William Stallings
Data and Computer Communications

Chapter 6

The Data Communications Interface

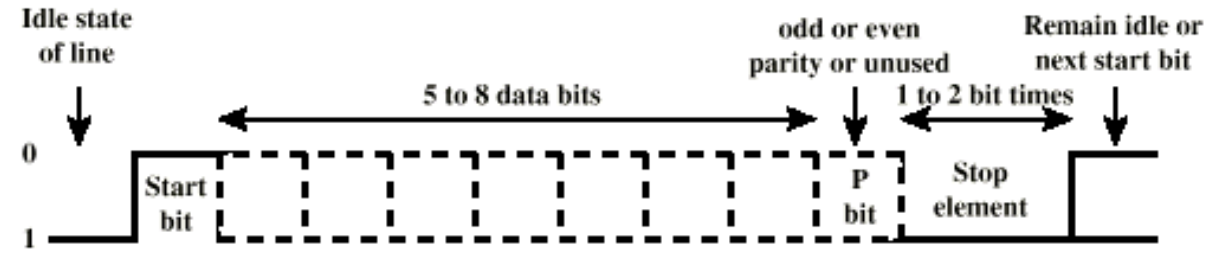
Asynchronous and Synchronous Transmission

- Timing problems require a mechanism to synchronize the transmitter and receiver
- Two solutions
  - Asynchronous
  - Synchronous

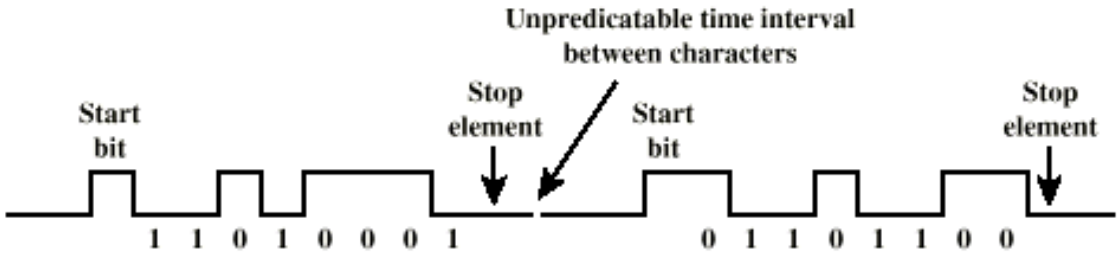
Asynchronous

- Data transmitted on character at a time
  - 5 to 8 bits
- Timing only needs maintaining within each character
- Resync with each character

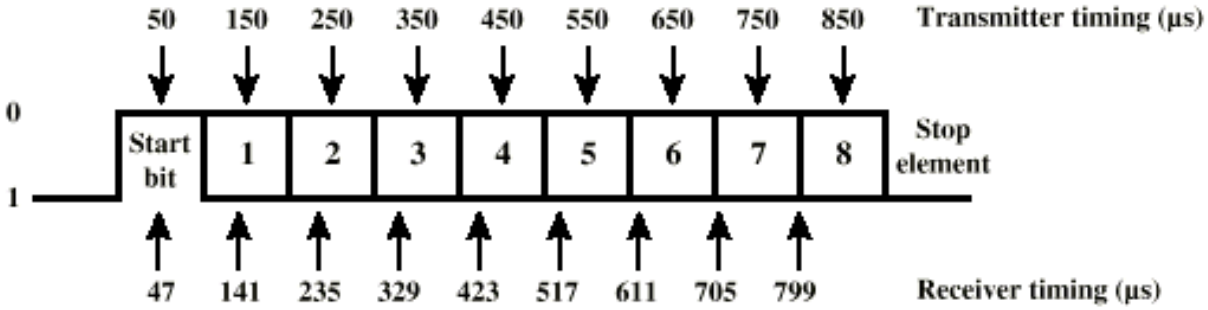
Asynchronous (diagram)



(a) Character format



(b) 8-bit asynchronous character stream



(c) Effect of timing error

Asynchronous - Behavior

- In a steady stream, interval between characters is uniform (length of stop element)
- In idle state, receiver looks for transition 1 to 0
- Then samples next seven intervals (char length)
- Then looks for next 1 to 0 for next char

- Simple
- Cheap
- Overhead of 2 or 3 bits per char (~20%)
- Good for data with large gaps (keyboard)

