Hub to the NT or an internal BRI of a PABX, use one of the connectors labelled 'NT'. Use the enclosed ISDN-cable. Both connectors are parallel connected, so it doesn't matter which one you chose. The second connector may be used to connect a test device or other TEs. (Bus configuration at the NT-port).

Termination of the NT-port may be switched on and off using the Term-switch. When installing the BRI-Hub, check that both ends of the bus are terminated properly.

Depending on the quality of your cables, a maximum length of 150m may be connected to every TE-port of the BRI-Hub. Note that the sum of the cable lengths (NT-BRI-Hub plus BRI-Hub-TE) should not be more than 150m. Since the BRI-Hub will normally be placed directly next to the NT or the PABX, the entire 150m are available for the TE connection.

The TE-ports termination resistors are permanently active and cannot be switched off.

Please install terminating resistors to the end of the connecting cables.
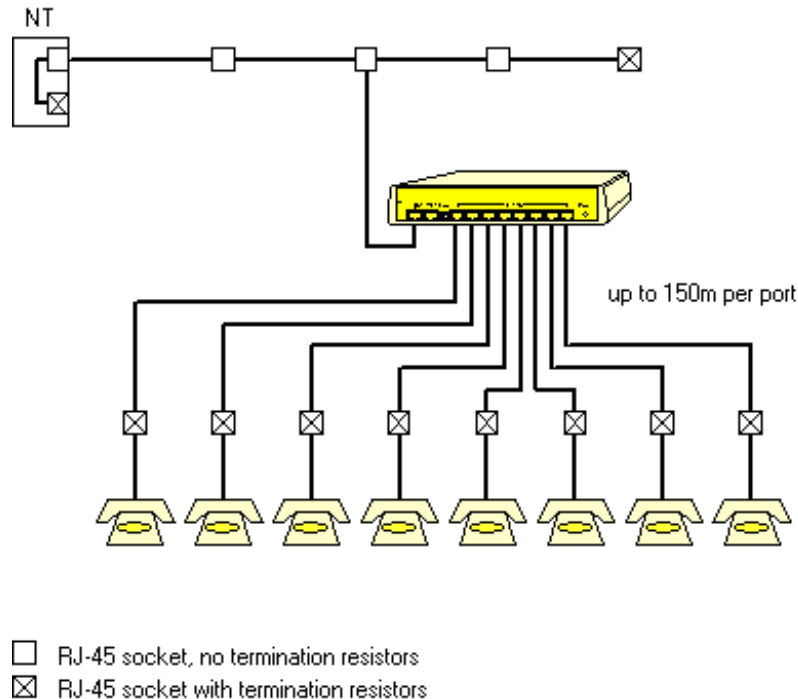
In the above example the Term-switch must be in the off position, i.e. termination resistors are off. This is because the BRI-Hub is not connected to the end of the bus.

Power Failure Operation

If the BRI-Hub loses power, the terminal devices directly connected to the NT ports will still operate. For this to happen case one must observe the maximum cable length and the position of the terminating resistors. In more detail this is:

- The length of the cable connecting the NT to the BRI-Hub plus the length of the cable connecting the BRI-Hub to the TE on the second NT port must not be longer than 150m. Both cables form a passive bus.

- In case of a bus installation at the NT port, BRI-Hub must be the last device on the bus.

- The termination resistors must be switched off. Termination resistors must be installed at the end of the TE's bus

