

University of Crete
Computer Science Department

CS-335

Fall Semester 2010

CS-335

Lecture preview:

- Synchronization
 - Preamble
- Encodings
 - NRZ, NRZI, Manchester, 4/5B
- Baseband/Passband Transmission
 - Modulation, Carrier
- ADSL
- ATM

Ethernet Frame

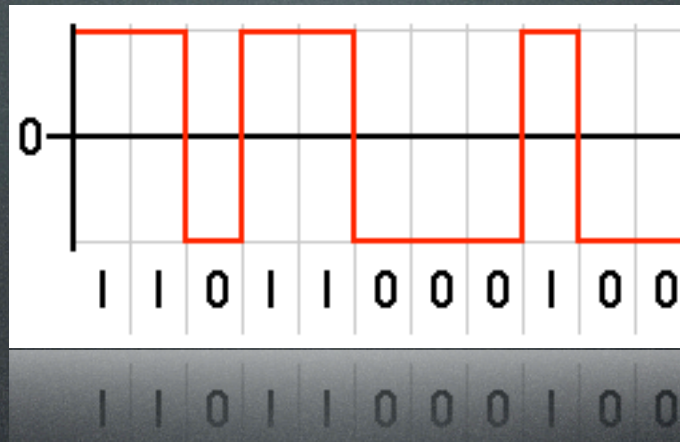
- Preamble: 15x 0101
- Star-of-Frame: 1101
- End-of-Frame: CRC-32 (4bytes)
- Interframe gap: 12 bytes period

Preamble	Start-of-Frame-Delimiter	MAC destination	MAC source	802.1Q header (optional)	Ethertype/Length	Payload (Data and padding)	CRC-32	Interframe gap
15 nibbles of 0101	1 nibble of 1101	6 octets	6 octets	(4 octets)	2 octets	46–1500 octets	4 octets	12 octets
		64–1522 octets						
		72–1530 octets						
		84–1542 octets						

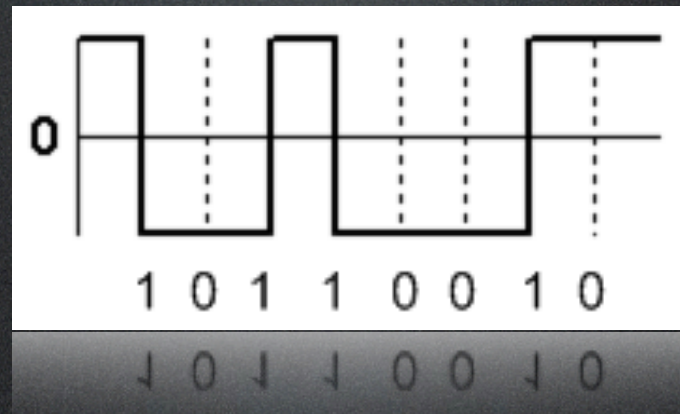
84–1542 octets

NRZ vs NRZI

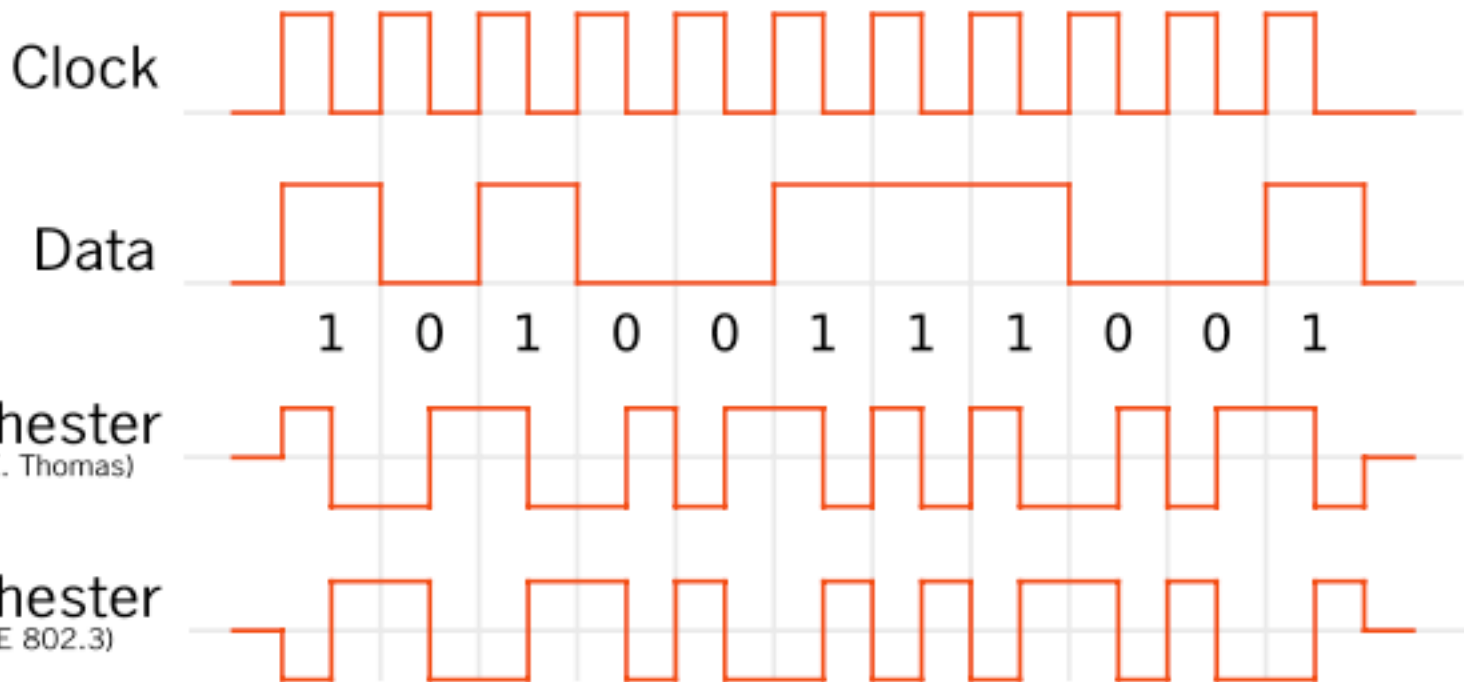
- Non-Return-to-Zero



- Non-Return-to-Zero Inverted



Manchester Encoding (10BaseT)

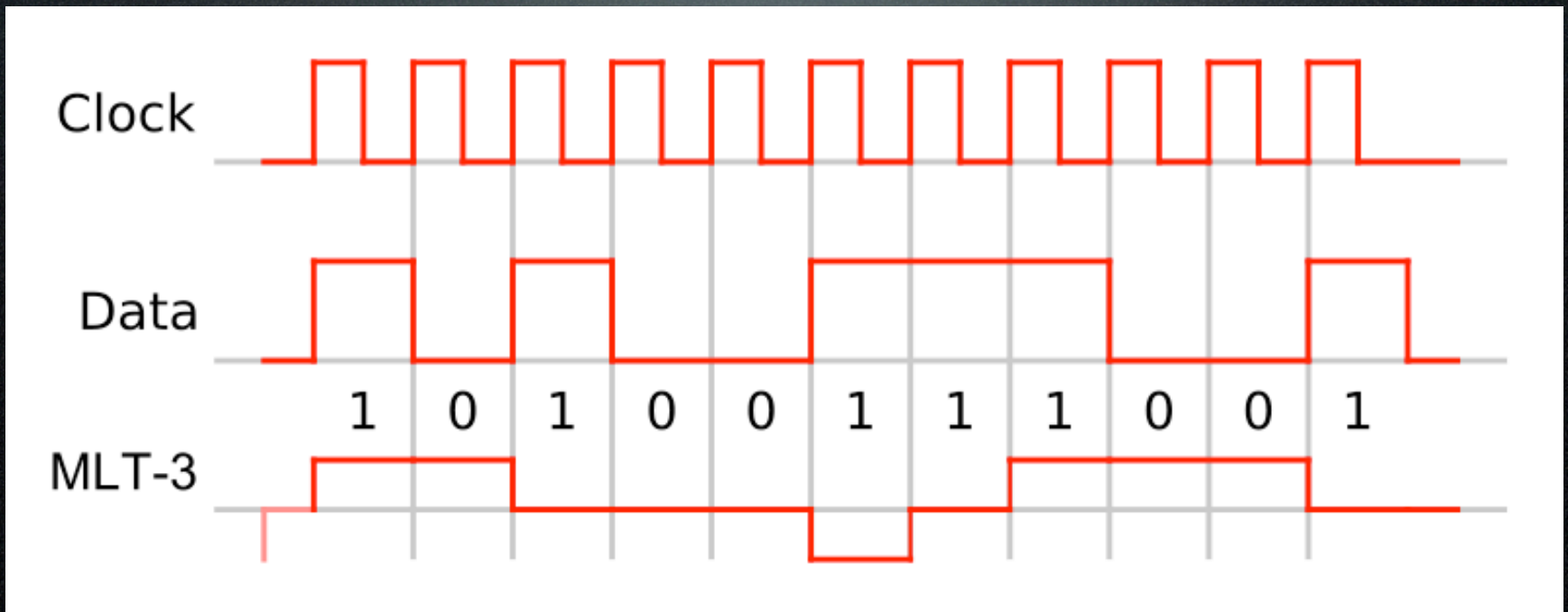


4B5B Encoding (100BaseTX)

- These 5 bit words are pre-determined in a dictionary and they are chosen to ensure that there will be at least two transitions per block of bits
- NRZI
- MLT3

Name	4b	5b
0	0000	11110
1	0001	01001
2	0010	10100
3	0011	10101
4	0100	01010
5	0101	01011
6	0110	01110
7	0111	01111
8	1000	10010
9	1001	10011
A	1010	10110
B	1011	10111
C	1100	11010
D	1101	11011
E	1110	11100
F	1111	11101