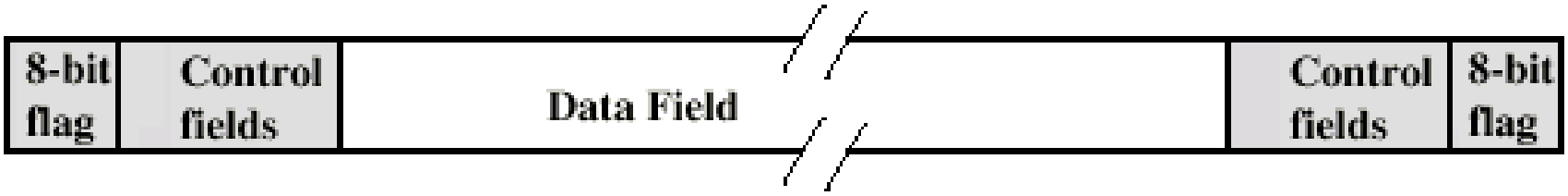
Synchronous - Bit Level

- Block of data transmitted without start or stop bits
- Clocks must be synchronized
- Can use separate clock line
  - Good over short distances
  - Subject to impairments
- Embed clock signal in data
  - Manchester encoding
  - Carrier frequency (analog)

Synchronous - Block Level

- Need to indicate start and end of block
- Use preamble and postamble
  - e.g. series of SYN (hex 16) characters
  - e.g. block of 11111111 patterns ending in 11111110
- More efficient (lower overhead) than async

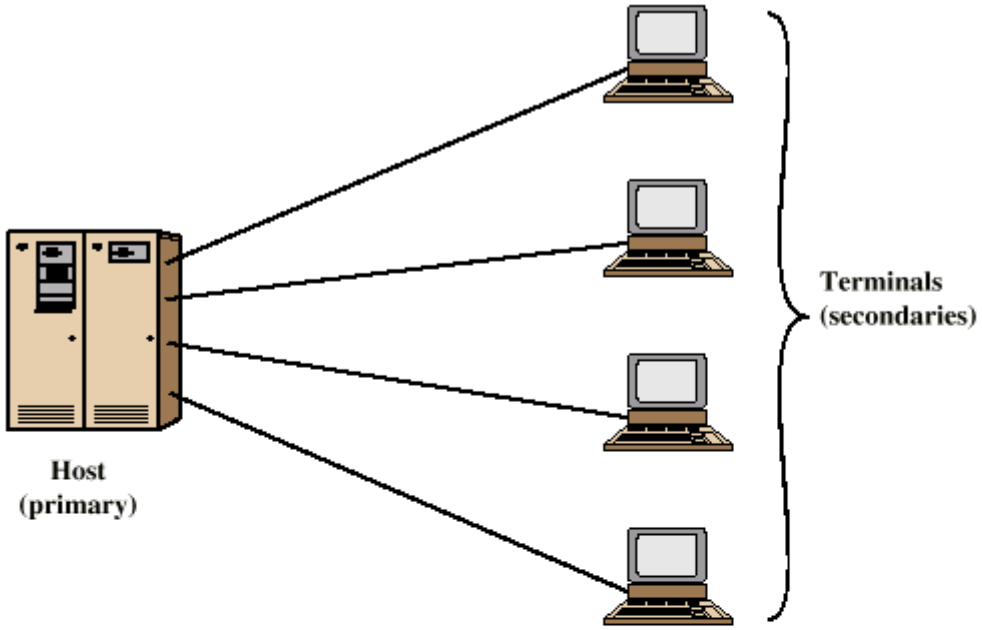
Synchronous (diagram)



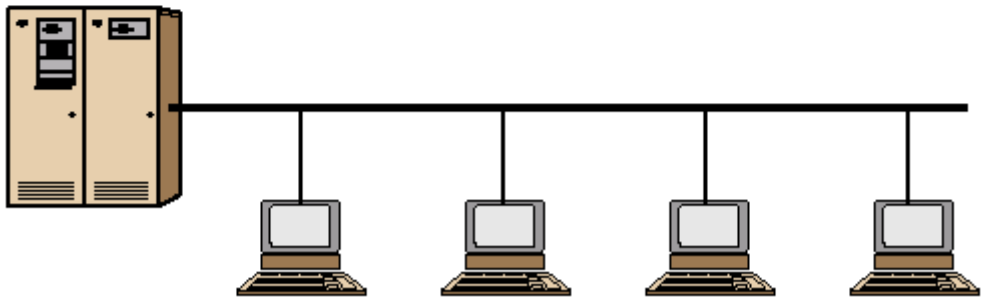
Line Configuration

- Topology
  - Physical arrangement of stations on medium
  - Point to point
  - Multi point
    - Computer and terminals, local area network
- Half duplex
  - Only one station may transmit at a time
  - Requires one data path
- Full duplex
  - Simultaneous transmission and reception between two stations
  - Requires two data paths (or echo canceling)

