

Packet Data Systems

Part 10e 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

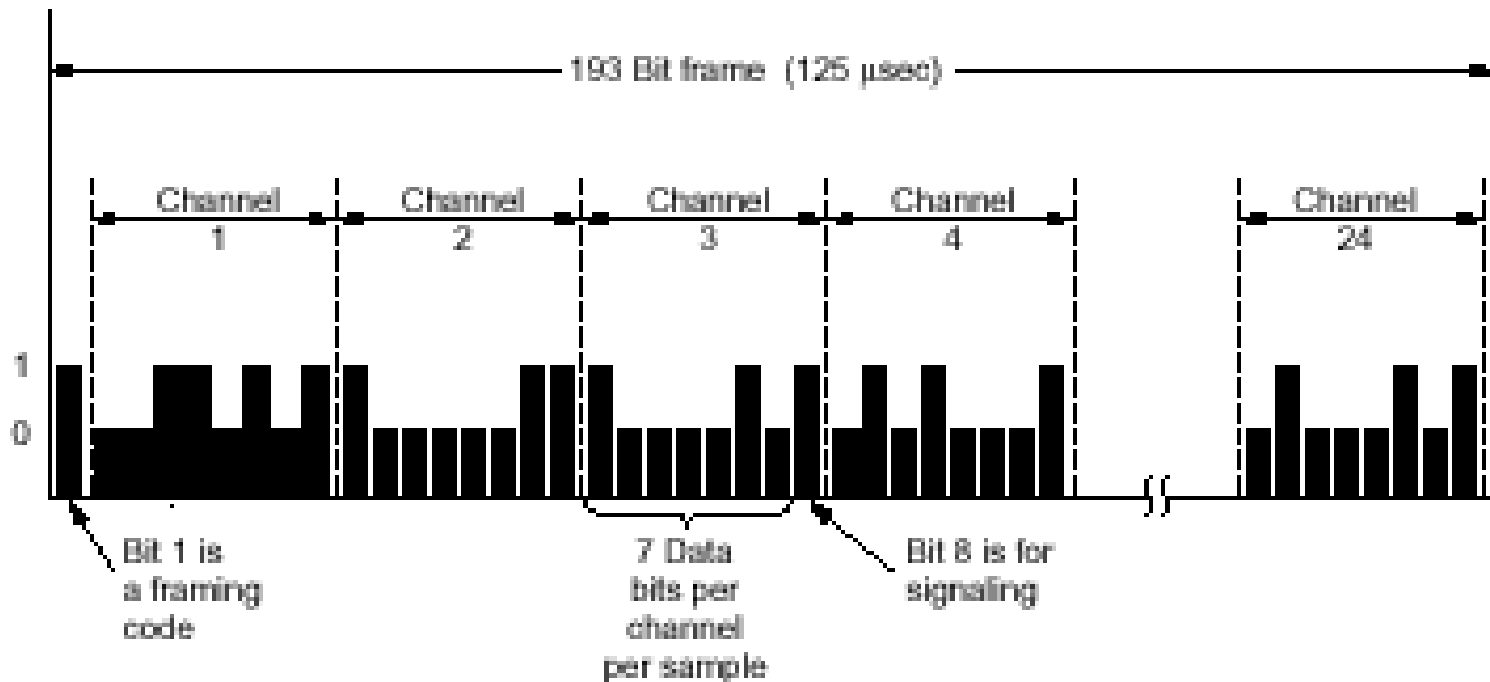
Session 10a	06/30	RS 232	Bigelow: 285-290; Blythe: 162-170
Session 10b	07/02	Telephone Modems	Bigelow: 290-307; Blythe: 170-176
Session 10c No class 7/14, 7/16	07/07	Modems 2: DSL, Cable, Fax & 56K	Bigelow: 307-321; Notes
Session 10d	07/09	T-Carrier	Bigelow: 198-210
Session 10e	07/21	Packets & SONET	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	

Digital Telephony Review

- Sample rate: 8000 per second
- 8 bits per sample – 64,000 bits/sec
 - Logarithmic encoding
(μ -255, Europe uses A-Law)
 - Sound quality: equivalent to 12-bit linear
- G.711 ITU standard