MLT-3 Encoding

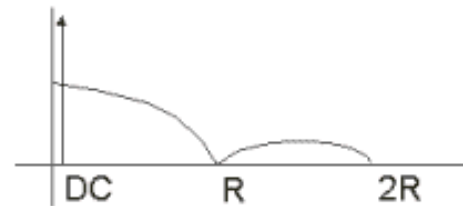


Time vs Frequency

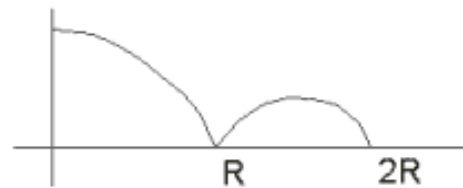
1 0 0 1 0 1 1 1 0 0 1 0 0 0 1 0 1

Rd = random data

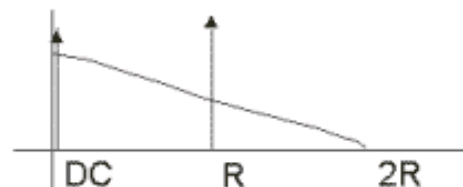
Unipolar Coding ("1" = +V , "0" = 0V)



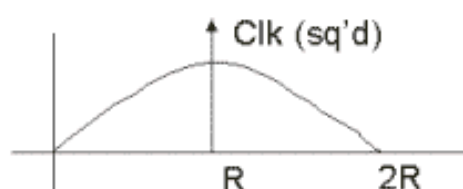
NRZ-L Coding ("1" = -V , "0" = +V)



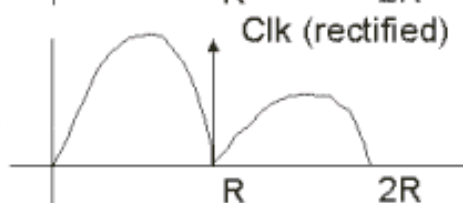
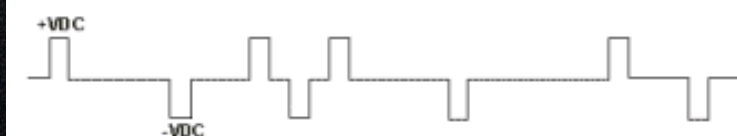
Unipolar RZ Coding ("1" = +V , "0" = 0V)



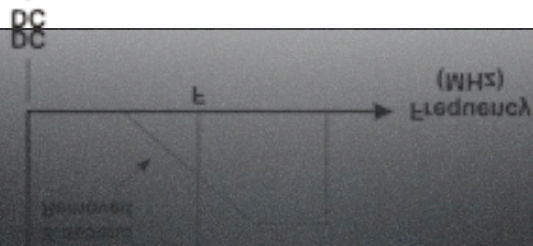
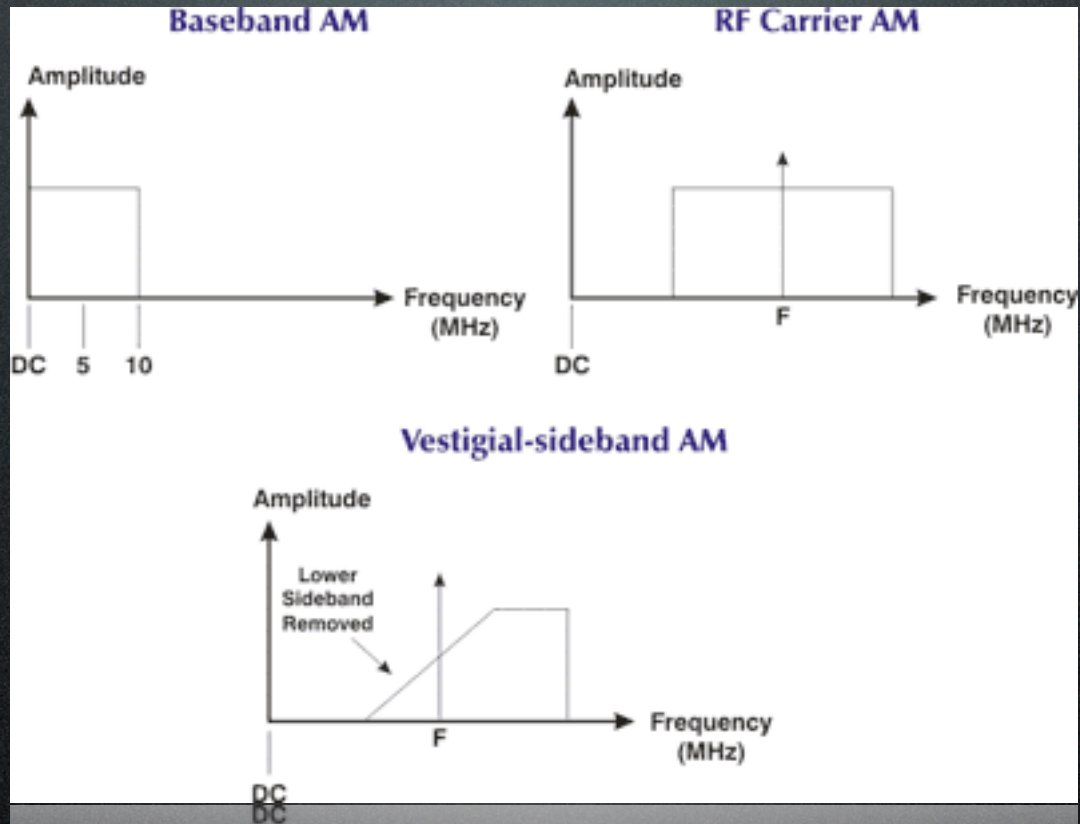
Manchester (+VDC , -VDC)



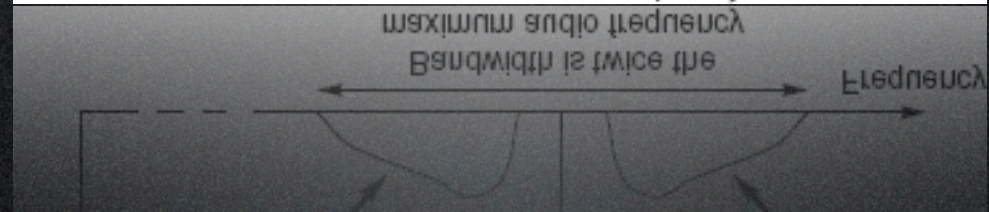
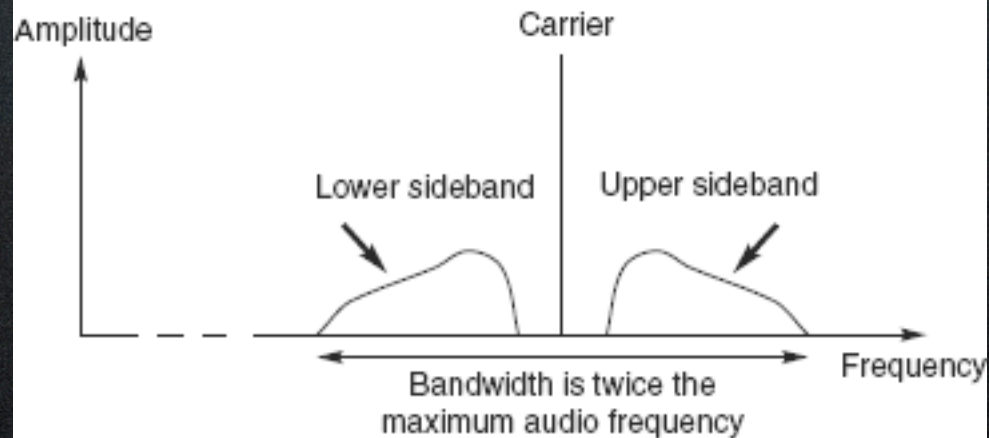
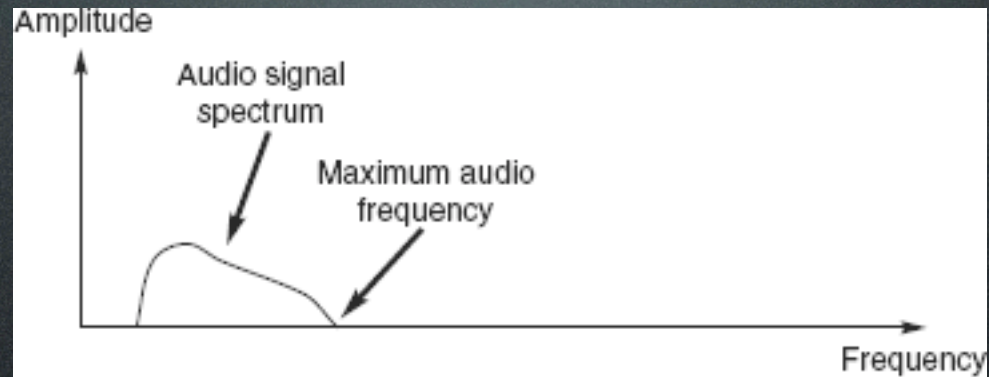
Bipolar AMI RZ (T1)/(+VDC , -VDC)