Traditional Configurations



(a) Point-to-point



(b) Multipoint

Interfacing

- Data processing devices (or data terminal equipment, DTE) do not (usually) include data transmission facilities
- Need an interface called data circuit terminating equipment (DCE)
  - e.g. modem, NIC
- DCE transmits bits on medium
- DCE communicates data and control info with DTE
  - Done over interchange circuits
  - Clear interface standards required

Characteristics of Interface

- Mechanical
  - Connection plugs
- Electrical
  - Voltage, timing, encoding
- Functional
  - Data, control, timing, grounding
- Procedural
  - Sequence of events

V.24/EIA-232-F

- ITU-T v.24
- Only specifies functional and procedural
  - References other standards for electrical and mechanical
- EIA-232-F (USA)
  - RS-232
  - Mechanical ISO 2110
  - Electrical v.28
  - Functional v.24
  - Procedural v.24

Mechanical Specification

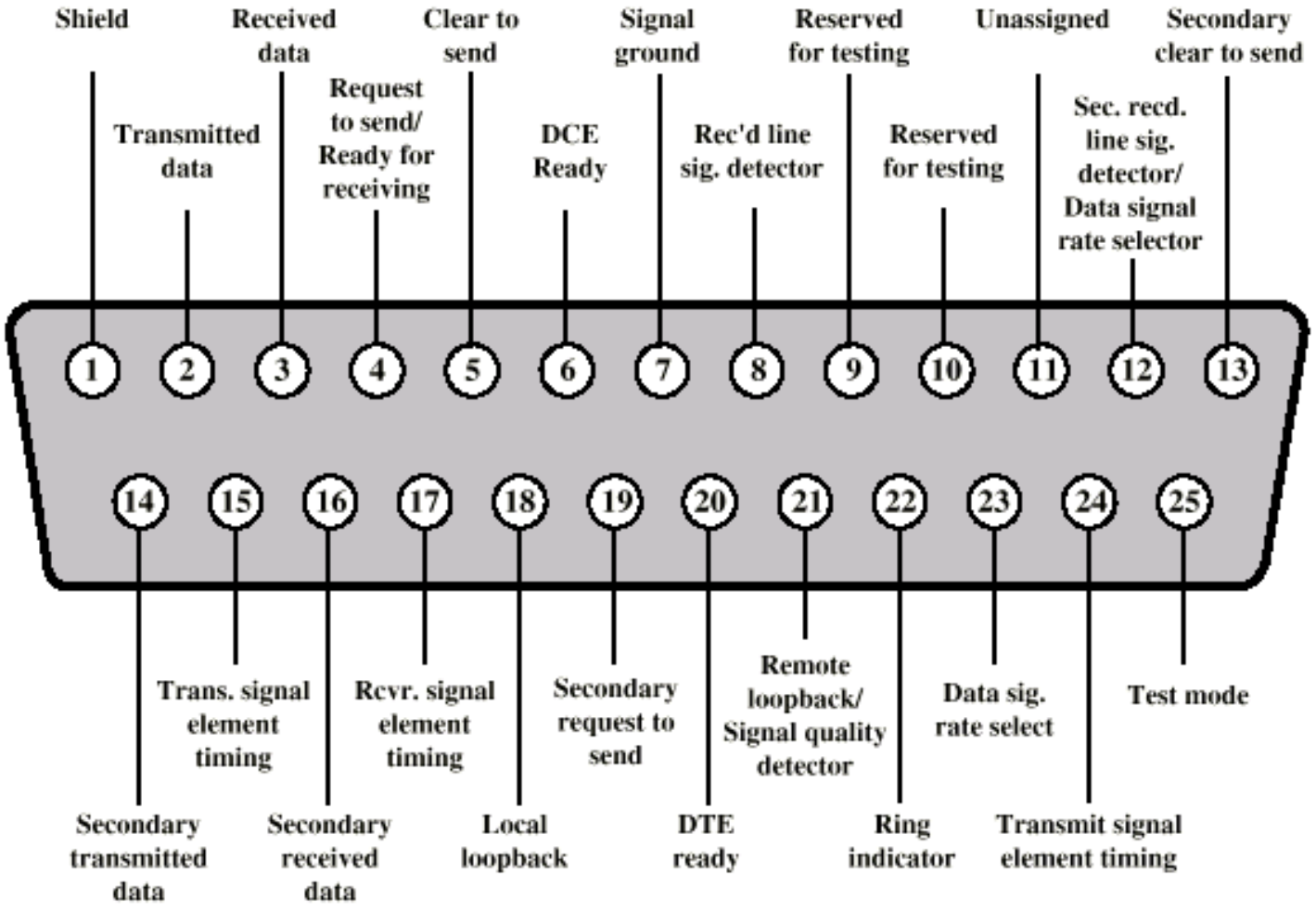


Figure 6.5 Pin Assignments for V.24/EIA-232 (DTE Connector Face)

