DATACOMM

John Abbott College JPC

Standard Interfaces & Transmission

M. E. Kabay, PhD, CISSP Director of Education, ICSA President, JINBU Corp

Copyright © 1998 JINBU Corp. All rights reserved

DC 4 - 1

Std I/F & Transmission

- Standards Organizations
- Digital I/F Stds
- Remote Digital Transmission
- Transmission Media
- Baseband vs Broadband
- Modulation
- Modems

DC 4 - 2

Standards Organizations

- De facto standards
 - e.g., Centronix Parallel
 - HP-IB
- ANSI--American National Stds Inst.
- IEEE--Inst. Electrical & Electronics Engineers
- EIA--Electronic Industries Assoc.
- ECSA--Exchange Carriers Stds Assoc.
- NIST--Natl Inst. of Stds & Technology
- CCITT--Consultative Ctee on Intl Telephone & Telegraph
- ITU--Intl Telecommunications Union
- ICSA -- Intl Computer Security Assoc.
 DC 4 3

Digital I/F Stds

- RS-232-C
- RS-232-C Handshaking
- Connecting DTEs using RS-232-C
- Other Digital I/F Stds

DC 4 - 4

Digital I/F Stds

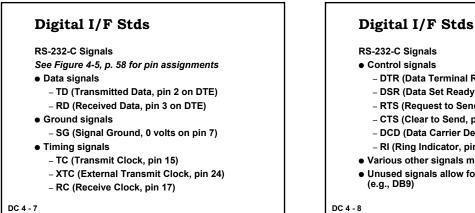
RS-232-C

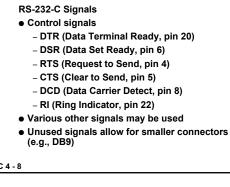
- Voltage levels for 0s and 1s
- 1 ("mark") represented by -3 to -15 v
- 0 ("space") is +3 to +15 v
- Must be able to change voltage fast enough
- to meet speed requirements
- Define 2 I/F:
 - data terminal equipment (DTE); e.g., terminals and computers
 - data circuit-terminating equipment (DCE);
 e.g., modems

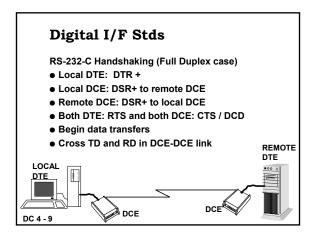
DC 4 - 5

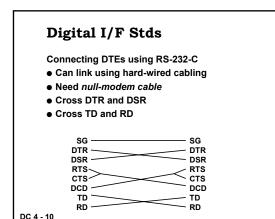
Digital I/F Stds

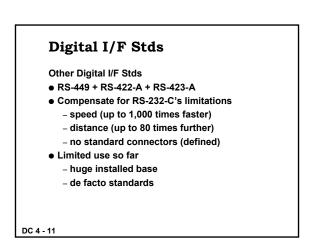
- Physical connectors not defined by RS-232-C
- But common connectors include
 - DB25 (ISO 2110) – DB9
 - RJ-11
- Theoretical limits of the RS-232-C std
 - 50 feet (15 m)
 - 20 Kbps
 - often exceeded in practice

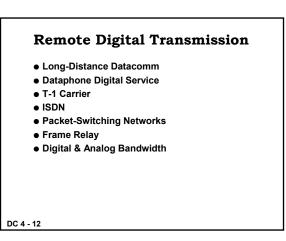












Remote Digital Transmission

Long-Distance Datacomm

- Signal degradation over distance
- Connect special devices to link digital signals
- to digital transmission equipment
- DSU (Digital Service Unit)
- CSU (Channel Service Unit)
- Usually combined (DSU/CSU)
- Digital circuits from common carrier include repeaters to regenerate and boost signals
- Can transmit digital signals worldwide (and beyond!)