Baseband vs Passband



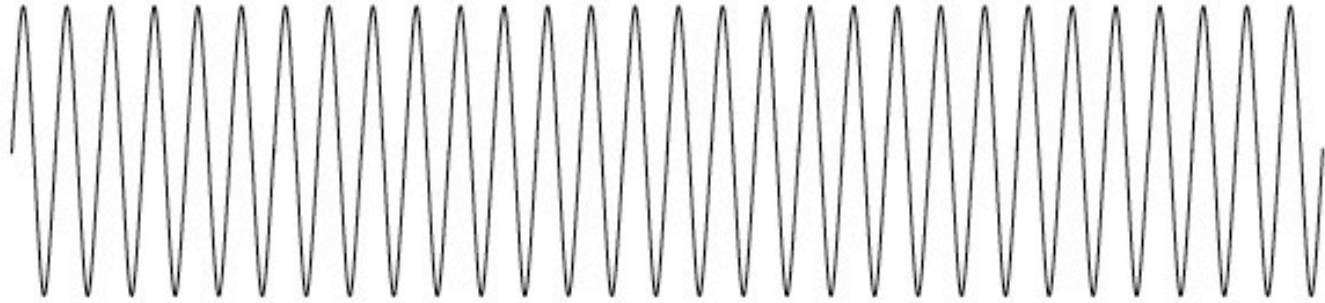
Carrier Modulation



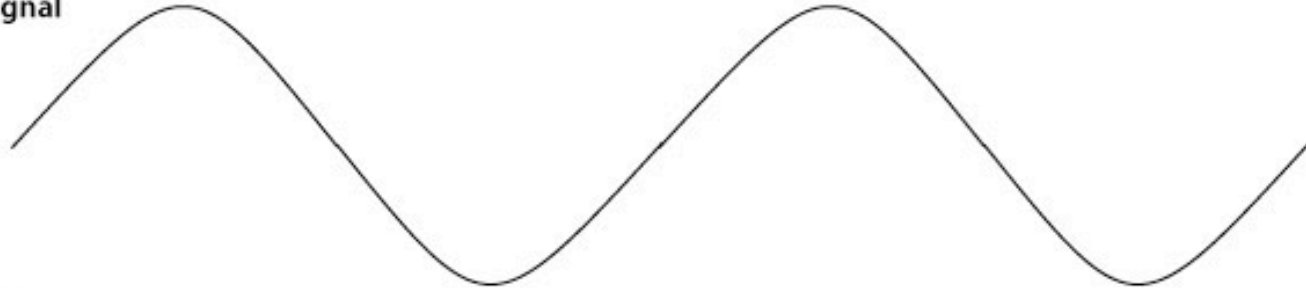
Amplitude Modulation

Amplitude Modulation

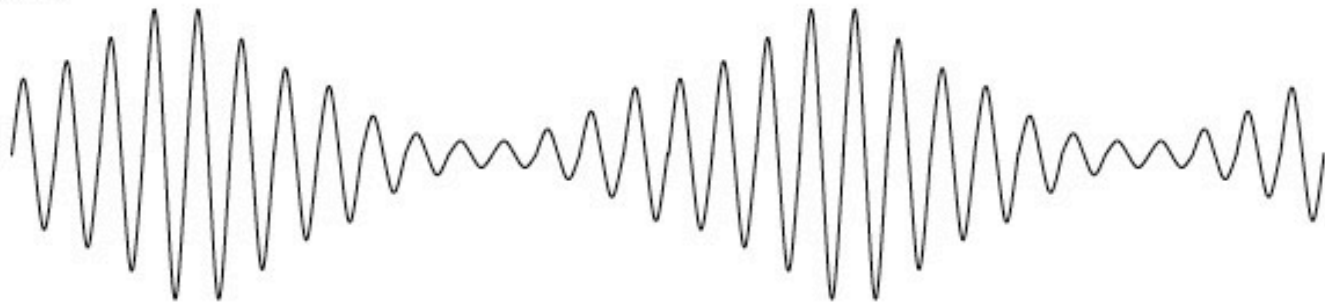
Carrier



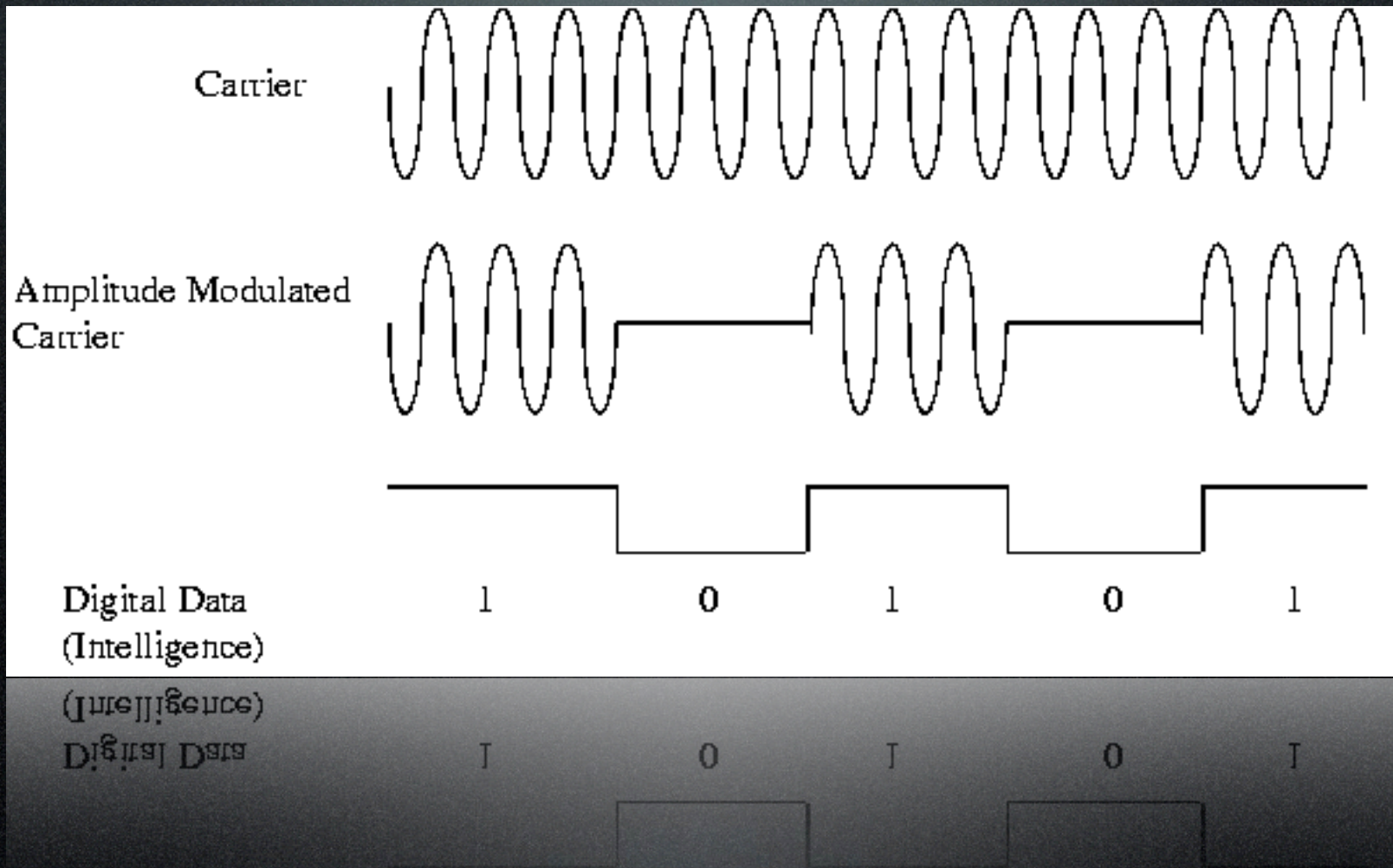
Signal



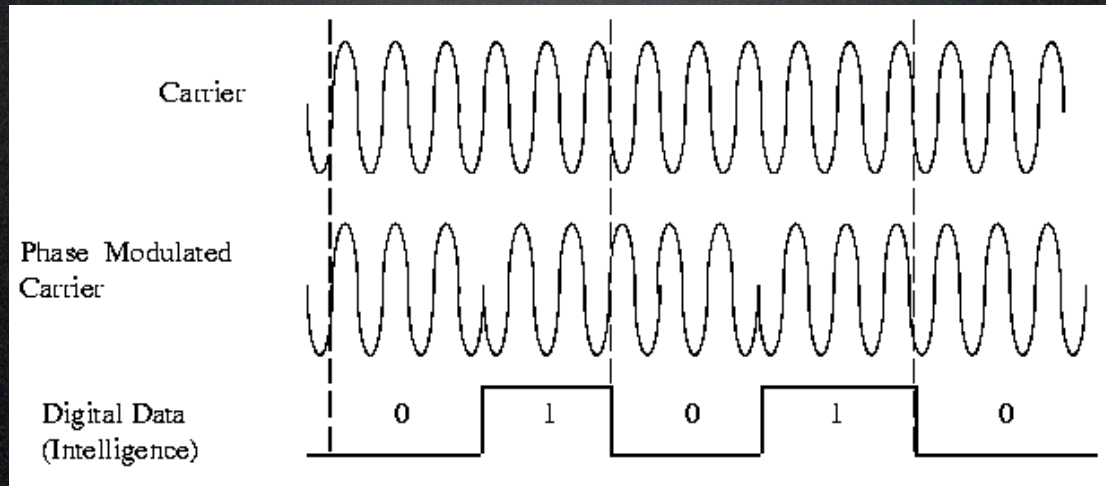
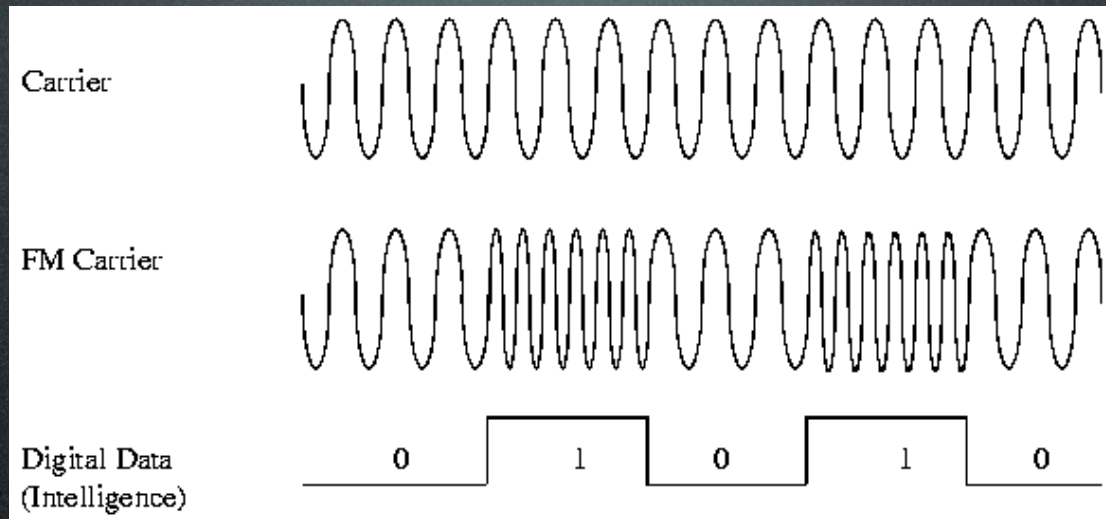
Result