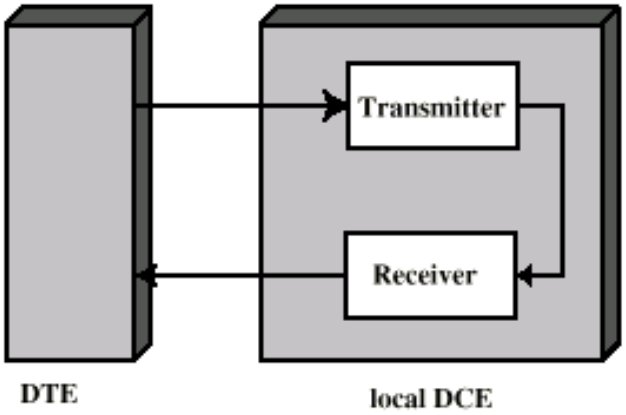
Electrical Specification

- Digital signals
- Values interpreted as data or control, depending on circuit
- More than -3v is binary 1, more than +3v is binary 0 (NRZ-L)
- Signal rate < 20kbps
- Distance <15m
- For control, more than-3v is off, +3v is on

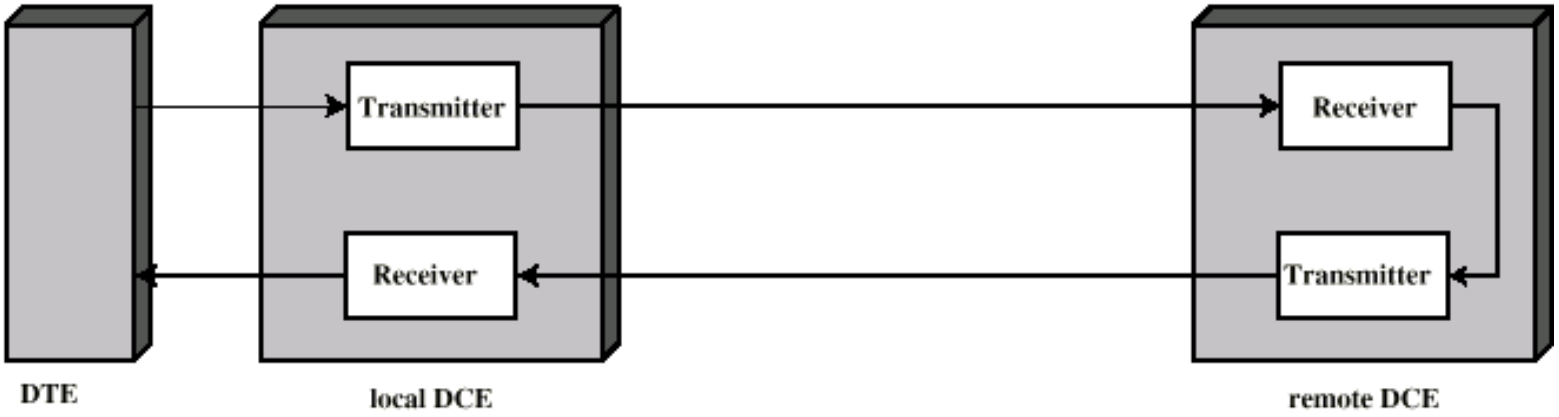
Functional Specification

- (See table in Stallings chapter 6)

