VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE | DEPARTMENT OF TELECOMMUNICATIONS
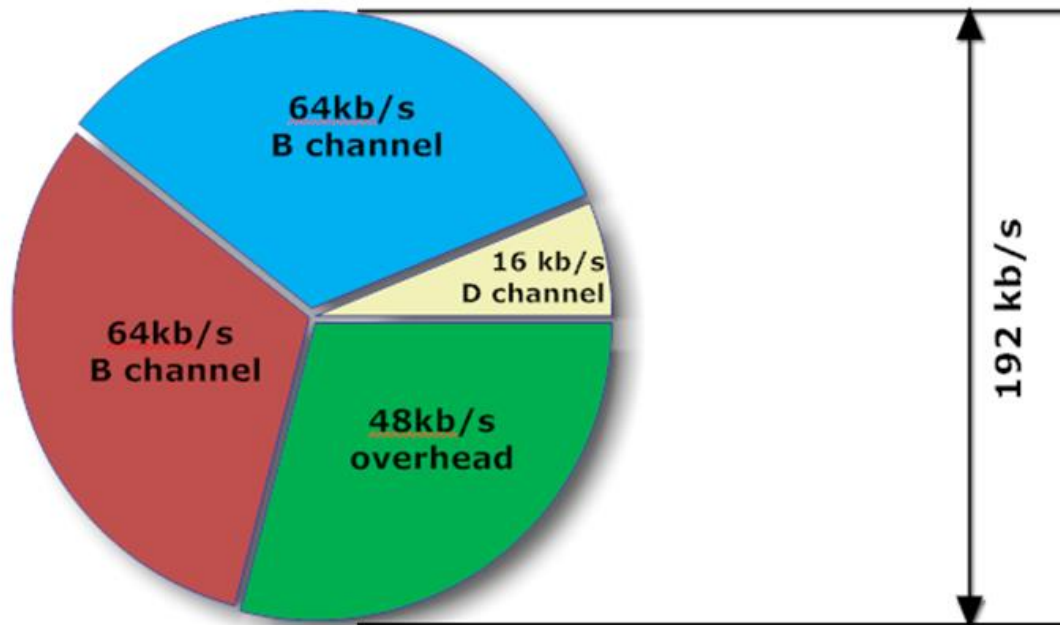
Telecommunication Networks
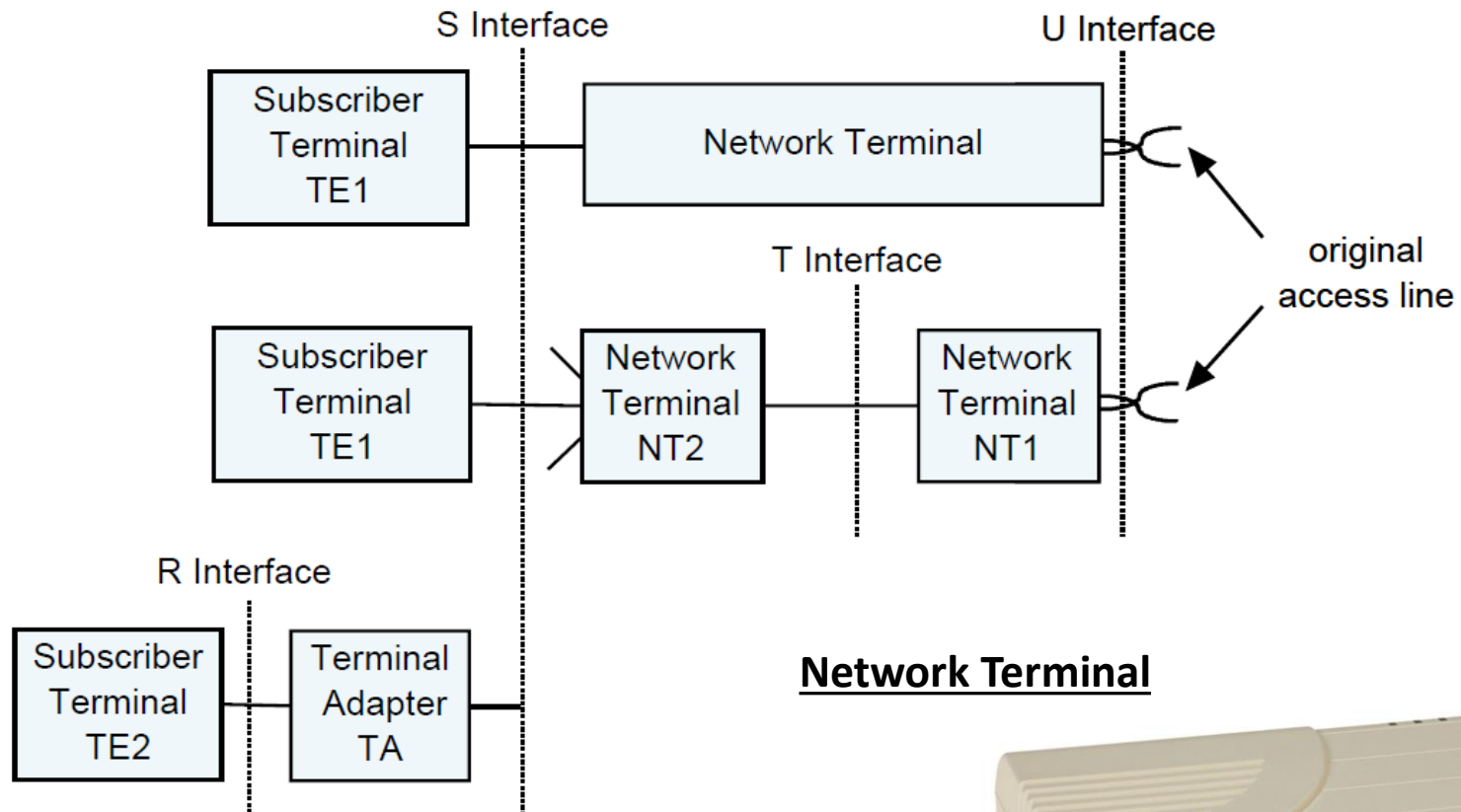# ISDN