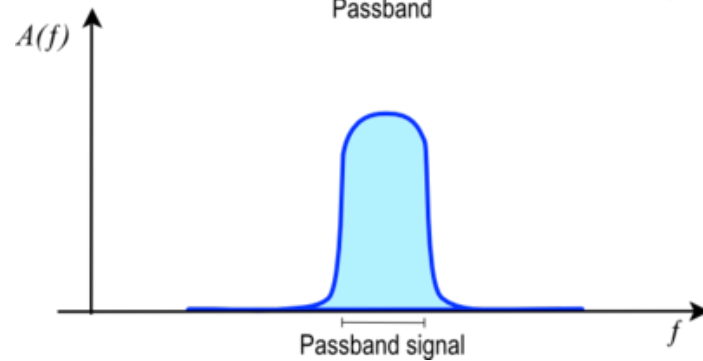
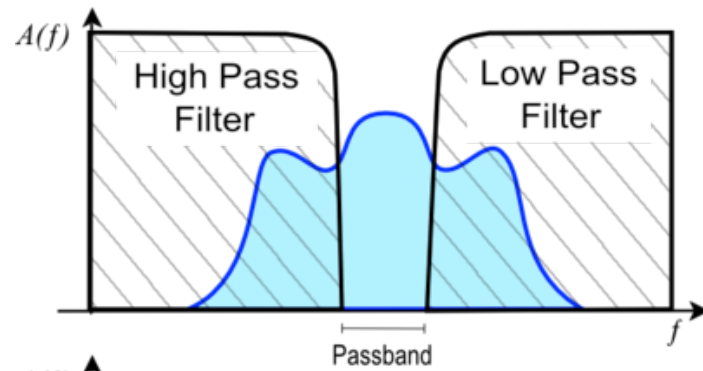
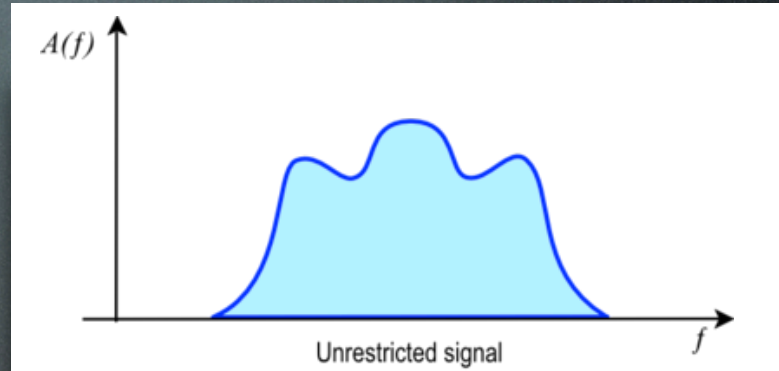
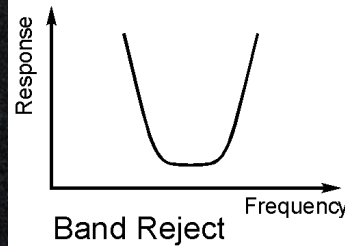
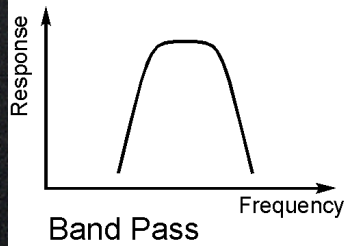
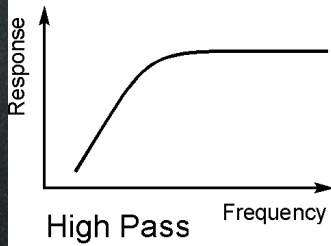
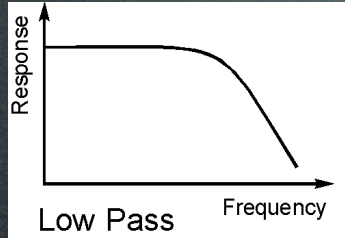
“digital” modulations