Configuration for power fail communication with the BRI-Hub

Term=off

NT

up to 150m per port

max 150m
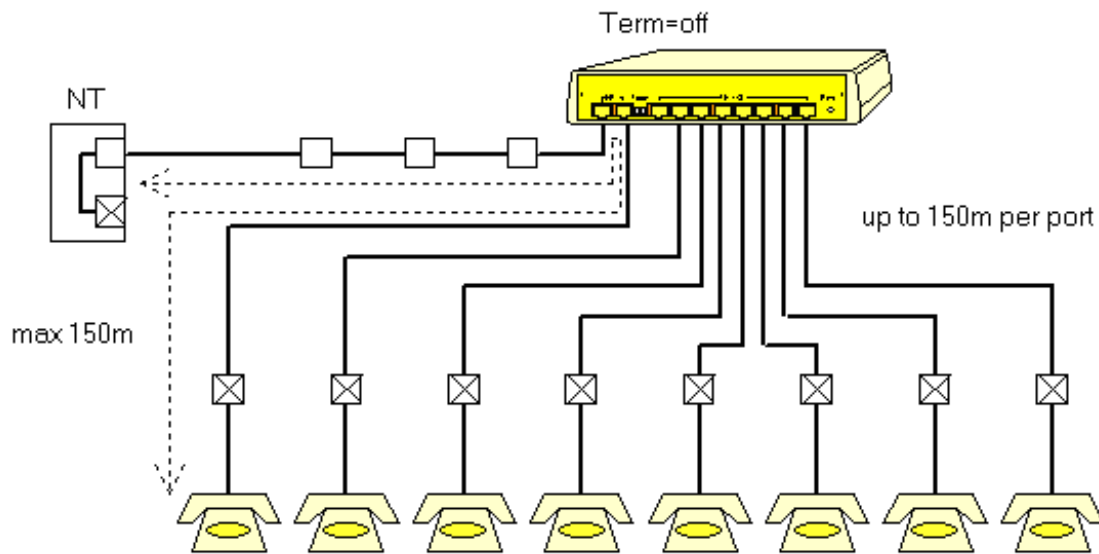
Note:

☐ RJ-45 socket, no termination resistors

☒ RJ-45 socket, with termination resistors

If cable connections between the BRI-Hub and the terminal equipment (TE) are longer than the proposed 150m, operation may be possible under specific conditions:

1. The NT must be switched to "extended passive bus". "Point-to-point" or "adaptive timing".

2. All cable connections at the TE ports must have the same range of length, i.e. +/- 50 to 100m, depending on the cable quality.

Operation

No service is needed during operation.

Cable shorts at one TE port only affect the power feeding voltage of all ports if they are internally connected. To reduce this effect self-healing fuses are connected to each port.

The current version of the BRI-Hub cannot clear problems with cable reversals of the TE pair (Pins 3 and 6 of the RJ-45). If one of the connected TEs has such a pair reversal, no operation is possible since the pulses sent by different TEs have different polarity.

Displays and Controls

Displays

Pwr   is on (green), when the BRI-Hub is operating. I.e. the power supply is active. This may be the power adaptor or the power feeding when using the 'S' option (BRI-Hub-**S**)

Controls

Term   **On**: (down position). Both pairs of the NT port are terminated (100Ω).
Off: (up position). Termination resistors off.

Maintenance

Cleaning

To clean the BRI-Hub use a damp piece of cloth or antistatic cloth. Please do not use scoring or alcoholic fluids.

Caution! Never clean the BRI-Hub wet. This may cause short circuits inside the device.

Troubleshooting

Fault	Problem	How to clear the problem
Pwr-LED is off	BRI-Hub is powered off	Plug in power adaptor
	No mains power	Check for main power
	Faulty power adaptor	Use other **compatible** power adaptor. Check polarity!
	For BRI-HUB-S only: loss of power inside NT or PABX	Use original power adapter
	BRI-Hub is faulty	Please return the device to your dealer.
Specific devices on a port do not operate via the BRI	Cable shorts	Use another port for test. Check for cabling faults.
	Faulty terminal equipment	Check with other equipment
	Cable too long	Connect TE directly to the BRI-Hub for test
Only devices at port 1 may communicate	A BRI-HUB is used which is in the power down mode	Power on the BRI-HUB

If you are still having problems with you BRI-Hub, please call Black Box technical Support.

ISDN Theory

To set up ISDN connections, judge and find bugs you need a certain basic knowledge of the electronic behaviour of the ISDN interface. The next chapter is intended to give you an overview. In addition you can use it as a quick reference. Since the topic ISDN is very versatile and complex, the information here cannot replace a reference book or a course. It is just an introduction to help you working with the BRI-Hub.

Since the BRI-Hub is a pure Basic Rate device, this description is limited to the Basic rate Interface only. The Primary Rate Interface is not a part of this description!