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Capacity of ISDN

- concept developed by CCITT in 1988

- set of communication standards for simultaneous digital transmission of voice, video, data, and other network services over the PSTN

- **Basic Rate Interface (BRI)** - two 64 kbit/s bearer channels (B channels) and one 16 kbit/s signaling channel (D channel). This is sometimes referred to as 2B+D.

ISDN BRI Concept

S Interface

U Interface

Subscriber
Terminal
TE1

Network Terminal

original
access line

T Interface

Subscriber
Terminal
TE1

Network
Terminal
NT2

Network
Terminal
NT1

R Interface

Subscriber
Terminal
TE2

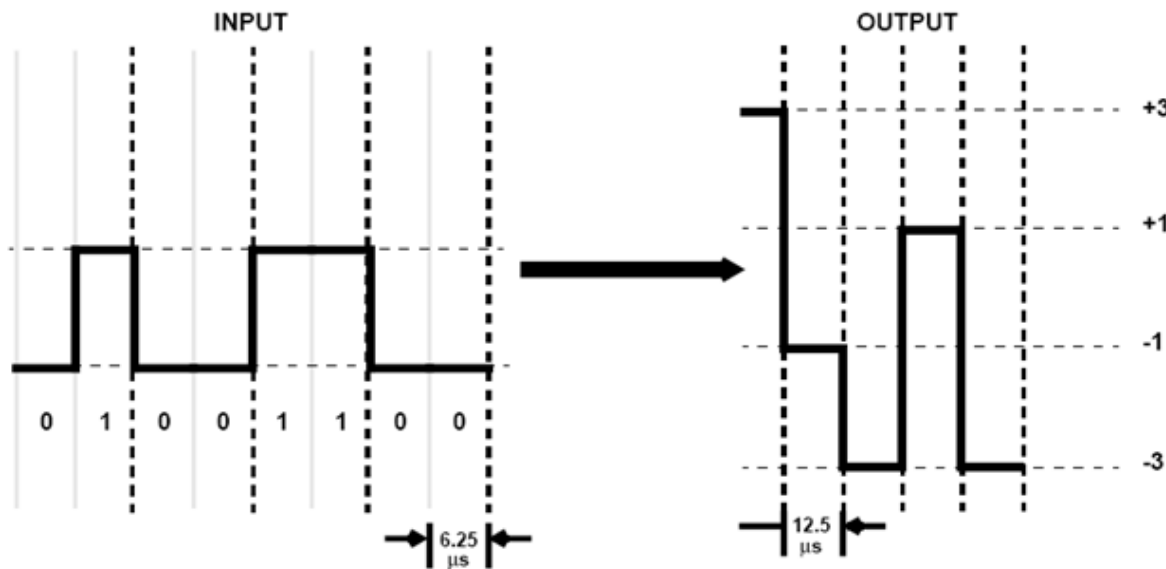Terminal
Adapter
TA

Network Terminal

BRI Properties

- BRI is Time Division Multiplex (TDM) interface where the B, D and overhead bits are interleaved

- BRI is created by the Network Terminal type 1 (NT1)

- NT1 creates a four-wire bus called T interface

- S and T interfaces are logically and physically identical

- NT2 could create multiple S interfaces, decides who access to the B channel on the T interface, up to 8 devices can be connected to the bus

- TE2
    - non ISDN, doesn't have an ISDN interface
    - standard „analog" device having an RS-232 or V.25 interface

- TA - primary function is to convert the ISDN interface for TE2
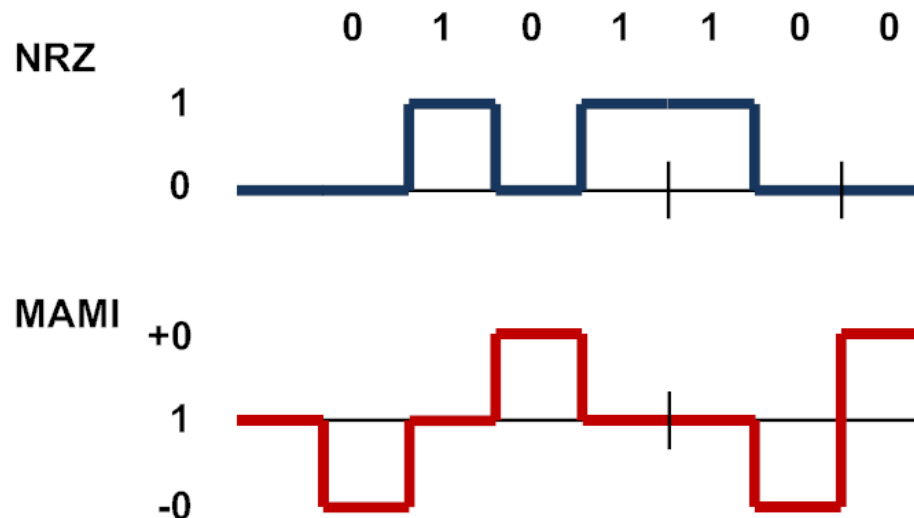
BRI - U Interface

- at the original access line side, can be two-wire or four-wire
- 2B1Q line code is used
- minimizes crosstalk , the DC component is suppressed
- each of the four levels contains two bits → baud rate if one half bitrate
- primary spectral peak is about 80 kHz

INPUT

OUTPUT

+3

+1

-1

-3

0   1   0   0   1   1   0   0

6.25 µs

12.5 µs

2-Level Binary Data
160 kbit/s

4-Level, Quaternary Data
80 kbaud/s

| DIBIT	OUTPUT QUAT
10	+3
11	+1
01	-1
00	-3

BRI - S Interface

- **S interface**
  - between NT and up to eight addressable devices such as a computer or a telephone
  - four wire
  - MAMI (Modified Alternate Mark Inversion) link code is used
 - **logical High=0V**, **logical Low= +0,75V or -0,75V**