“digital” modulations

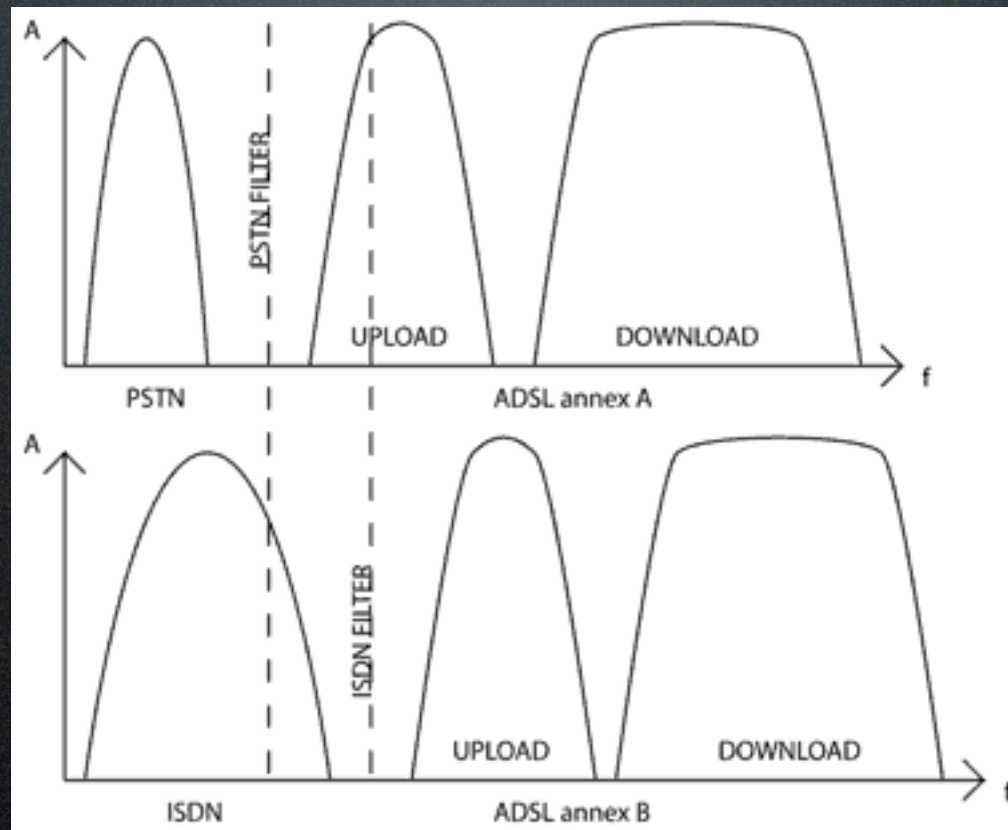


Filters

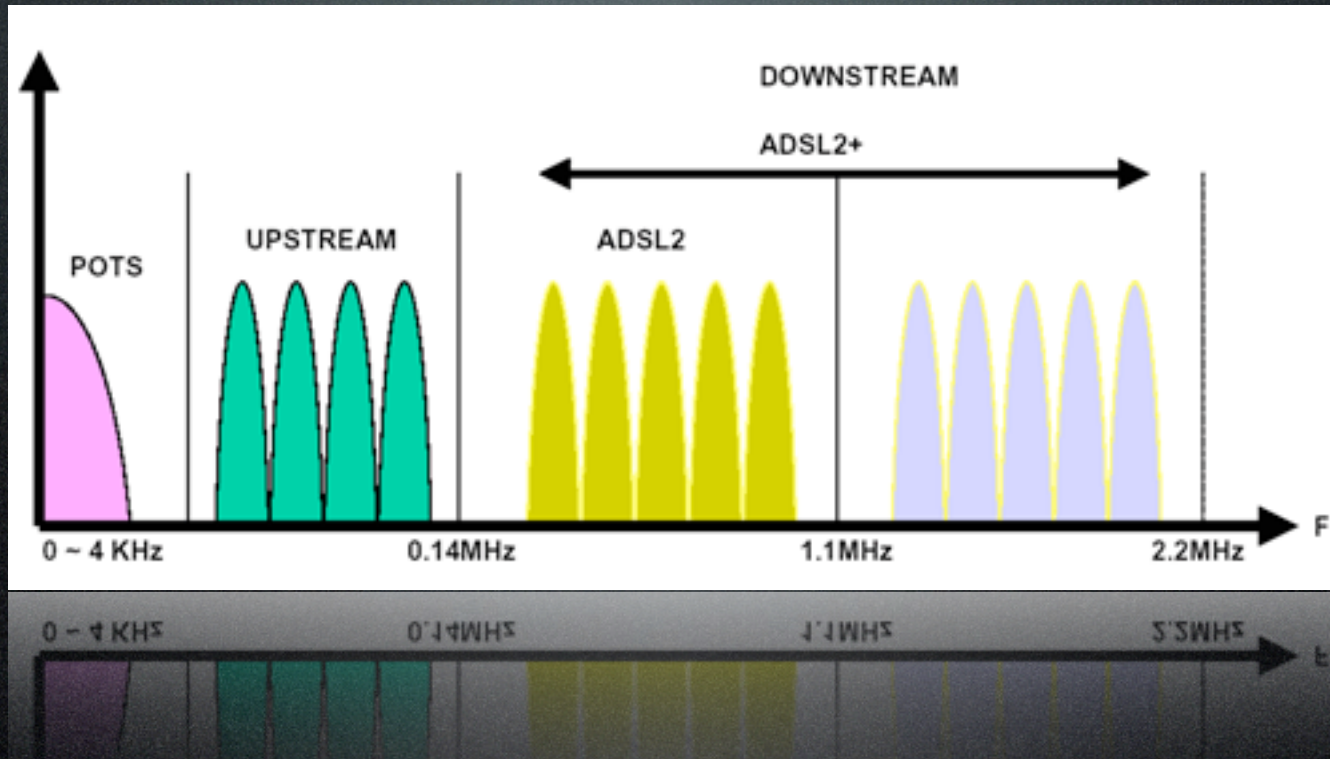


ADSL

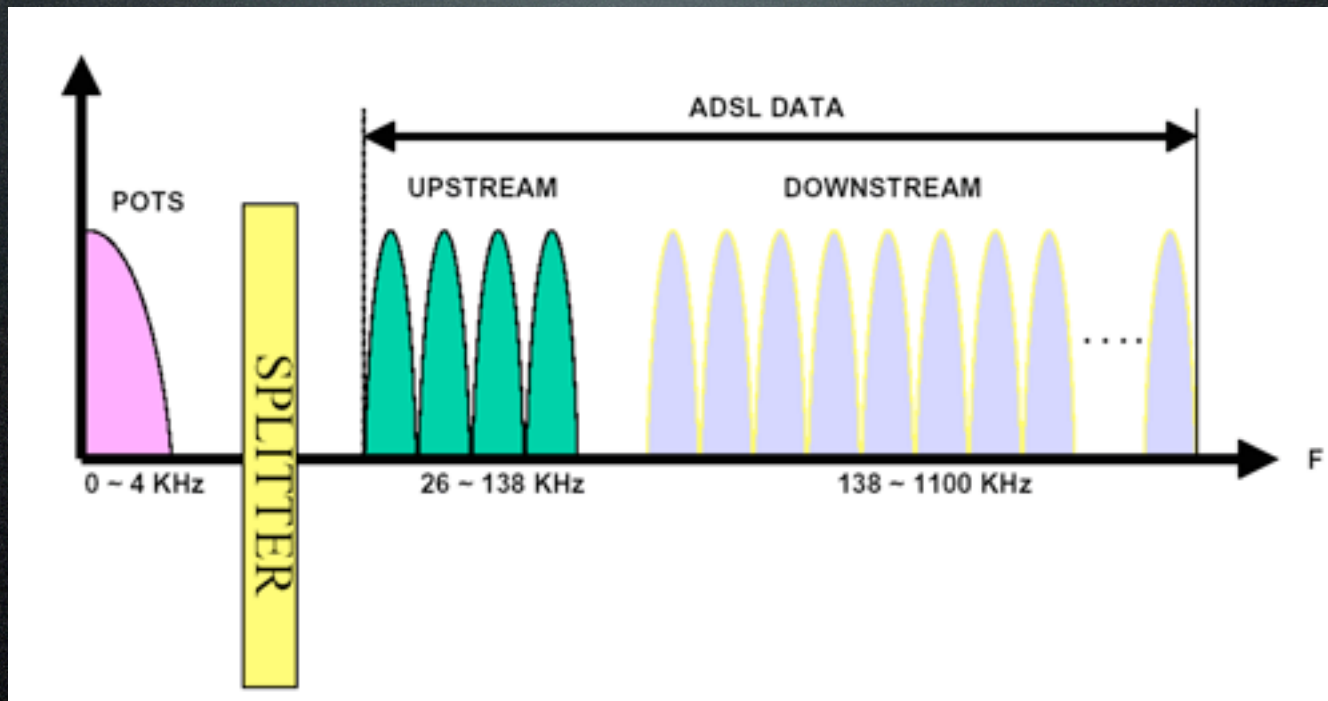
- Layer 1 (physical)



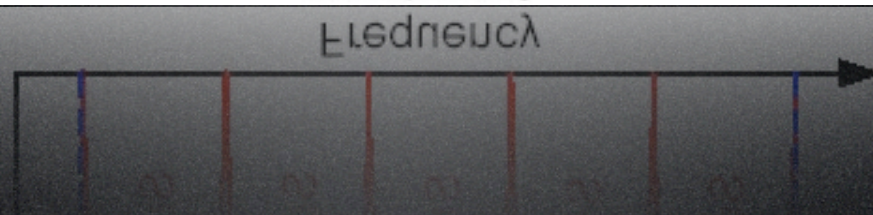
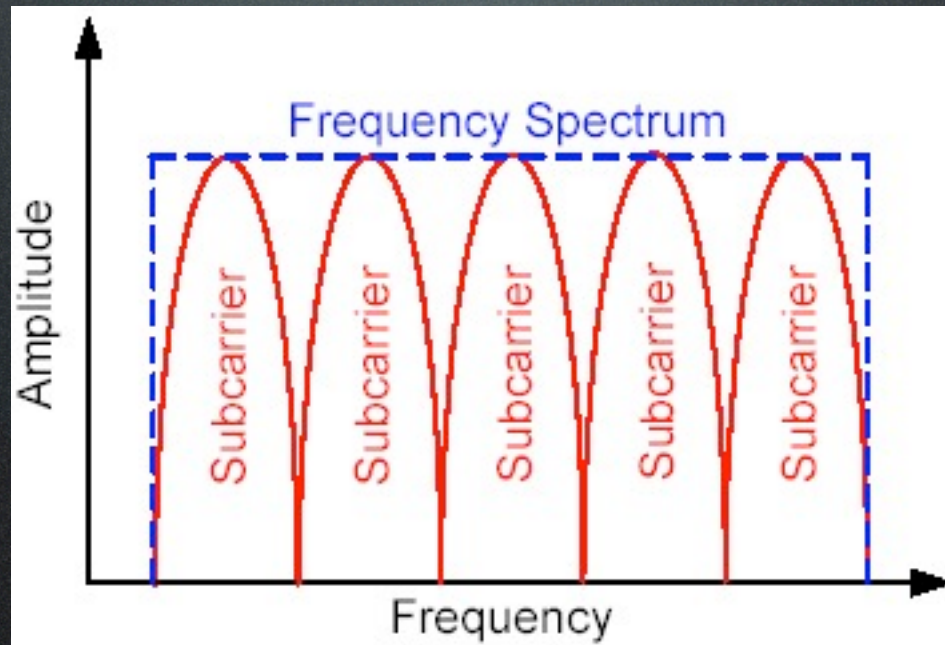
ADSL spectrum



ADSL spectrum



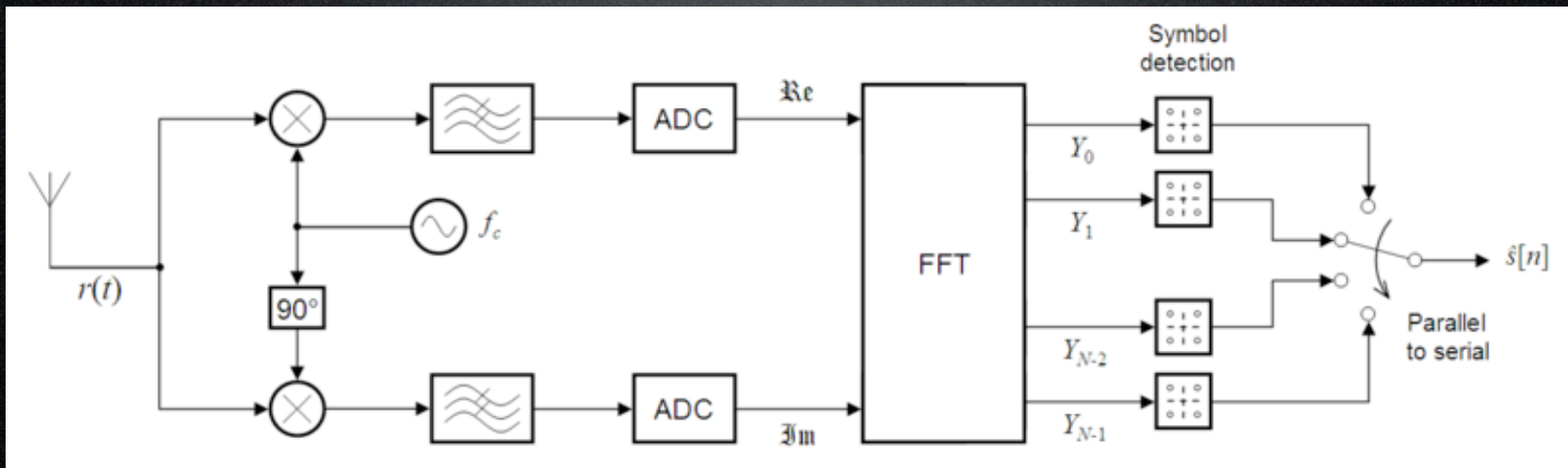
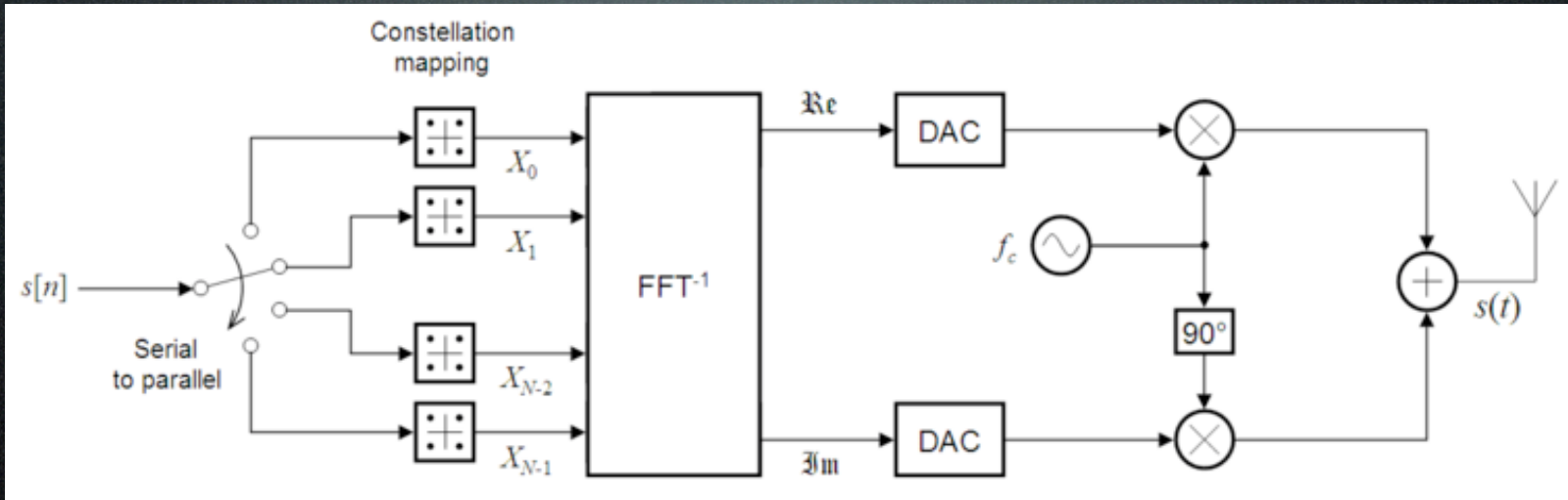
OFDM



OFDM/COFDM/DMT

- Orthogonal Frequency-Division Multiplexing (OFDM)
- Coded OFDM (COFDM)
- Discrete Multi-Tone modulation (DMT),
- ADSL spectrum per carrier: 4.3125 kHz