T1 Review

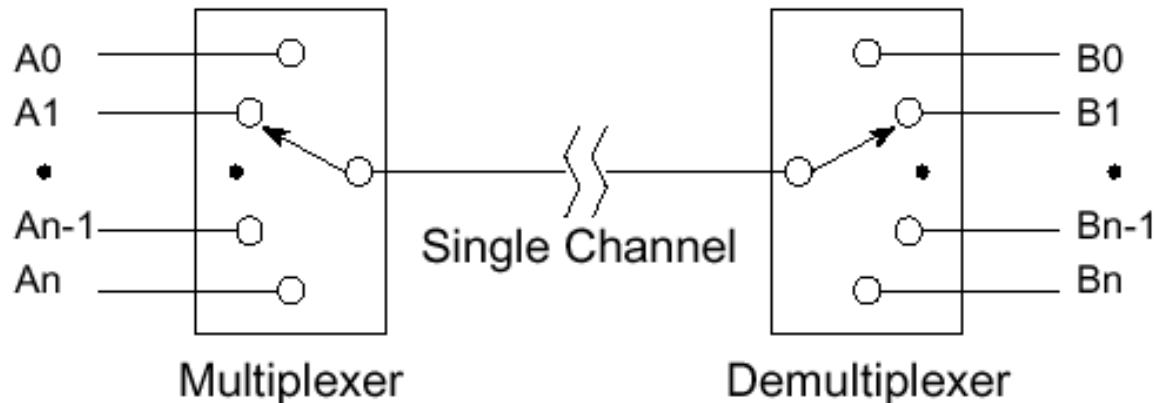
- Time Division Multiplexing
- 24 Channels; One byte at a time (192 bits/frame)
- One bit / Frame for synchronization
- 1.544 mbit/sec



Multiplexers and Demultiplexers

4.4 Multiplexer

- Multiplexer - A **data selector** that selects one of many inputs to appear on a single output line
- Demultiplexer - A **data distributor** that takes a single input line and routes it to one of several output lines



