

Telephone Modems

Part 10b of
“Electronics and Telecommunications”
A Fairfield University E-Course
Powered by LearnLinc

Module: Digital Systems (in two parts)

- Texts:
 - “Computers,” Capron, Benjamin Cummings, 1996, ISBN 0-10053-0662-5
 - “Telecommunications,” Blyth, McGraw-Hill, 1990, ISBN 0-02-61001041-2
 - “Understanding Telephone Electronics,” Bigelow, Newnes, 1997, ISBN 0-7506-9944
- References:
 - [Electronics Tutorial](#) (Thanks to Alex Pounds)
 - [Electronics Tutorial](#) (Thanks to Mark Sokos)
- Part 9 – Computers
 - 5 on-line sessions plus one lab
- Part 10 – Digital Communications
 - 5 on-line sessions plus one lab
- Mastery Test part 5 follows this Module

Digital Systems: Topics

- Computer Architecture
 - Memory: ROM, RAM, Cache, Error Checking
 - CPU and Program Control **Part 9**
 - Secondary Storage: Floppy, Hard Drive, CD / DVD
 - I/O (Human: Video, Keyboard, & Pointer)
 - Digital I/O: Serial, Parallel, IDE, USB, FireWire, SCSI
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- Serial I/O: RS232
- Modems **Part 10**
 - Telephone: Modulation and Data compression
 - Cable and DSL
- Telephony Digital Transmission
- Packet Transmission
- Fiber Optics: SONET

Section 10 Schedule

Session 10a	06/30	RS 232	Bigelow: 285-290; Blythe: 162-170
Session 10b	07/02	Telephone Modems	Bigelow: 290-307; Blythe: 170-176
Session 10c No class 7/14, 7/16	07/07	Modems 2: DSL, Cable, Fax & 56K	Bigelow: 307-321; Notes
Session 10d	07/09	T-Carrier	Bigelow: 198-210
Session 10e	07/21	Packets & SONET	Bigelow: 308-309; Notes
Session 10f (Quiz 10 due 07/27) (Lab - 07/26, Sat.)	07/23	Review for Quiz 10	
Session 10g	07/28	Quiz 10 Results	
Session 10h No Class 8/4, 8/6	07/30	MT 5 Q&A	
Session 10i	08/13	MT 5 Q&A 2	If I'm back in time from Chicago
MT5 (Sat, Cheshire)	08/16	MT 5	
MT5 Results	08/18	MT 5 Results	

RS232 Review

- DTE (PC) vs DCE (Modem)
- DB25 (DB9) Signal pins

CD (8)	DTR (20)	RTS (4)
RxD (3)	Ground (7)	CTS (5)
TxD (2)	DSR (6)	RI (22)

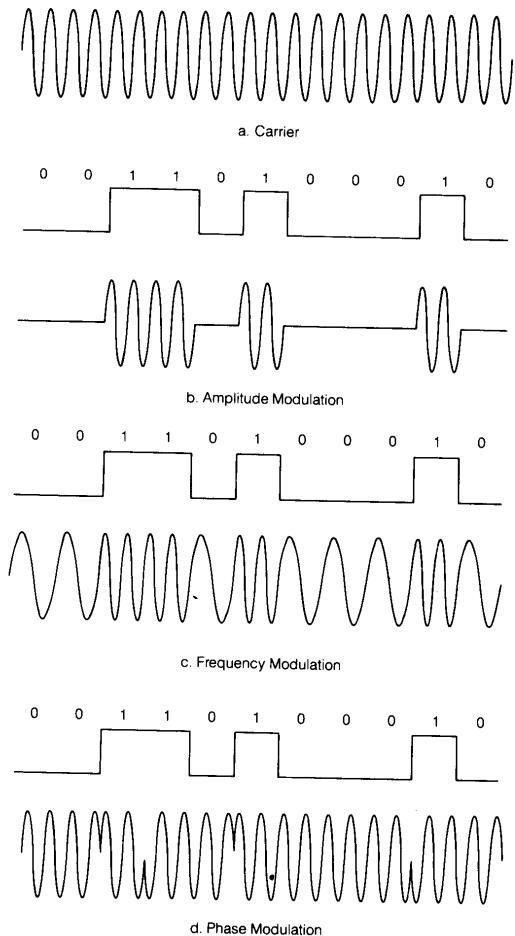
- Asynchronous Data
 - Start Bit
 - Data bits (7)
 - Parity
 - Stop bits (2)

Modem

- Modem = Modulator / Demodulator
- Baseband Serial Data (RS232 – TxD & RxD)
 - Sequence of 0's and 1's
 - A time varying DC signal
- The Telephone Channel
 - Does not pass DC
 - Passes AC from 300 Hz to 3.3 kHz
- Modulation puts the serial data in a form that can pass through the Telephone Channel
- Demodulation is the recovery of the Baseband Serial data from the corrupted modulated signal.

Modulation

- Amplitude Modulation
(Amplitude Shift Keying)
 - Bit value controls the amplitude of the carrier (sine wave)
- Frequency Modulation
(Frequency Shift Keying)
 - Bit value controls the frequency of the carrier (sine wave)
- Phase Modulation
(Phase Shift Keying)
 - Bit value controls the Phase of the carrier (sine wave)
 - Here a “1” shifts the phase by 180°; A “0” lets the sine wave continue smoothly



Modem Standards

- 300 Baud – Bell 103
- 1200 Baud – V.23 (FSK)
- 2400 Baud – V.22bis (PSK, QAM)
- 9600 Baud – V.32
- 14.4 kBaud – V.32bis
- 28 kBaud – V.42
- 33 kBaud – V.42bis (includes data compression)
- 56 kBaud – Only on a 64 kBit/s digital channel

Data Compression

- Modern modems include data compression
 - Lossless: no introduced errors
 - Two schemes combined to give up to 4x reduction
- Run Length encoding
 - Replace a long sequence of 1's (or zeros) with an escape code and a number representing its length
- Dynamic Lemple Ziv: keep a “dictionary” of repeatedly used sequences at both ends and give them a short name. Used in V.42bis
- Huffman Code: Use statistics to give common sequences short names (Used in Faxes)

Modem Handshake – a protocol

- Receiving Modem transmits a pseudorandom sequence of 1's and 0's using its fastest standard. (if no response, it drops to a slower standard and tries again)
- Sending modem uses the initial signal to characterize the transmission channel and adjust an equalizer to compensate for flaws. It then sends a similar response back to the other end to allow it to adjust to the channel.

Modem Startup

- CTS asserted by modem to tell PC that it is ready to communicate
- PC responds by asserting RTS and sending the modem the number to be dialed.
- The modem dials the number, waits for the ringing to stop and the modem handshake begins.
- When both modems are ready, the CD signal is asserted and data communication can commence.

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