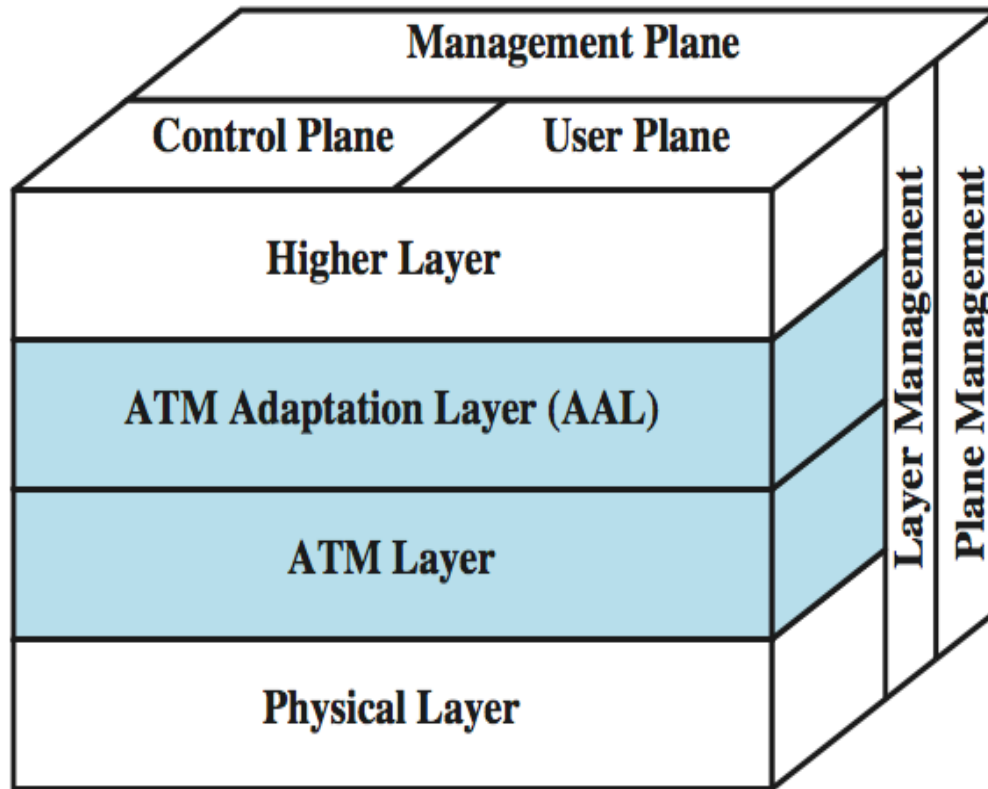
OFDM Tx & Rx



ADSL

- Layer 2 (Data Link):
- PPPoA
 - Point-to-Point Protocol over ATM
- PPPoE
 - Point-to-Point Protocol over Ethernet
- VC? = Virtual Circuit

ATM



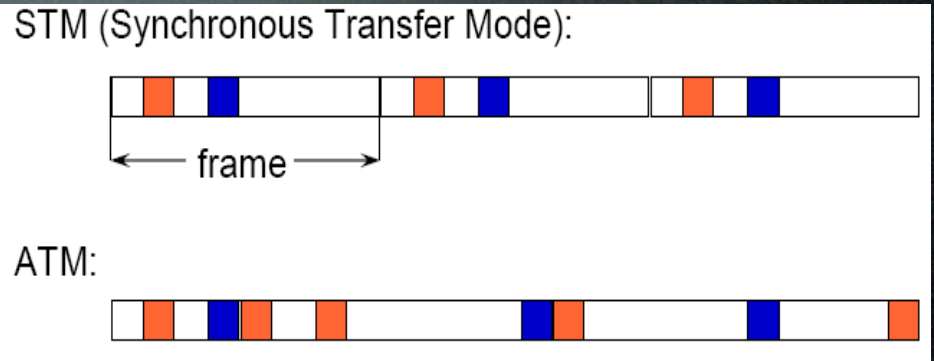
Physical Layer

ATM

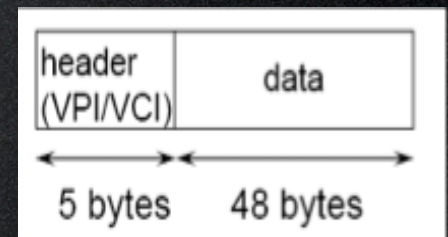
- a streamlined packet transfer interface
- similarities to packet switching
 - transfers data in discrete chunks
 - supports multiple logical connections over a single physical interface
- ATM uses fixed sized packets called cells
- minimal error & flow control capabilities
- data rates of 25.6Mbps to 622.08Mbps

Key Features

- Asynchronous

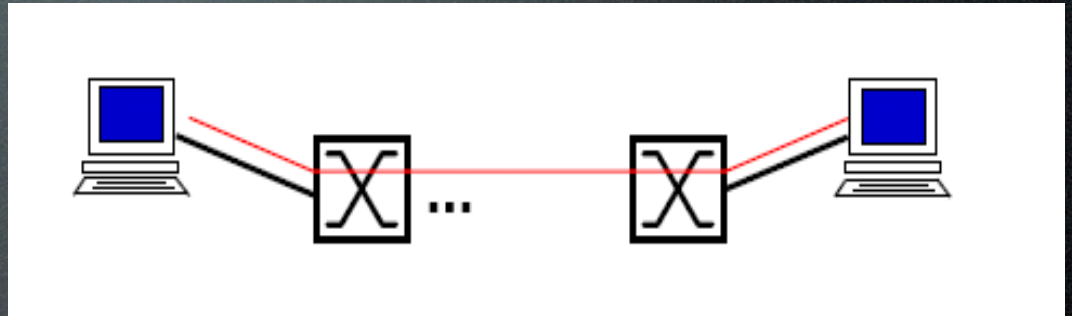


- Fixed Small Cell Size

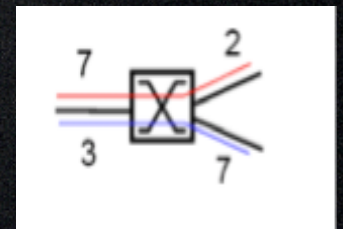


Key Features

- Connection Oriented

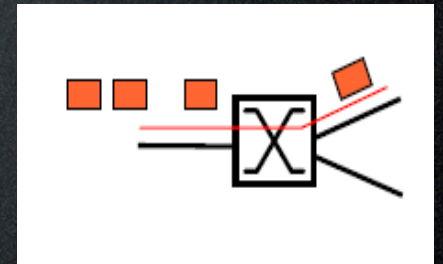


- No addressing: Labeling
 - Labels carry local significance → scalability



Key Features

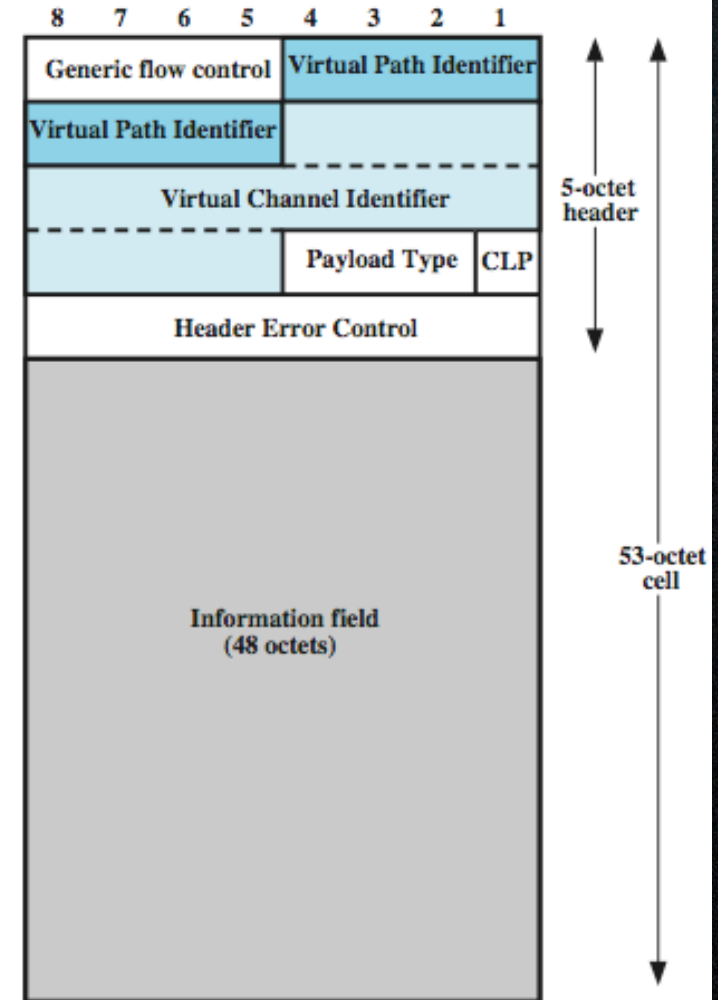
- Cells are switched rather than routed.
 - Switching cells based on small header info: fast