National Central University

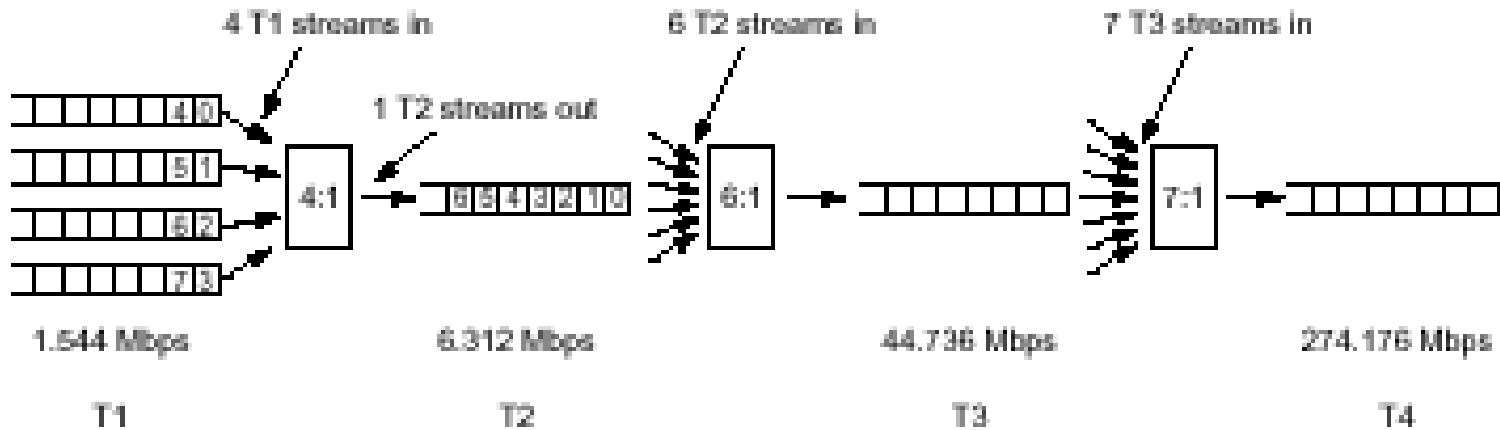
www.ee.ncu.edu.tw/~ccsu

Introduction to Digital Systems

Chapter 4 P.25

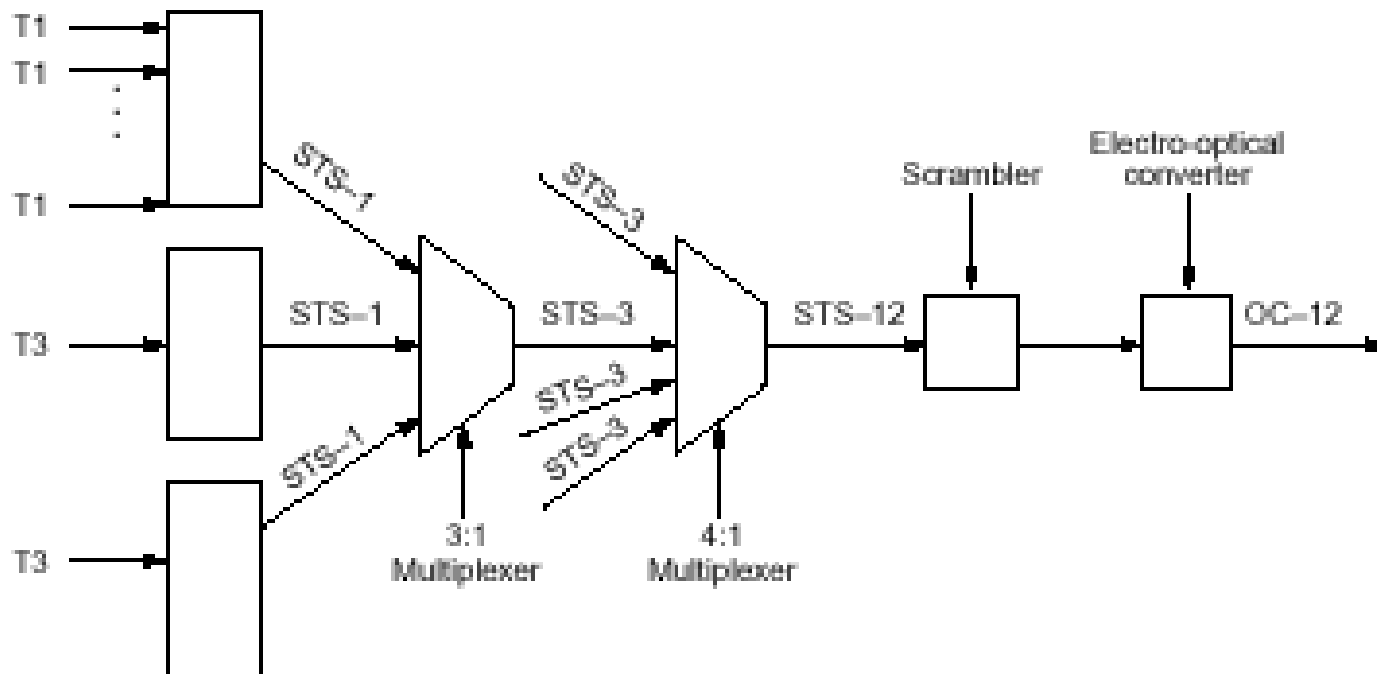
Higher Level Multiplexes

- T3
 - 24 T1s: ~ 45 Mbit/sec
- T4
 - 7 T3s: ~ 274 Mbit/sec



SONET

- Synchronous Optical NETWORK
- Data modulated onto light carrier in a fiber

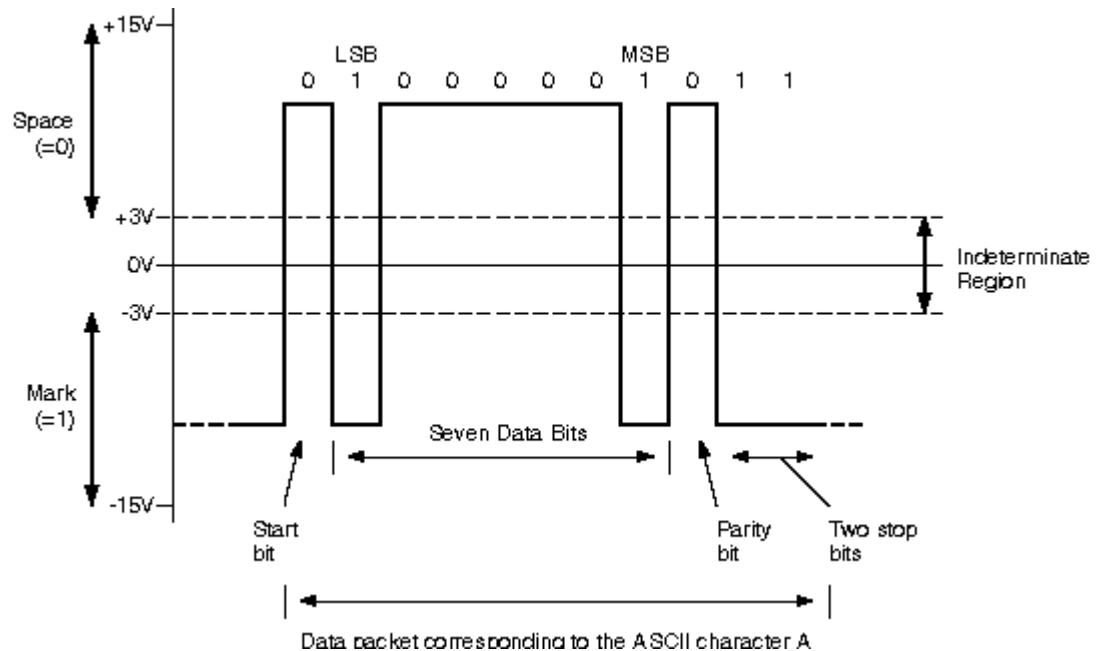


SONET (2)

SONET		SDH	Data rate (Mbps)		
Electrical	Optical	Optical	Gross	SPE	User
STS-1	OC-1		51.84	50.112	49.536
STS-3	OC-3	STM-1	155.52	150.336	148.608
STS-9	OC-9	STM-3	466.56	451.008	445.824
STS-12	OC-12	STM-4	622.08	601.344	594.432
STS-18	OC-18	STM-6	933.12	902.016	891.648
STS-24	OC-24	STM-8	1244.16	1202.688	1188.864
STS-36	OC-36	STM-12	1866.24	1804.032	1783.296