BRI - S Interface

- the frame is defined on the physical layer
- different format of frame for NT → TE and for TE → NT
- constant length 250 µs and 48 bits = 192 kbit/s
- in each frame 32 x **B bits,** 4 x **D bits**
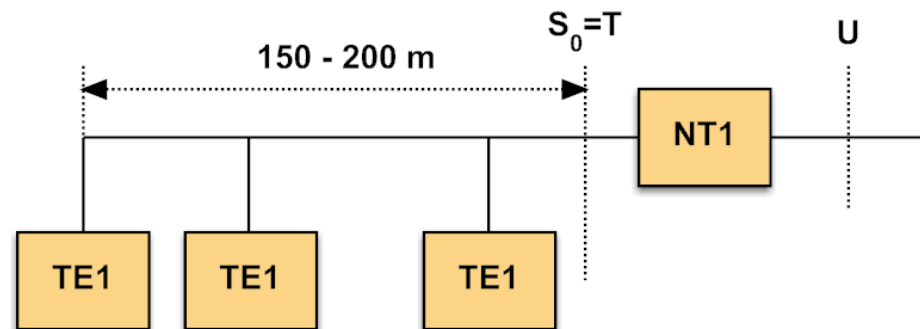- service bits F, L, E, S, A
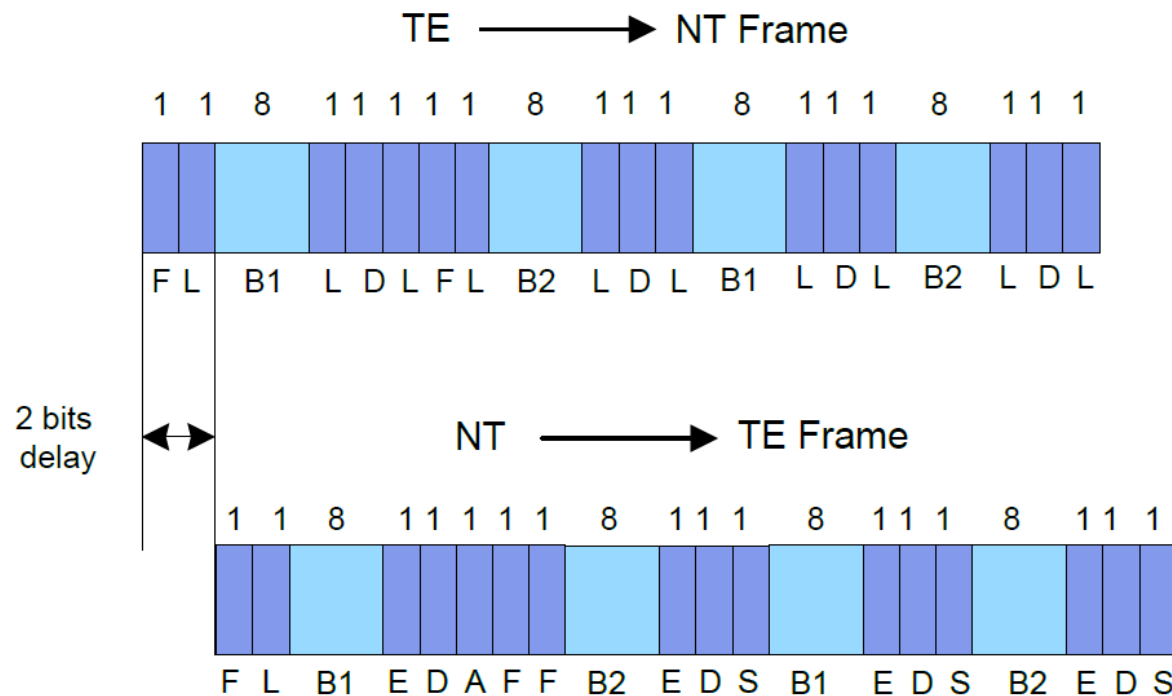
BRI - Configuration of Interfaces