DC 4 - 13

Remote Digital Transmission

Dataphone Digital Service (DDS)

- AT&T offers digital circuits
 - 2400 bps
 - 4800 bps
 - 9600 bps
 - 56 Kbps
 - 64 Kbps
- High-speed circuits can be shared among multiple devices using multiplexing (see later in section/chapter 5)

DC 4 - 14

Remote Digital Transmission

- T-1 Carrier
- 1.544 Mbps digital channel
- Can be split into 24 56 Kbps data channels
- Or split into 24 64 Kbps digitized voice channels
- Higher-bandwidth channels available (e.g., T2, T4)
- Europeans use 2.048 Mbps channel called E-1

DC 4 - 15

Remote Digital Transmission

ISDN

- Integrated Services Digital Network
- 1.544 Mbps bandwidth
- Multiple channels up to 64 Kbps
- Widely installed in Europe
 - e.g., 10 lines, each with different ring
 - simultaneously have multiple conversations + use fax and modem
- Becoming available in Canada and U.S.
 - Kirkland in 1998 \$80/mo + \$600 modem
 - 128 Kbps data channel + 2 voice/fax lines

DC 4 - 16

Remote Digital Transmission

Packet-Switching Networks

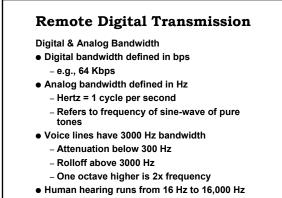
- PAD (Packet Assembler-Disassembler)
- Data packaged into *packets* by PAD
 - typically 256 b fixed size
- Each packet has attached header
 - includes origin and destination
 - has sequence number
- Packets routed through cloud of connections
- Packets arrive in any order and are reassembled by PAD using sequence numbers
- e.g., X.25 networks

DC 4 - 17

Remote Digital Transmission

Frame Relay

- Similar to X.25 packet-switching
- But dispenses with extensive error-correction during transmission
- Relays frames of data instead of packets
- Much faster than X.25
- More details in Section/Chapter 8



DC 4 - 19

Transmission Media

- Twisted pair
- Coax
- Fibre optic
- Satellite
- Terrestrial microwave

DC 4 - 20

Transmission Media

Twisted pair

- Thin twisted wire
 - Twists reduce RFI
 - Shielding increases distance and bandwidth
- Max bandwidth 100 Kbps
- Inexpensive, easy to pull through conduits
- RJ-11 and other modular jacks for connections
- Frequently pull multiwire cable to provide easy access to data and voice outlets in each office

DC 4 - 21

Transmission Media

Coaxial cable

- Single wire surrounded by insulation + outer conductive layer
- Shields against RFI--but makes cable stiffer
- High data rates (e.g., up to 500 Mbps)
- Extensively used in LANs (e.g., IEEE 802.3 Ethernet and IEEE 802.5 Token Ring)
- Used in cable TV transmissions

 Basis for Metropolitan Area Networks (MANs) using IEEE 802.7 standards
 Will be important in interactive TV
- Twinax cable used for broadband systems

DC 4 - 22

Transmission Media

Fibre optic

- Light beams transmitted through glass fibres
- Bandwidths up to 2.4 Gbps
- Expensive to cable
- Immune to RFI
- Connections also expensive and difficult
 - Must "tap" cable without reducing transmission efficiency
- Used in campus cabling and mediumdistance connections (even many km)

DC 4 - 23

Transmission Media

Satellite

- Uplink station beams to satellite transponder
- Geosynchronous satellites 22,500 miles
- (36200 km) above earth
- Satellite beams signal to downlink station
- Bandwidth depends on # channels
- Beam spreads to 50 miles radius around target
- Can introduce long delays which foul up datacomm and can cause echoes in voice calls