Local and Remote Loopback



(a) Local loopback Testing

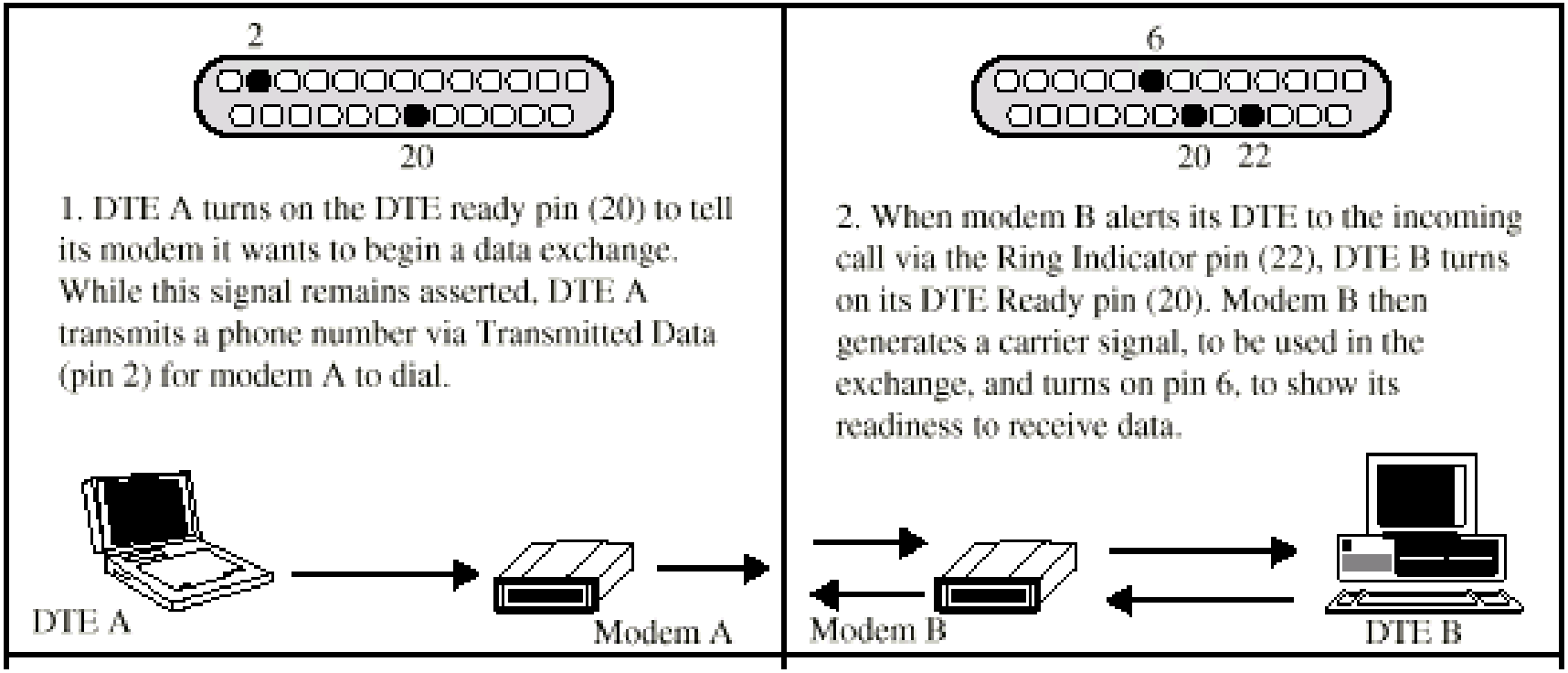


(b) Remote loopback Testing

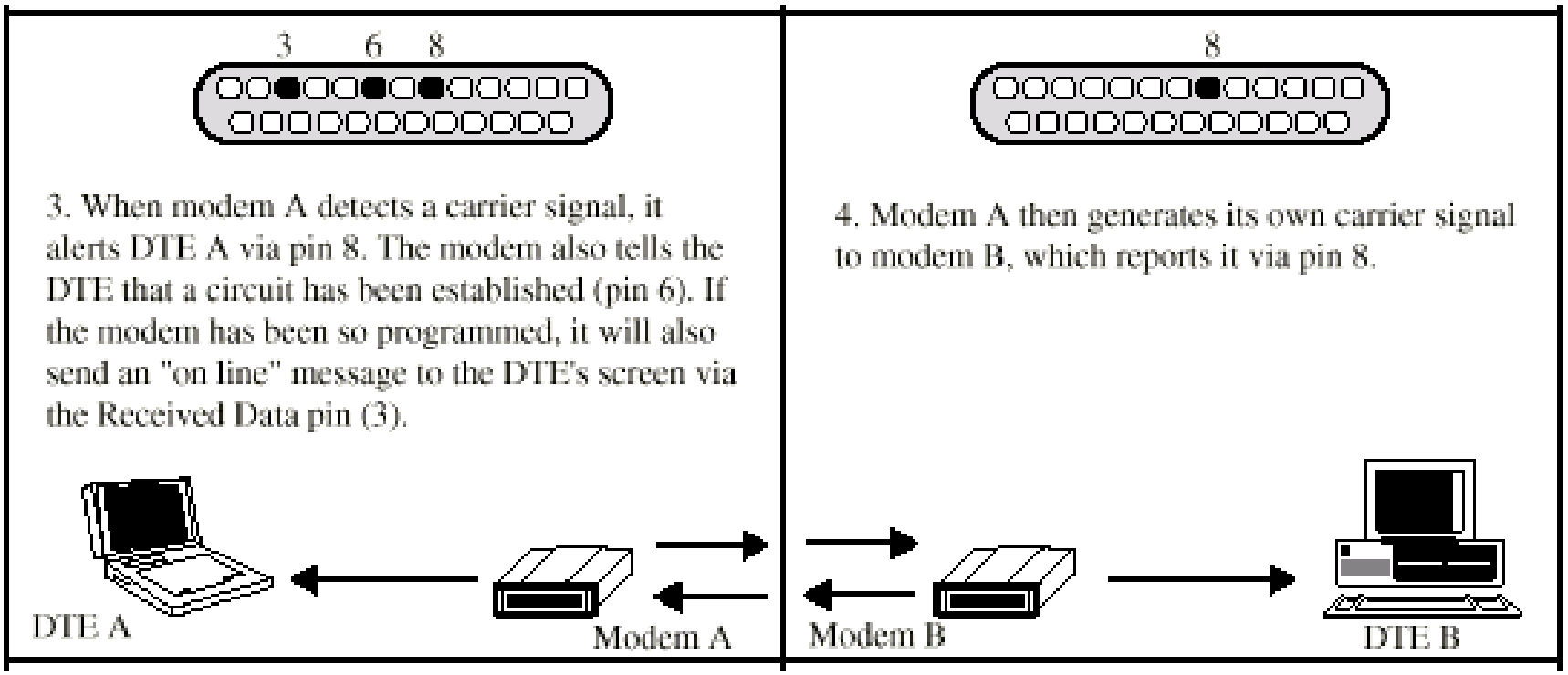
Procedural Specification

- E.g. Asynchronous private line modem
- When turned on and ready, modem (DCE) asserts DCE ready