ISDN Reference Model

The ISDN- Reference Model defines several interfaces and functions between network and subscriber:
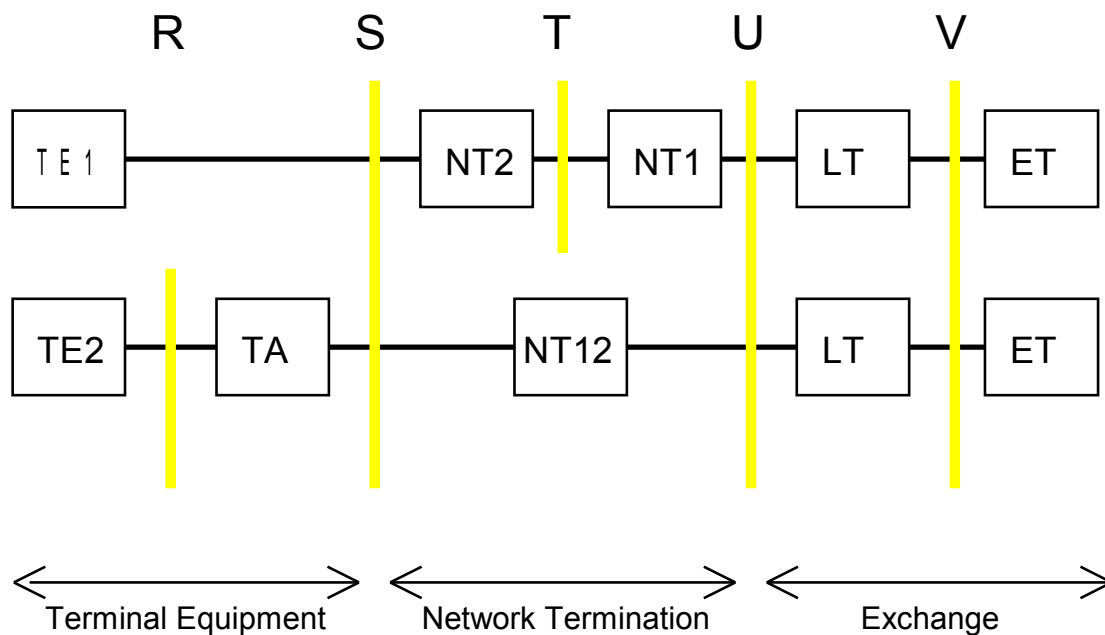
- One end of the network (i.e. local exchange) is the **ET (Exchange Termination)**. It mainly carries out the signalling between subscriber and network (D-channel protocol).

- The transmission apparatus on the network side for the extension circuit is the **LT (Line Termination)**.

- The **LT** and the **NT** are connected to each other via the extension circuit- through the U-interface.

- The NT1 (Network Termination 1) is the line termination on the subscriber's side. It can only carry out layer-1-functions, i.e. electrical functions.

- The NT2 (Network Termination 2), if existing, carries out transmitting multiplexing functions. A NT2 can be an ISDN-PABX for example.

- The NT 12 = Network Termination 12 is the line termination (U) on one side and the subscriber's interface on the other side. It is commonly known as "NT". The reference point T is left out.

- The **S-interface** is the actual subscriber's interface. It exists in the variants S_0 (2B+ D) and S_{2M} (30B+D). The Basic Rate Interface (BRI= S_0) also exists in two variants: As point-to point (PP) with one terminal equipment only, and as point-to-multipoint (PMP) with up to eight terminal equipments attached to a bus.

- **TE1 (Terminal Equipment)** has an ISDN-interface and can be directly attached to an NT. An example of a TE1 is an ISDN-telephone.

- A **TA (Terminal Adapter)** makes an ISDN-incompatible Terminal Equipment (TE2) apt for the subscriber's interface S. TE2 can be an analogue telephone or a PC with a V.24-interface.

Layer 1 (Electrical functions)

The S-interface uses a four-wire scheme. Two wires (a pair) are used to transmit data from the NT to the TE(s), the other two wires are used for the opposite direction.

There is no common ground or common return path. The transmission is called 'symmetrical'. If one wire carries a positive voltage, the other wire of the same pair carries a negative voltage. This has significant advantages because of its safety against noise.

Modes of Connection

Point-to-Point Connection (PP)

A point-to-point connection only exists if one piece of Terminal Equipment is attached to the Basic Rate Interface (BRI). It is usually an ISDN-PABX where the actual TEs are attached.

In a point-to point connection (PP) the cable length between the NT and the TE may not run to more than 1100 m. Both ends of the bus are to be equipped with 100Ω terminating resistors. It is the cross section of the cable and the capacitance per unit length that determines the actual maximum length of the connecting cable (see table below).

All information on electrical and protocol qualities given in the following sections are also valid for the PP.