- **S_0 interface – point-to-point**
  - only one device is connected to the bus
 - maximum is 1000 m from NT to TE
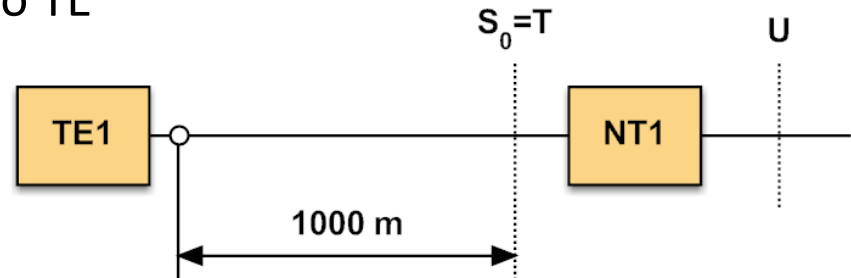
- **Point To Multipoint (short passive bus)**
  - up to 8 terminals

ISDN Link Layer
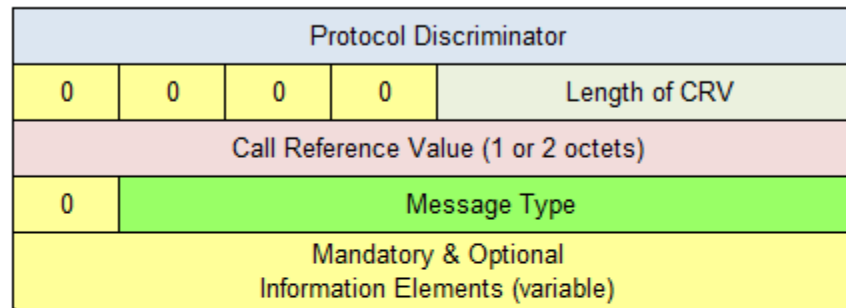
- LAPD (Link Access Protocol - Channel D) is a layer 2 protocol which is defined in ITU-T Q.920/921.

- LAPD protocol provides framing, sequence control, error detection, and recovery of multiple logical data links on the same D channel.

- LAPD frame is defined:

| 1	2	1	Variable	1	1
Flag	Address Field	Control Field	Information	FCS	Flag
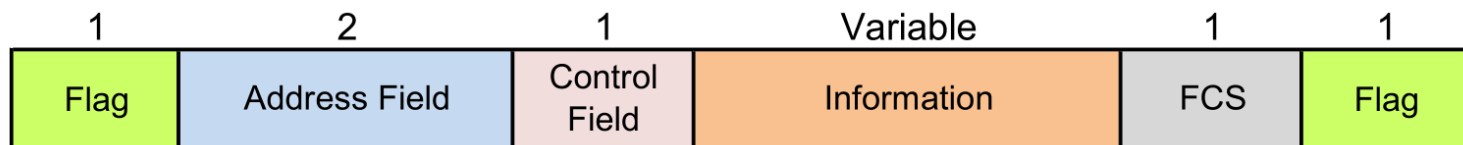
ISDN Network Layer

- defined by ITU-T Q.931 as Digital subscriber Signalling System No. 1
- designed for ISDN call establishment, maintenance, and release of network connections
- A Q.931 message is defined (frame is defined on 2nd layer):

Protocol Discriminator				
0	0	0	0	Length of CRV
Call Reference Value (1 or 2 octets)				
0	Message Type			
Mandatory & Optional Information Elements (variable)				

- Message type – Specifies the type of a layer 3 message
  - SETUP, CALL PROCEEDING, ALERTING, CONNECT, RELEASE, RELEASE COMPLETE