Transmission Media

Terrestrial microwave

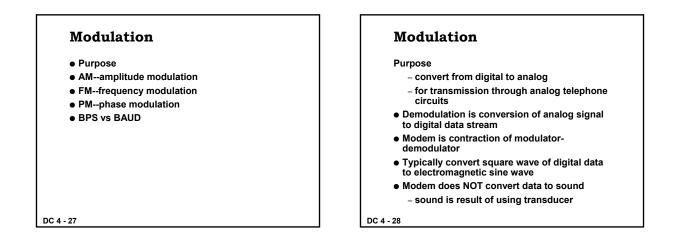
DC 4 - 25

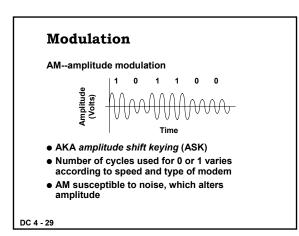
- Line-of-sight transmission (like satellites)
- Towers usually 20-30 miles (35-50 km) apart
- Bandwidth around 250 Mbps
- About 80% of all long-distance calls go through microwave relays

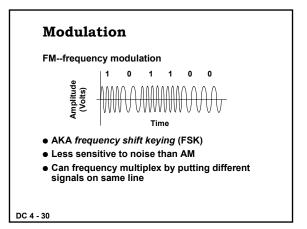
Baseband vs Broadband

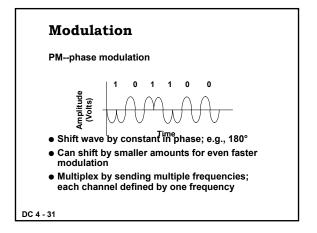
- Baseband--relatively low bandwidth

 Single data signal
- Broadband--relatively high bandwidth
- frequency-domain multiplexing
 - different channels (frequencies) carry data simultaneously
 - frequency-agile modems receive and transmit data on different channels on demand
- e.g., cable TV supplies broadband signals for hundreds of channels on 1 wire









Modulation

BPS vs BAUD

- BAUD refers to frequency of changes in signal
- Thus examples so far have BAUD rate equal to their data transfer rate (BPS)
- But can use signals which have more than 2 states; e.g., 4 different amplitudes or frequencies or phase shifts
- So each state would encode 2 bits, not 1 bit
- Thus BAUD rate would be half the BPS
- Generally error now to refer to BAUD on modern modems--just refer to BPS

DC 4 - 32

Modems Multispeed Modems fall back to lower speeds if necessary now standard in industry

- Older, slower modems
 - 9600 bps defined by CCITT V.32 std
 14.4 Kbps: CCITT V.32bis
- High-speed Modems
 - 28.8 Kbps: CCITT V.34
 - generally use trellis-coded modulation
 - extra information sent along with data
 - allows correction for phase shift and noise
 - 33 Kbps & 56 Kbps modems still evolving -
- competing standards from mfrs

Modems

Error-correcting Modems

- Microcom Network Protocol (MNP)
- CCITT V.42 = LAPM = Link Access Procedure for Modems
- Errors cause retransmission of block
- As error rate rises, throughput falls

DC 4 - 34

Modems

Data Compression in Modems

- Can replace repeated sequence of symbols by a symbol + symbol-count
 - e.g., 3525555555555289434343434343890...
 - becomes 352@5|9@289@43|6@890...
- Limpel-Zev-Welch (LZW) encoding
- lookup tables for most frequent sequences
 alter tables as data change
- MNDE: ab aut 50%
- MNP5: about 50% compression
- CCITT V.42bis: about 75% compression

DC 4 - 35

Modems

Short-haul Modems

- designed for use within buildings or a few km only
- use higher frequencies than phone system
- can pass; therefore higher bandwidth
- cannot link through public phone system
- inexpensive

Modems

Fax Modems

- Send images (bit maps)
- CCITT Group 1 and Group 2
 - 100 lines per inch (lpi) resolution
 - used to take 3-6 minutes per page
- Modern fax machines use compression
 - Run-length encoding (RLE)
 - Group 3 fax runs 9600 bps
 - 200 lpi
- Group 4 faxes run up to 65 Kbps and 400 lpi

DC 4 - 37

Homework

- Read Chapter 4 of your textbook in detail, adding to your workbook notes as appropriate.
- Review and be prepared to define or expand all the terms listed at the end of Chapter 4 of your textbook (no hand-in required)
- Answer all the exercises on pages 90-91 of the textbook using a computer wordprocessing program or absolutely legible handwriting (hand in after quiz tomorrow morning)