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Point-to-Multipoint Configuration

The point-to-multipoint configuration (PMP) allows up to eight pieces of terminal equipment to be attached to a BRI at the same time.

There exist two variants of cabling for the PMP:

1. **Short passive bus**
   The short passive bus allows up to 12 sockets on its overall length. The maximum length of the bus runs to 220m, depending on the cross section of the cable and its capacitance per unit length.

   A variant of the short passive bus is created if the NT is not installed at the end of the bus, but within it. Hereby it is recommended to switch on the NT's termination resistors in addition to the terminating resistors of the bus, especially with a long cable length.

2. **Extended passive bus**
   All sockets (maximum 12) are distributed on the last 50m (from the perspective of the NT). The overall maximum length of the extended passive bus runs to 825m, depending on the cross section of the cable and its capacitance per unit length.

Both variants

- Have to have both buses' ends equipped with terminating resistors (100Ω).

- Have their terminal equipment attached to the sockets with connecting cords not longer than 10m

Maximum Cable Lengths

Maximum length of the connecting cable with a cross section of 0.6mm.

Capacitance per unit length	PP	Short passive bus (PMP)	Extended passive bus	Extended passive bus TEs on last Xm
30nF / Km	1100m	220m	825m	50m
40nF / Km	1000m	200m	750m	43m
50nF / Km	920m	180m	690m	39m
60nF / Km	820m	165m	615m	35m
80nF / Km	730m	145m	550m	31m
100nF / Km	660m	130m	495m	27m
120nF / Km	600m	120m	450m	25m

Power Feeding

The supply of power via the wires of the BRI is called 'Power Feeding'. Since the cross section of the transmission cables are proportionately small and the resistance is high, a voltage of 40 VDC is used to keep the loss in the cable low.

Wiring configuration of the RJ-45-Socket according to ISO 8877

Pin	Power Source	Normal Polarity
1	Power Source 3	+
2	Power Source 3	-
3	Power Source 1	+
4	Power Source 1	-
5	Power Source 1	-
6	Power Source 1	+
7	Power Source 2	-
8	Power Source 2	+

There are three different variants of power feeding which are described in the following.

Phantom Feeding (Power Source 1)

Phantom feeding is the most frequent kind of power feeding.

In this case the feeding voltage is led symmetrically via the signalling links (a1/b1 and a2/b2). The data signals are separated from the DC voltage using transformers.

Normally up to four pieces of terminal equipment can be provided with power via the signalling links of the BRI. This can be achieved as the NT has its own local power supply, which again is supplied via the local mains net. The NT itself is provided with power through the extension circuit (U-interface).

To feed the terminal equipment, the NT- sending pair is usually loaded with a positive voltage, the TE -sending pair with negative voltage (40 VDC). As the data signals are put in and out of the line via transformers, the AC signal may be decoupled from the DC voltage. The DC voltage can be taken from the primary side of the transformer.

In case of a local power failure, the NT is able to supply one piece of terminal equipment (but only one!) with its own power supply, which comes from the U-interface of the exchange. In order to indicate this state, the polarity of the DC voltage is reversed in the "Restricted Mode", as it is called.

Direct Power feeding (Power Source 2)

Feeding by Power Source 2 means that separate signalling links of the BRI are being used. In addition to the 4 existing signalling links two more links are needed - This procedure is rarely used

Feeding of the NT (Power Source 3)

In this case, power feeding of the NT is executed by an external power feeding-device or by a TE via the BRI. Two separate links are also used. This procedure is, like the Power Source 2, rarely used.
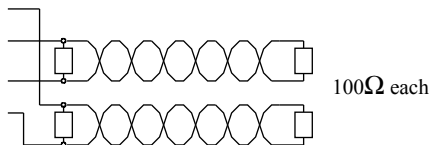
Termination Resistors

The signal pairs must be terminated with 100Ω resistors at both ends of the bus.

These must be installed as shown below. If not placed correctly, they may short the power feeding voltage.