- When DTE ready to send data, it asserts Request to Send
  - Also inhibits receive mode in half duplex
- Modem responds when ready by asserting Clear to send
- DTE sends data
- When data arrives, local modem asserts Receive Line Signal Detector and delivers data

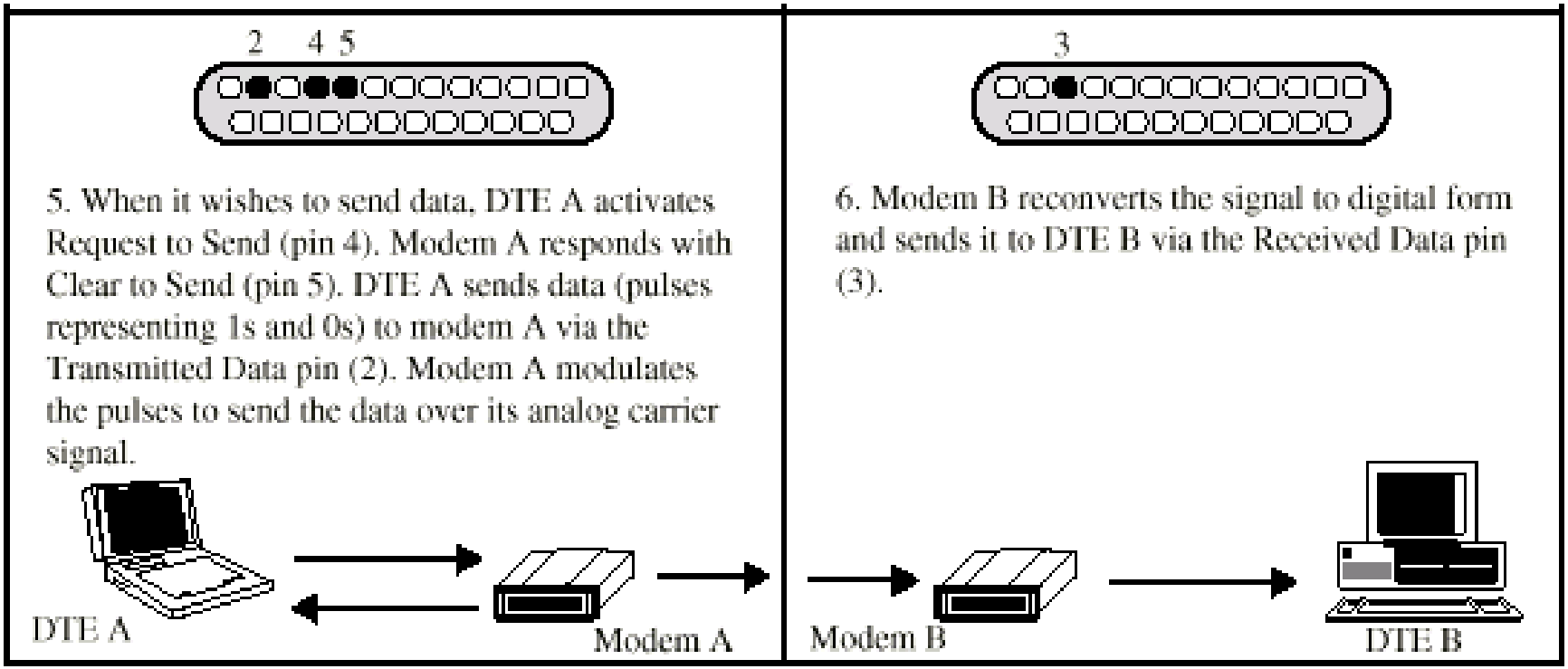
Dial Up Operation (1)