- Same technology for LAN, WAN

Header & Cell Format

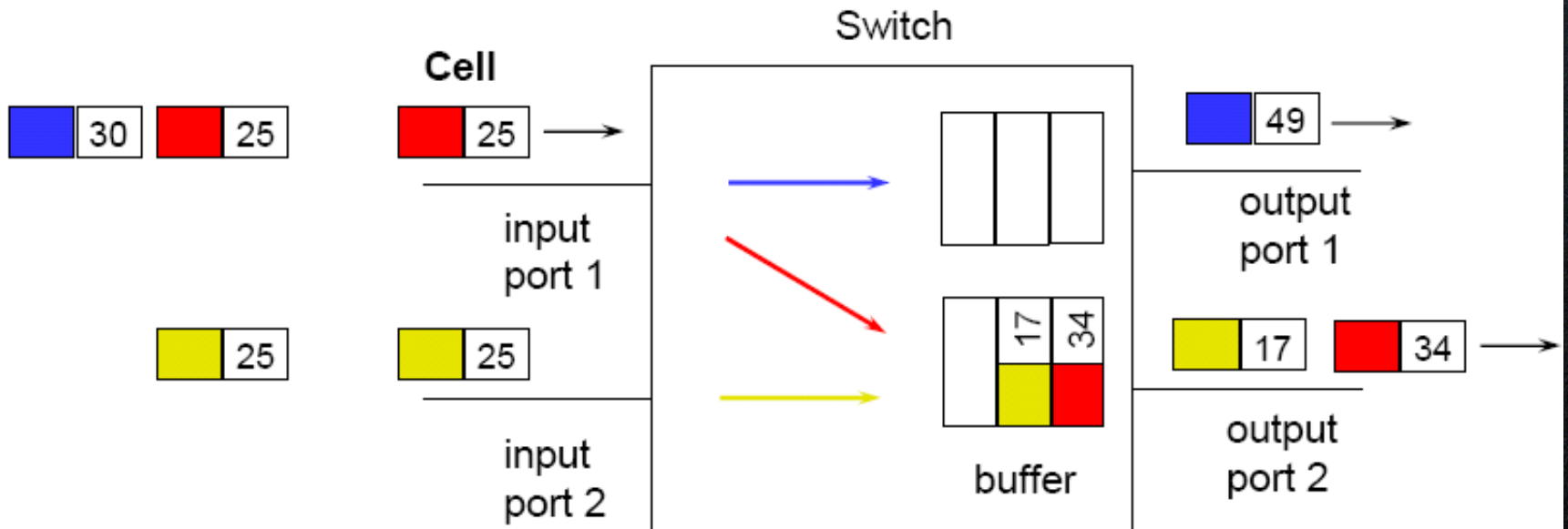
- GFC: only in User-Network Interface
- CLP=1 → cell has low priority
- Payload Type: identifies user cell/data cell, congestion control



(a) User-network interface

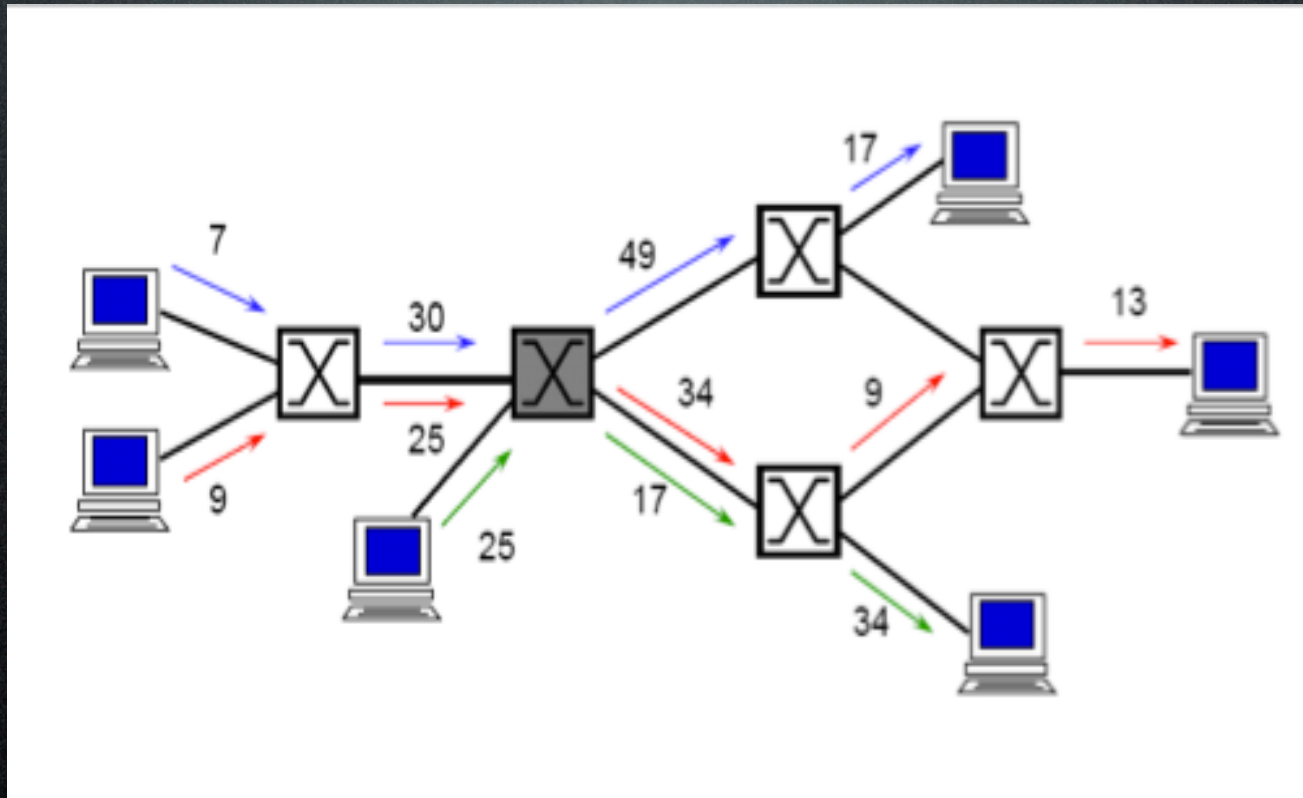
(b) User-network interface

Cell Switching



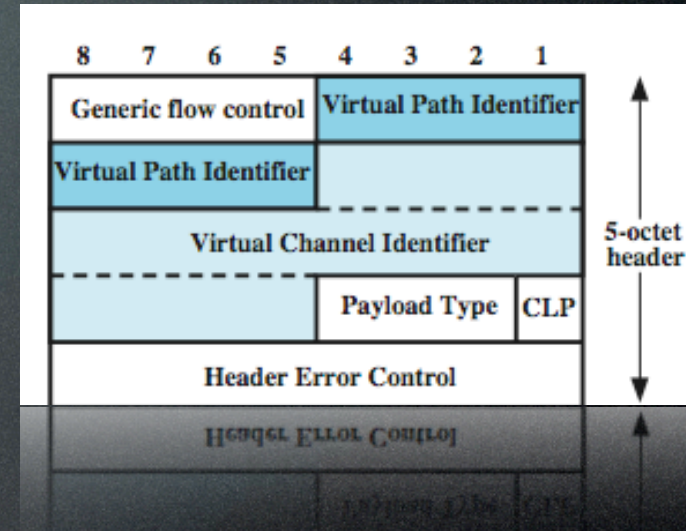
Input Port	VPI/CI	Output Port	VPI/CI
1	25	2	34
1	30	1	49
2	25	2	27

Switching In a Network



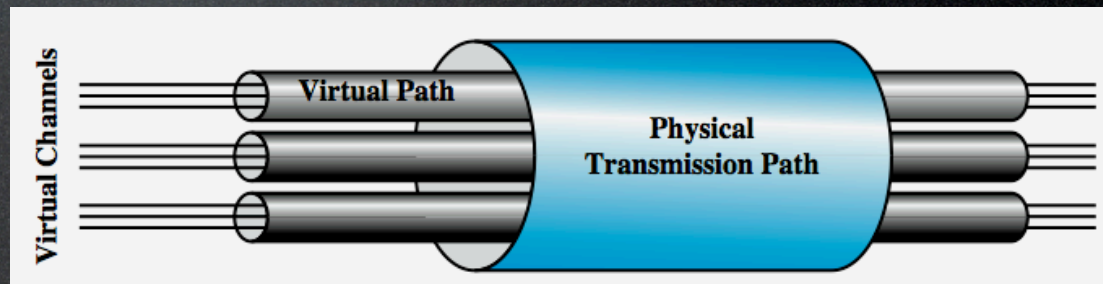
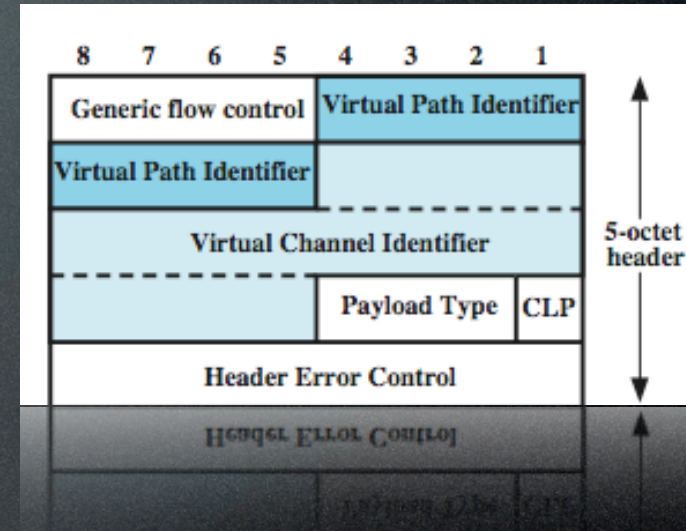
Virtual Channels & Virtual Paths

- Remember the Cell label:
 - First 8(12) bits: Virtual Path Identifier
 - Last 16 bits: Virtual Circuit Identifier
 - Virtual Path: group of VCs treated similarly