ISDN socket

1 2 3 4 5 6 7 8

2 x 100 Ohm
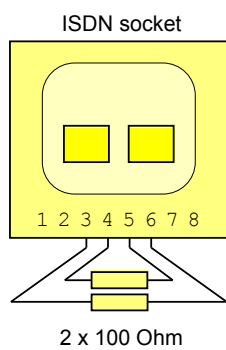
Pin	Pin description	Direction
1		
2		
3	2a	TE ➔ NT
4	1a	NT ➔ TE
5	1b	NT ➔ TE
6	2b	TE ➔ NT
7		
8		

100Ω each

Normally the NT (or NT-port) is placed at one end of the bus. However it is possible to place the NT at a random position. If the cables connected to it are long (>25m each), it is recommended to add terminating resistors at or in the NT. (Below 25m it is not necessary).

NT
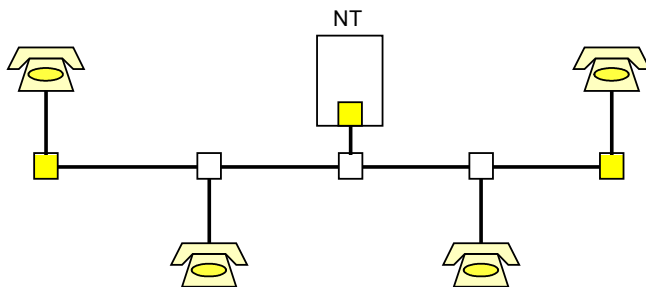
Line Code

The line code of the BRI is called modified AMI code. (AMI = Alternate Mark Inversion). In this code for every '1' no pulse is sent (high impedance). For a '0', alternating pulses are sent. To identify the beginning of a frame a so-called 'code violation' is used. This is a positive pulse following a second positive pulse or vice versa .

Pulse Form

The ideal pulse form is a square impulse with a width of 5.2μs (1 / 192KHz) and the voltage of 750mV.

Frame Structure

To transmit several channels (2B + D) via the same cable a technique called 'time division multiplexing' is used. This means that all channels may transmit their data at a given time, one after the other. To let the receiver know when the data of the different channels are transmitted a frame is added. As mentioned above the frame start is indicated by code violations.

The Basic Rate Interface uses a frame length of 48 Bits. With the transmission rate of 192 kbps it is 250μs long.

Within the frame the D- and B-channel bits are transmitted at specific positions. Other bits are used for control and status information.
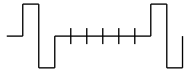
Pair Reversals

Reversals within the same pair are not very critical at first glance. Such a pair reversal has the consequence that positive pulses are received as negative pulses and vice versa. Since positive and negative pulses have the same meaning ('0') no information is lost.

With the point-to-point configuration there is a problem regarding pair reversals: Since all TEs on the bus are partly sending at the same time, positive and negative pulses cancel each other out. Thus no communication is possible if a pair reversal exists between two TEs.

Activation / Deactivation

The BRI may be changed to a passive low power state by the deactivation. If communication is requested, the BRI must be activated with a specified procedure. With the point-to-point configuration and on request at the local network provider it is possible to have the BRI permanently active.

The activation procedure passes through several states. These states are called 'Info states'. They are numbered from Info S0 to Info S4

TE sends	NT sends
Info S0 No signal, idle state	
Info S1 Continuous signal (11000000) 192kbps	
Info S3 S_0-frame, B- and D-bits transparent	**Info S2** S_0-frame, D-, E-, B- and A-bits set to '0' (maximal pulses)
	Info S4 S_0-frame, B- and D-bits transparent A-bit = '1', E-bits = received D-bits
Info S3 S_0-frame, B- and D-bits transparent	**Info S4** S_0-frame, B- and D-bits transparent A-bit = '1', E-bits = received D-bits
Info S0 No signal, idle state	

Remarks:

The idle state is Info S0. If a TE requests activation it sends Info S1. If the NT receives the Info S1 signal it activates its U-interface and sends Info S2 in turn. When Info S2 is received by a TE it synchronizes to the bit stream and sends Info S3. This applies to all TEs on the bus. If the NT sees Info S3 it sends Info S4. The active state is reached when the TEs are sending Info S3 and the NT is sending Info S4. Within the active state (Layer 1 up) it is possible to set-up layer-2 connections.

If the activation requests come from the network side (e.g. an incoming call) the procedure starts with Info S0 -> Info S2.

The NT may initialise deactivation because only the network knows about the state of the connected TEs and about open connections. The deactivation procedure is simple: The NT sends Info S0 (no pulses) which in turn causes all TEs to send Info S0 also (i.e. stop sending).