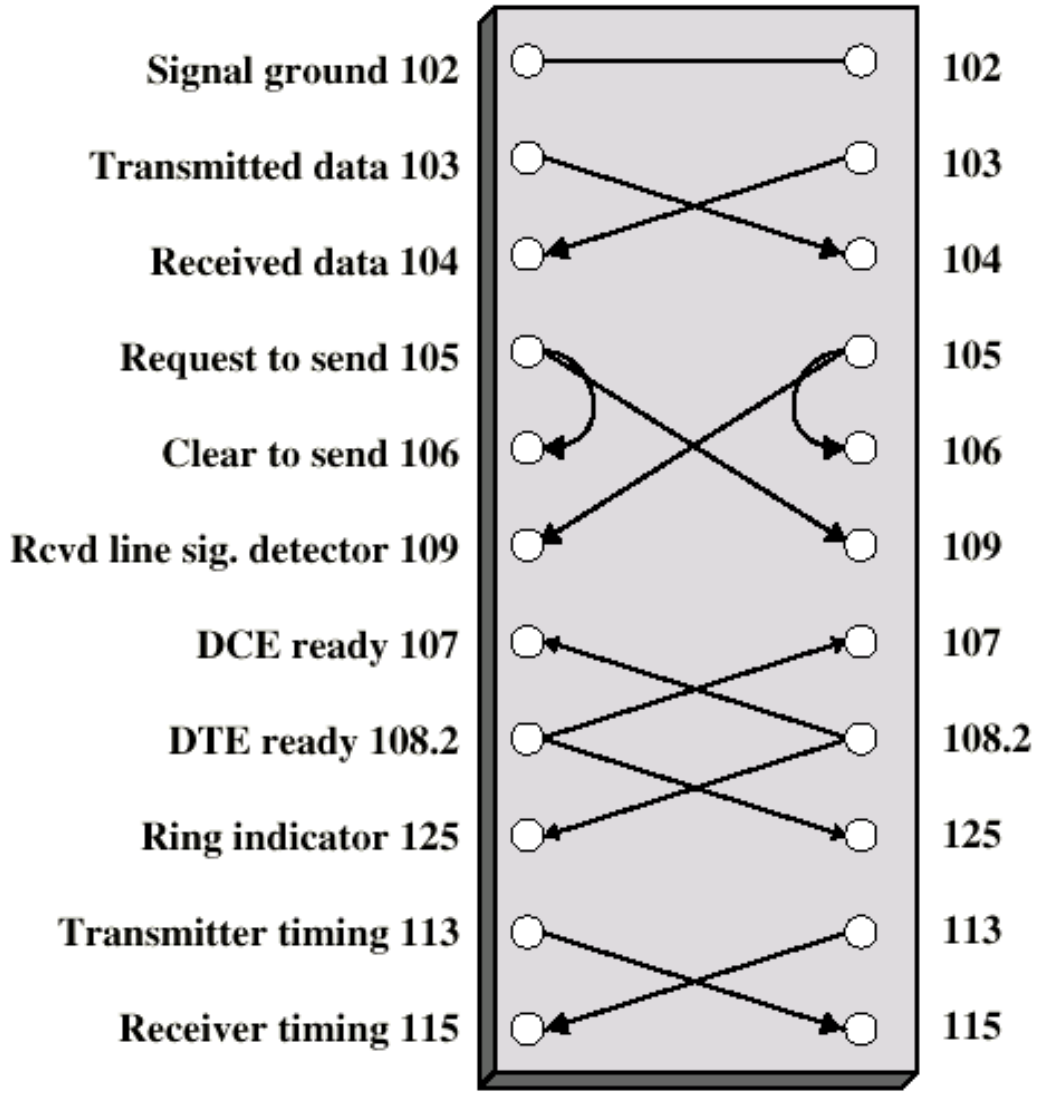
Dial Up Operation (2)