STS-48	OC-48	STM-16	2488.32	2405.376	2377.728

Asynchronous Serial Data

- Data rate is approximate
- Data line often idle
- Start bit – 1 is sent to tell the other end that data is coming
- 8 bits plus “parity”
- At least two “stop bits” follow to let the far end get ready for the next “packet”

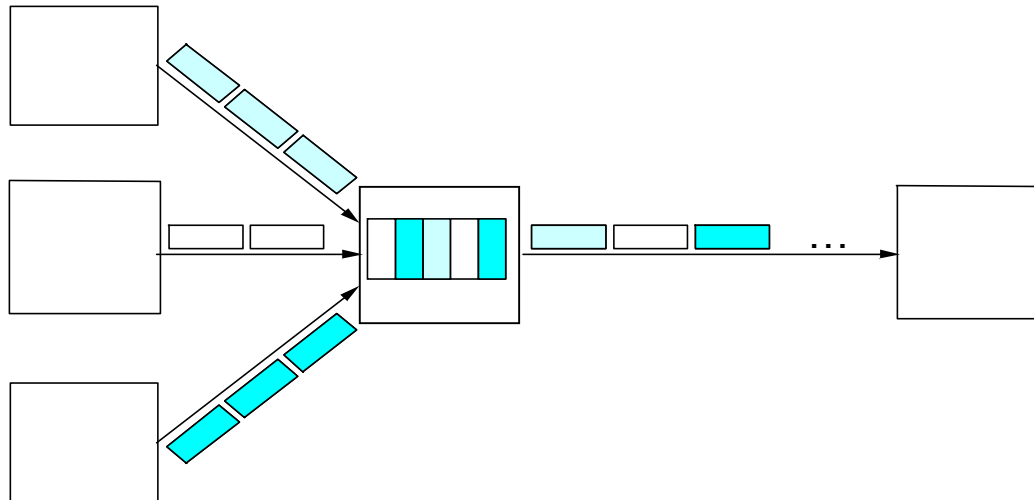


Packets

- Sending end segments the information into small blocks of data
- Each block of data is put into an “envelope”
 - Header
 - Starting Flag
 - Source Address
 - Destination Address
 - Sequence number
 - Data length (in bytes)
 - Data Bytes
 - Trailer
 - Frame Check Sequence (FRS)
 - Ending Flag
- Receiving end reassembles the information from the full set of ordered packets