Hardware

Diagram

The diagram below shows the internal functions of the BRI-Hub.
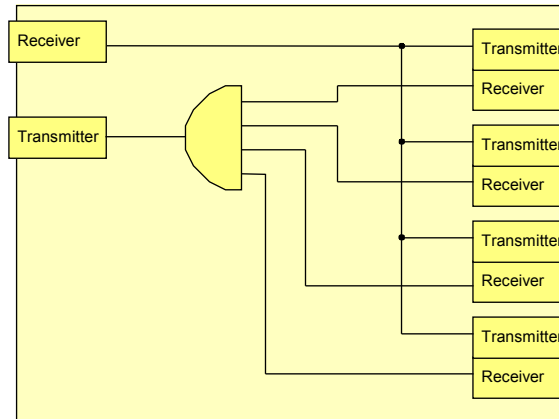
Hardware Configuration

J1	Description
Plugged	DC-DC-Wandler of BRI-Hub is active also in the restricted mode of the power feeding.
Unplugged	In the restricted mode BRI-Hub is off

Appendix A –S$_0$-Interface

Connector: RJ-45 (ISO 8877, EN 28877)

Pin	Signal	Direction	Power Feeding
1			PS3 +
2			PS3 -
3	TE(+)	TE ➔ NT	PS1 + (Phantom)
4	NT(+)	NT ➔ TE	PS1 - (Phantom)
5	NT(-)	NT ➔ TE	PS1 - (Phantom)
6	TE(-)	TE ➔ NT	PS1 + (Phantom)
7			PS2 -
8			PS2 +

Standards and Recommendations

EN 60 950 / IEC 950	Safety of information technology equipment
ETS 300 012	Basic User Network Interface - Layer 1 Specification
ETS 300 102	DSS1: User-Network-Interface Layer 3
ETS 300 125	DSS1: User-Network Interface Data Link Layer (Layer 2)
I.430	Basic User-Network Interface Layer 1 Specification
IEC 950	See EN 60 950
Q.921 / I.441	Digital Subscriber Signalling System No. 1 - User-Network Interface Layer 2
Q.931	Digital Subscriber Signalling System No. 1 - User-Network Interface Layer 3, Specification for Basic Call Control

Abbreviations

Abbr.	Meaning	Description
1TR6	TR = Technical Requirement	German national ISDN-D-Channel-Protocol Layer 2 and 3
2B1Q	2 Binary 1 Quad	Type of line code for the BRI (UK_0)
4B3T	4 binary 3 Ternary	Type of line code for the BRI (UK_0)
AMI	Alternate Mark Inversion	Coding of digital Signals (DC free)
BA	Basic Access	
BER	Bit Error Rate	
BERT	Bit Error Rate Test(er)	
bps	bit per second	
CCITT	Commitee Consultatif Internationale de Telegraphique et Telephonique	International Telegraph and Telephone Consultative Commitee. Now: ITU-T
DSS1	Digital Subscriber Signalling System No. 1	Common european D channel protocol
E-DSS1	European Digital Subscriber Signalling System No. 1	Now DSS1
ET	Exchange Termination	Reference model
ETS	European Telecommunication Standard	by ETSI
ETSI	European Telecommunication Standards Institute	
FAG	Fernmelde anlagen gesetz	
ISDN	Integrated Services Digital Network	
ISO	International Standardisation Organisation	
ITU	International Telecommunications Union	
ITU-T	International Telecommunications Union-Telecommunications Standards Sector	
LE	Local Exchange	Reference model
LT	Line Termination	Reference model
MMS43	Modify Monitor Sum	Line code for the Basic Access (UK_0) in some countries (e.g. Germany)
NT	Network Termination	Reference model
NTBA	Network Termination Basic Access	
NTBIBA	Network Termination Bilingual Basic Access	Intelligent NT with speaks two D channel protocols
OSI	Open Systems Interconnection	
PABX	Private Automatic Branch Exchange	

PBX	Private Branch Exchange	
PMP	Point-to-Multipoint	Layer 1 and 2 access type
PP	Point-to-Point	Layer 1 and 2 access type
S		S-Interface
S_0		S-Interface Basic Access
S_{2M}		S-Interface Primary Access (2 MBit/s)
STP	Shielded Twisted Pair	
TA	Terminal adapter	
TE	Terminal Equipment	Reference model
TP	Twisted Pair	
U		U-Interface
UTP	Unshielded Twisted Pair	