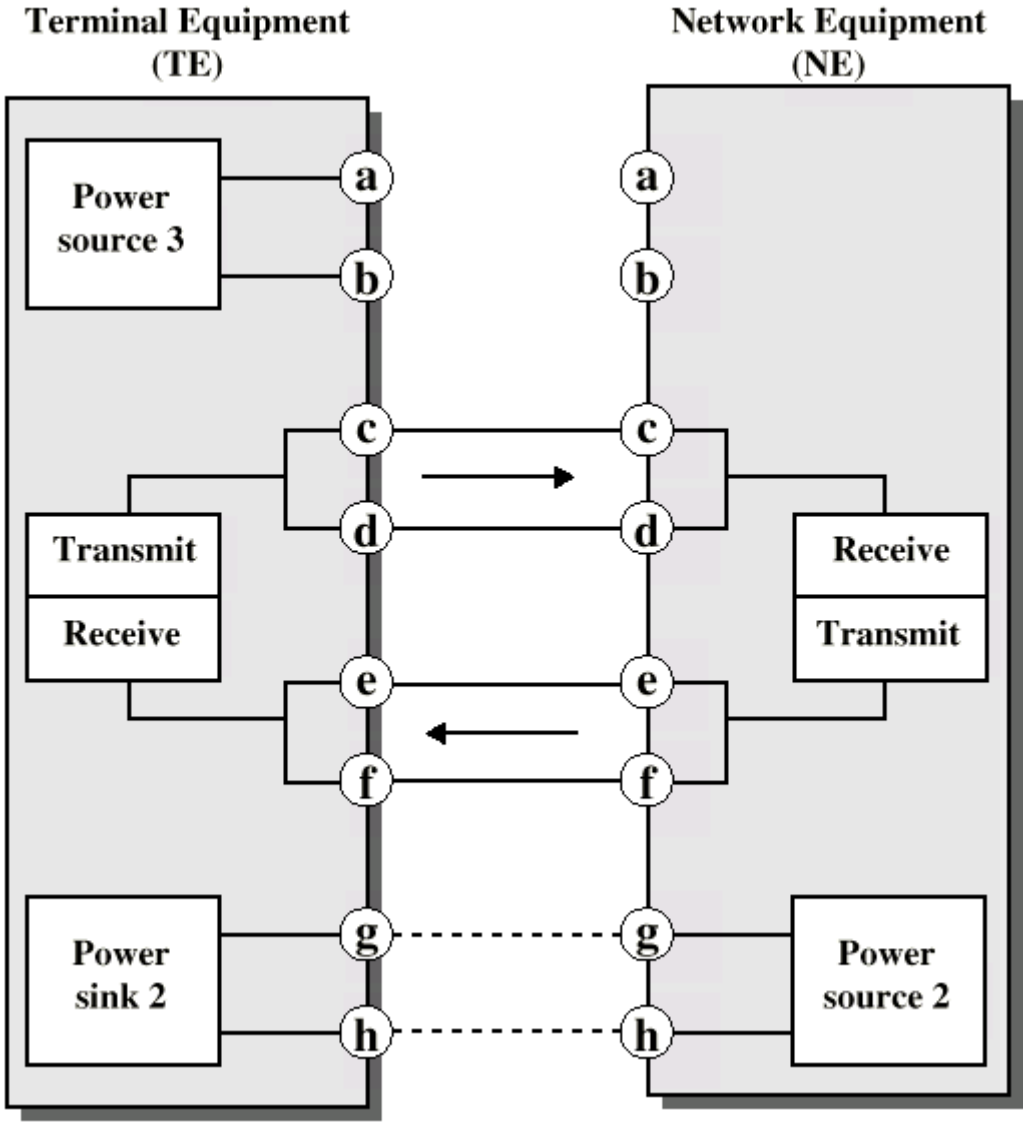
Dial Up Operation (3)



Null Modem


Signal ground 102
Transmitted data 103
Received data 104
Request to send 105
Clear to send 106
Rcvd line sig. detector 109
DCE ready 107
DTE ready 108.2
Ring indicator 125
Transmitter timing 113
Receiver timing 115
102
103
104
105
106
109
107
108.2
125
113
115

ISDN Physical Interface Diagram



ISDN Physical Interface

- Connection between terminal equipment (c.f. DTE) and network terminating equipment (c.f. DCE)
- ISO 8877
- Cables terminate in matching connectors with 8 contacts
- Transmit/receive carry both data and control

ISDN Electrical Specification

- Balanced transmission
  - Carried on two lines, e.g. twisted pair
  - Signals as currents down one conductor and up the other
  - Differential signaling
  - Value depends on direction of voltage
  - Tolerates more noise and generates less
  - (Unbalanced, e.g. RS-232 uses single signal line and ground)
  - Data encoding depends on data rate
  - Basic rate 192kbps uses pseudoternary
  - Primary rate uses alternative mark inversion (AMI) and B8ZS or HDB3

Foreground Reading

- Stallings chapter 6
- Web pages from ITU-T on v. specification
- Web pages on ISDN