Statistical Multiplexing

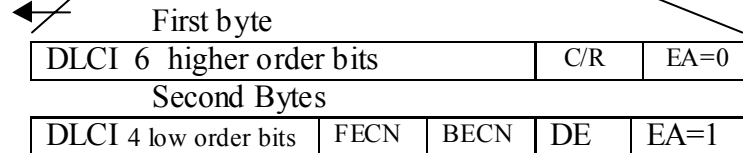
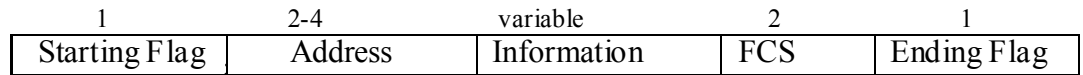
- On-demand time-division multiplexing
- Schedule link on a per-packet basis
- Packets from different sources interleaved on link
- Buffer packets that are *contending* for the link
- Buffer (queue) overflow is called *congestion*



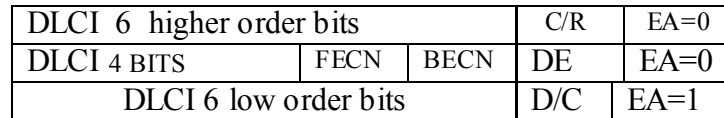
A Typical Packet (Frame Relay)

- Starting Flag
- Source Address
- Destination Address
- Enclosed Data
- Frame Check Sequence (Cyclic Redundancy Check)
- Ending Flag

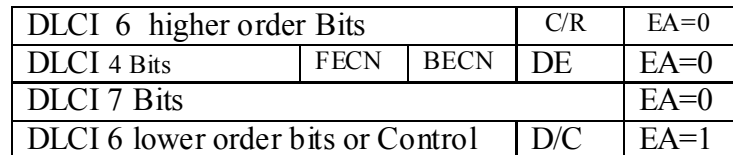
Field Length In Bytes



2 bytes address



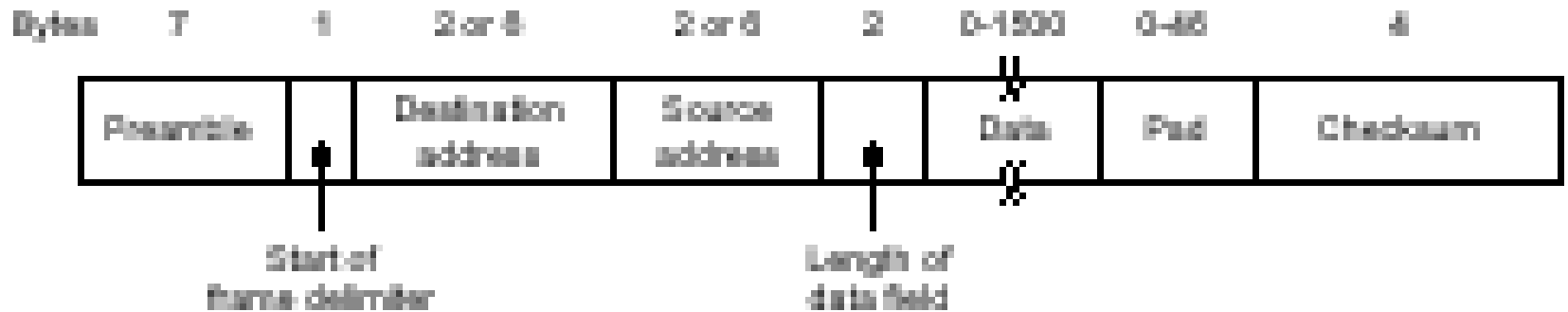
3 bytes address



Four Bytes address

Digital Electronics

A TCP/IP Packet



1. Start Flag		4. Data Size (bytes)
2. Destination Address		5. Data filler
3. Source Address		6. Checksum (CRC)

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