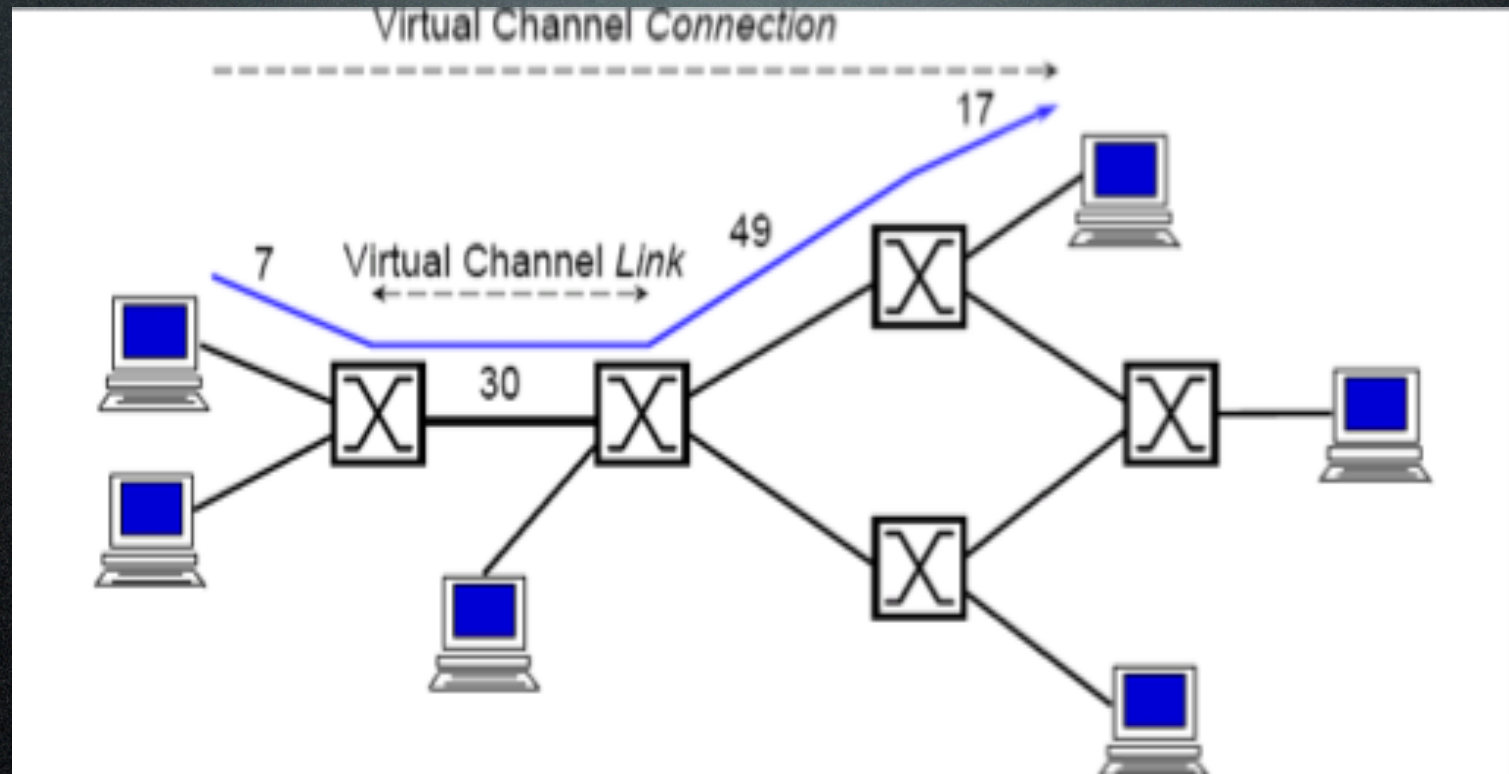


Virtual Channels & Virtual Paths

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VC Connection



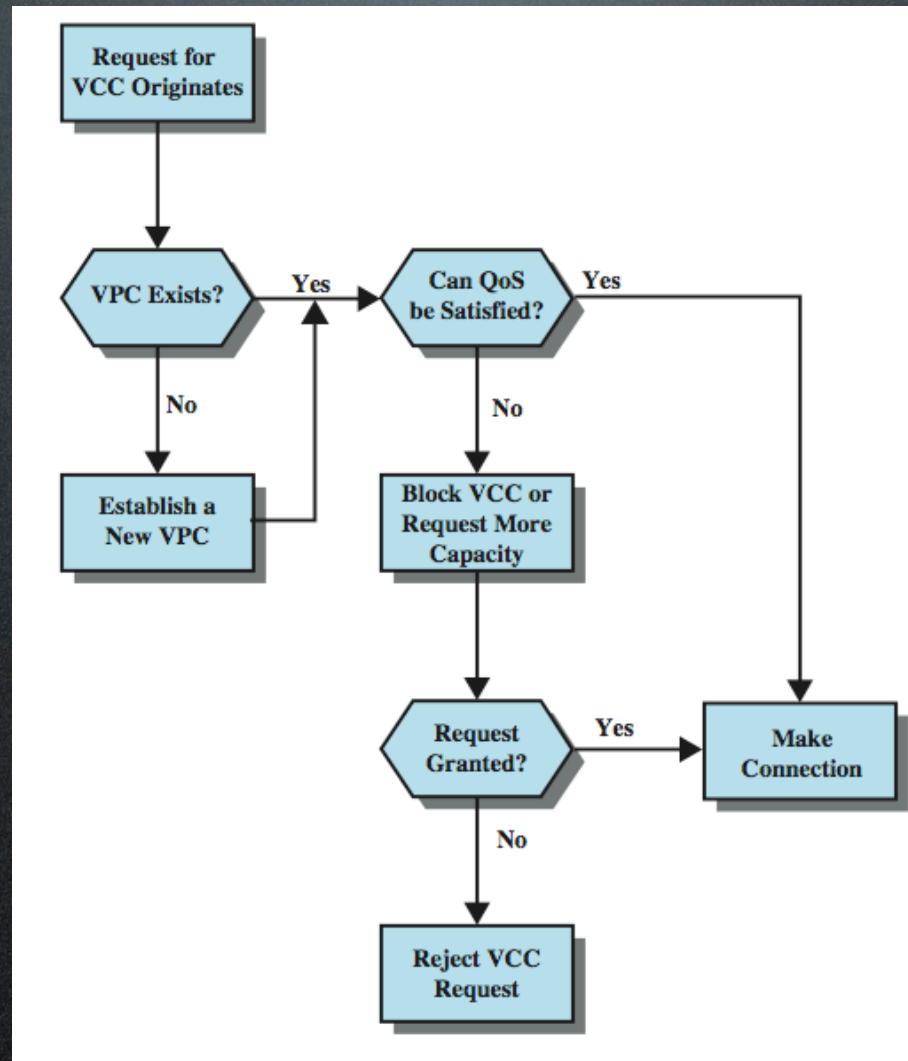
VC Connection

- Two types of Virtual Channels:
 1. Switched Virtual Channels (SVC):
connection setup with signaling
 2. Permanent Virtual Channels (PVC):
connection setup with management

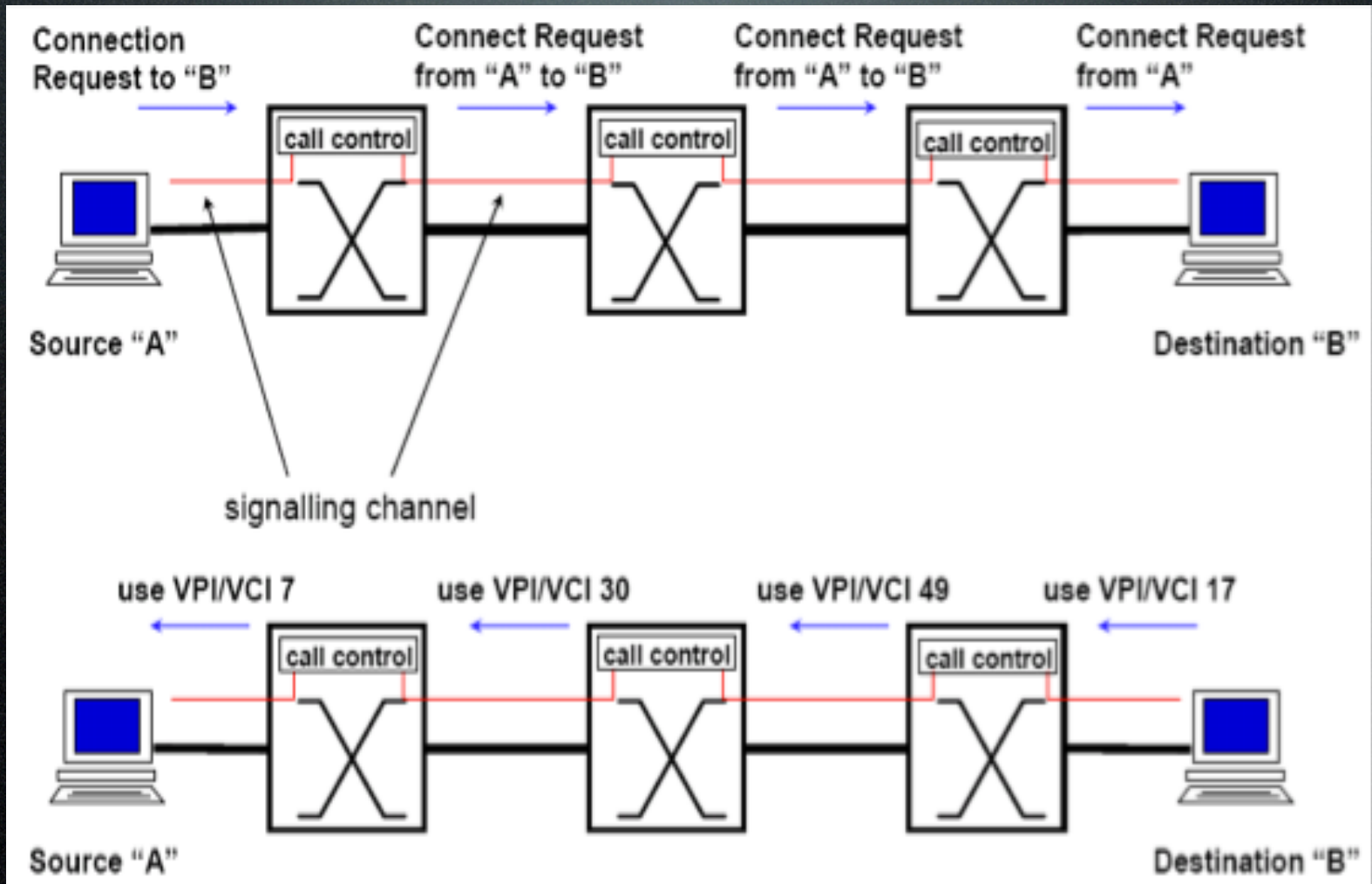
VC Connection Uses

- **between end users**
 - end to end user data
 - control signals
 - VPC provides overall capacity
 - VCC organization done by users
- **between end user and network**
 - control signaling: Reserved VC's on each VP for maintenance
- **between network entities**
 - network traffic management
 - routing

VC Connection



SVC Connection setup



Service Categories Attributes and QoS Guarantees

Service Category	Traffic Description	Guarantees			Feedback Control
		Min Loss (CLR)	Delay/ Variance	Bandwidth	
CBR	PCR	✓	✓	✓	NO
rt-VBR	PCR,SCR, MBS	✓	✓	✓	NO
nrt-VBR	PCR,SCR, MBS	✓	NO	✓	NO
ABR	PCR,MCR+ behavior	✓	NO	✓	✓
UBR	(PCR)	NO	NO	NO	NO

UBR	(PCR)	NO	NO	NO	NO
ABR	PCR,MCR+ behavior	✓	NO	✓	✓