Flag	Address Field	Control Field	Information	FCS	Flag
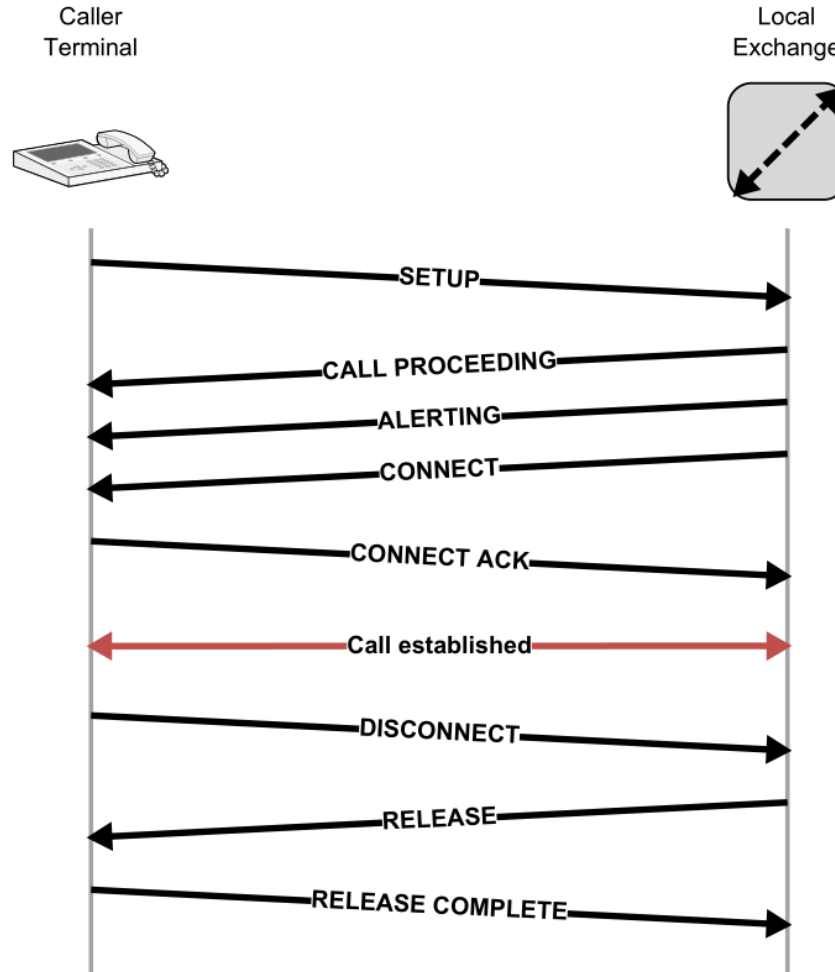
ISDN Call Flow

ISDN Call Flow

1. A (caller) sends a **SETUP** to the local exchange.

2. If the SETUP is OK, the local exchange sends a **CALL PROCeeding** to the A, and then a SETUP to the B (calling).

3. The B gets the SETUP. If it is OK, then it rings the phone and sends an **ALERTING** message to the local exchange.

4. The local exchange forwards the **ALERTING** message to the A.

5. When the B answers the call, is sends a **CONNECT** message to the local exchange

6. The local exchange forwards the **CONNECT** message to the A.

7. The A sends a **CONNECT ACKnowledge** message to the local exchange

8. The local exchange forwards the **CONNECT ACK** message to the B.

9. Done. The connection is now up.

10. A hangs-up first and sends **DISCONNECT.**

11. The **RELEASE** message send B to release the trunk circuit between the local exchangees.

12. Upon receiving the **RELEASE**, the destination local exchange disconnects the trunk from the called party's line, sets the trunk state to idle, and transmits an release complete message RLC to the originating local exchange to acknowledge the release of the remote end of the trunk circuit.

13. When the originating local exchange receives (or generates) the **RELEASE COMPLETE**, it terminates the billing cycle and sets the trunk state to idle in preparation for the next call.

ISDN PRI (Primary Rate Interface)

- developed specifically for industrial or large quantity users

- is made up of 23 x 64 kb/s B-channels and one 64 kb/s D-channel in a **T1** *(1,536 Mb/s)* configuration

- or is made up of 30 x 64 kb/s B-channels and one 64 kb/s D-channel in an **E1** (2,048 kb/s) configuration

- typically used to establish communication between a PBX

- the advantage of primary rate interface or PRI is that the 23 or 30 B channels can be used in various combinations for specific data transmission needs

References

- ITU-T. I.430 (11/95). Basic user-network interface – layer1 spec
- ITU-T I.431 Primary rate user-network interface - Layer 1 specification
- ITU-T Q.931 ISDN user-network interface layer 3 specification for basic call control
- ITU-T Q.921 ISDN user-network interface – Data link layer specification