TE = Terminal Equipment
(DTE - Data Terminal Equipment)
NT = Network - Terminating Equipment
(DCE - Data Circuit - Terminating Equipment)
GENERIC INTERFACE TO TRANSMISSION MEDIUM

Digital data transmitter/receiver

Transmission line interface device

Terminal equipment (TE)

Computer

Signal and control leads

1 0 1 1 0 1 1

Transmission line interface device

Network-terminating equipment (NT)

Modem

Bit - serial transmission medium

e.g., RS232 Interface

Modem

Computer

Digital data transmitter/receiver
INTERFACING

Devices which include terminals and computers, are generically referred to as Data Terminal Equipment (DTE) or Terminal Equipment (TE). A TE makes use of the transmission system via the Network-Terminating Equipment (NT) e.g., Modem.

The NT is responsible for transmitting and receiving bits, one at a time, over the transmission medium. The NT must also interact with the TE. In general, this requires both data and control information to be exchanged. This is done by a set of wires referred to as interchange circuits.

Standards have been developed that specify the exact nature of the interface between the TE and the NT. These standards are known as Physical Layer Protocols.
The **Mechanical** characteristics pertain to the actual physical connection of the Terminal Equipment (TE) and Network Terminating Equipment (NT).

The **Electrical** characteristics have to do with the voltage levels and timing of voltage changes. Both TE and NT must use the same coding schemes (e.g., NRZ-L).

**Functional** characteristics specify the functions that are performed, by assigning meaning to the various interchange circuits. Functions can be classified into the broad categories of data, control, timing and ground.

**Procedural** characteristics specify the sequence of events for transmitting data, based on the functional characteristics of the interface.
COMMON INTERFACE STANDARDS

- RS-232-C, RS-232-D
- RS-449 with RS-422-A & RS-423-A
- RS-530 with RS-422-A & RS-423-A
- X.21
- ISDN Physical Connector
RS -232
Commonly Used to Interface Terminal or Computer to Modem

Up to 25 circuits

transmission line

DTE

MODEM

TE

NT
By far the most common interface standard is RS-232. It has a 25-pin connector, and has a maximum 50-foot cable length but, by means of special low impedance cable it can be stretched to 100 feet or greater.
Layout of the 25-pin Connectors
Used for EIA RS-232
RS-232 CIRCUITS (DIRECTION TO)

DATA SIGNALS
- Transmitted data (DCE)
- Received data (DTE)
- Secondary transmitted data (DCE)
- Secondary received data (DTE)

TIMING SIGNALS
- Transmitter signal
  Element timing (DCE)
- Transmitter signal
  Element timing (DTE)
- Receiver signal
  Element timing (DTE)

GROUNDs
- Signal ground/common return
- Shield

CONTROL SIGNALS
- Request to send (DCE)
- Clear to send (DTE)
- DCE ready (DTE)
- DTE ready (DCE)
- Ring indicator (DTE)
- Received line signal detector (DTE)
- Signal quality detector (DTE)
- Data signal rate select (DCE)
- Data signal rate select (DTE)
RS-232 Interface Example

4. Request to send (request from DTE for permission to start transmitting)

5. Clear to send (signal from the modem to inform the DTE it can start to transmit)

2. Transmit data (carries digital data)

15. Transmit timing (clocking signal used for synchronous transmission)

3. Receive data (carries digital data)

17. Receive timing (clocking signal used for synchronous transmission)

8. Received line signal detector (Advises the DTE that the modem (DCE) is receiving a carrier signal and is ready to demodulate)
RS-232-C (1969) LIMITATIONS

- Signal-rate limit of 20 Kbps
- Cable-length limit of 15 M (50 Feet)
- Proliferation of mechanical interface design
- Inability to control loop-test functions for fault isolation.
NEW STANDARD IN 1977

RS-449, with RS-422-A and RS-423-A

RS-449
- Defines mechanical, functional, procedural characteristics
- Retains RS-232-C features
- Procedurally similar to RS-232-C
- Increased modem control
- 37 pins and added more functions

RS-422-A and RS-423-A
- Defines electrical characteristics
- Improved speed
- Improved distance = 4000 feet
DIAGNOSTIC LOOPBACK

TERMINAL EQUIPMENT  LOOP  MODEM  LOOP  CARRIER CHANNEL  LOOP  MODEM  LOOP  TERMINAL EQUIPMENT
X.21

- Relies on digital logic rather than a proliferation of circuits.
- 15-pin connector
- Defined for synchronous operation
- Balanced mode transmission
- Advanced automatic calling features
- Major improvement over RS-232&RS-449
- More flexible and should cost less
X-21 INTERFACE

Customer's premise  Network

DTE

Transmit (T)
Control (C)
Receive (R)
Indication (I)
Signal element timing (S)
Byte Timing (B)
Common Return (Ga)
Ground (G)

DCE

TE

Customer access line

NT

- Compatible with RS-232-C
- Main differences from RS-232-C
  - Defines a specific cable connector
  - Added 3 additional circuits for test operations
- Limited to short distances (15M/50feet)
- Maximum data rate: 20 KBPS
EIA-530 WITH RS-422-A AND RS423-A

- 1987
- Data rates: 20 KBPS TO 2 MBPS
- Same 25 pin connector as RS-232
- Improved electrical characteristics using RS-422-A and RS-423-A standards.
- Takes advantage of integrated circuit technology
ISDN PHYSICAL CONNECTOR

8-pin physical connection (modular jack and plug)
ISO standard 8877
Provides 4, 6, or 8 contacts

<table>
<thead>
<tr>
<th>CONTACT</th>
<th>TE (TERMINAL EQ)</th>
<th>NT (NETWORK-TERMINATING EQ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power source 3</td>
<td>Power sink 3</td>
</tr>
<tr>
<td>2</td>
<td>Power source 3</td>
<td>Power sink 3</td>
</tr>
<tr>
<td>3</td>
<td>Transmit</td>
<td>Receive</td>
</tr>
<tr>
<td>4</td>
<td>Receive</td>
<td>Transmit</td>
</tr>
<tr>
<td>5</td>
<td>Receive</td>
<td>Transmit</td>
</tr>
<tr>
<td>6</td>
<td>Transmit</td>
<td>Receive</td>
</tr>
<tr>
<td>7</td>
<td>Power sink 2</td>
<td>Power source 2</td>
</tr>
<tr>
<td>8</td>
<td>Power sink 2</td>
<td>Power source 2</td>
</tr>
</tbody>
</table>