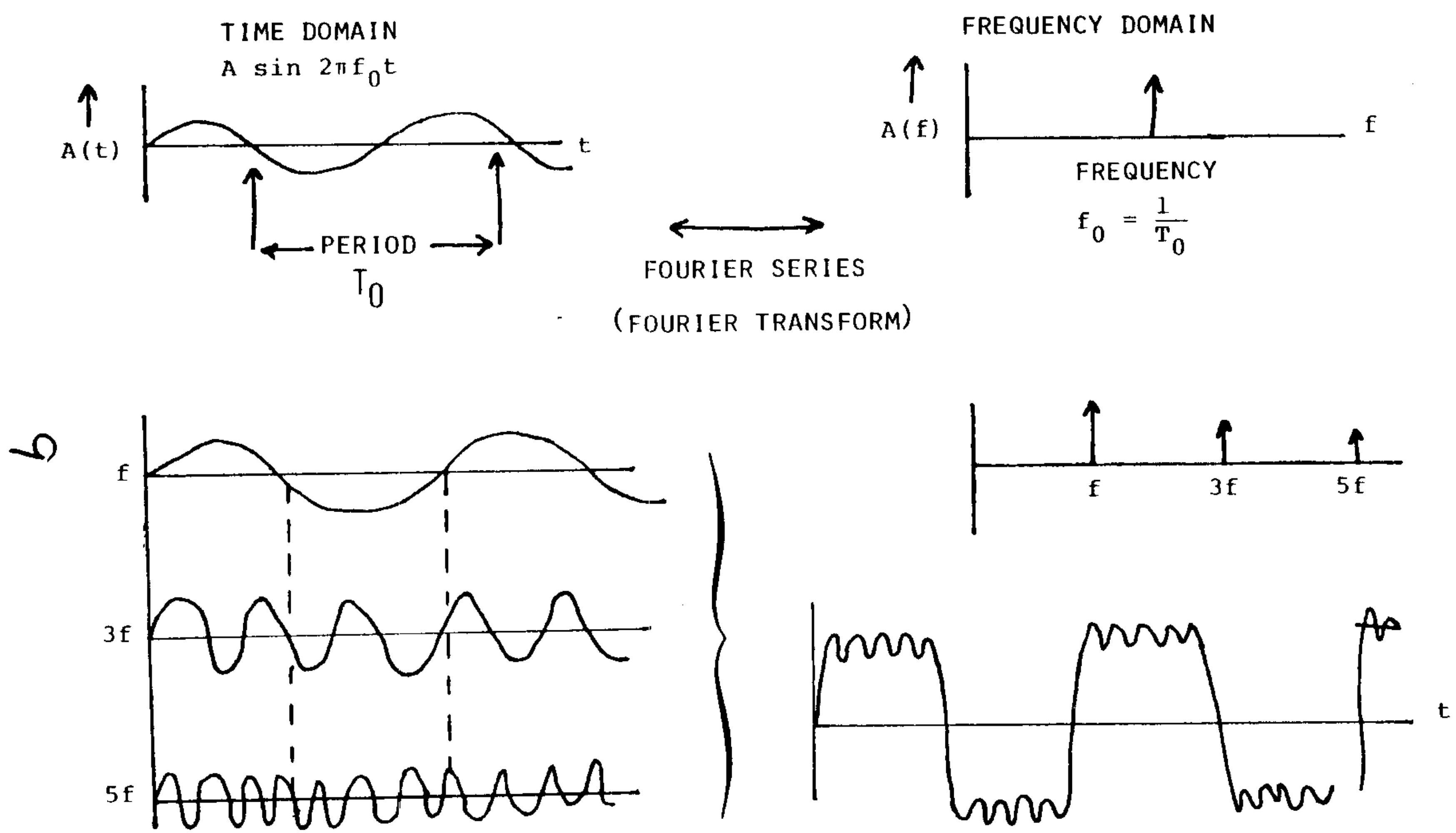
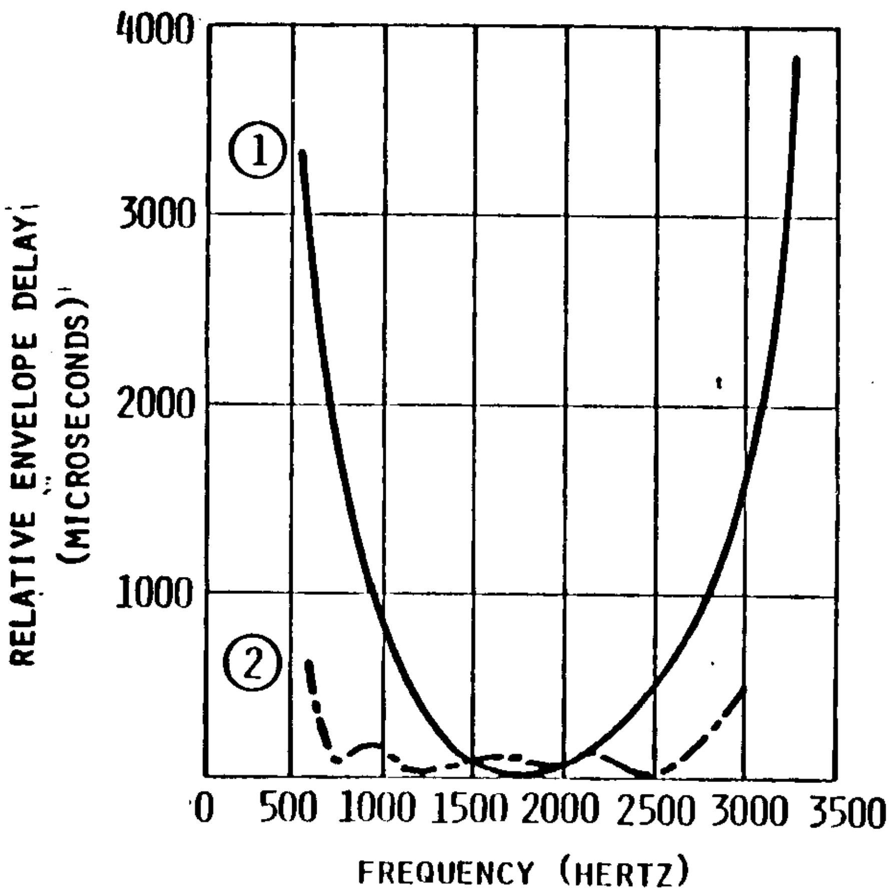
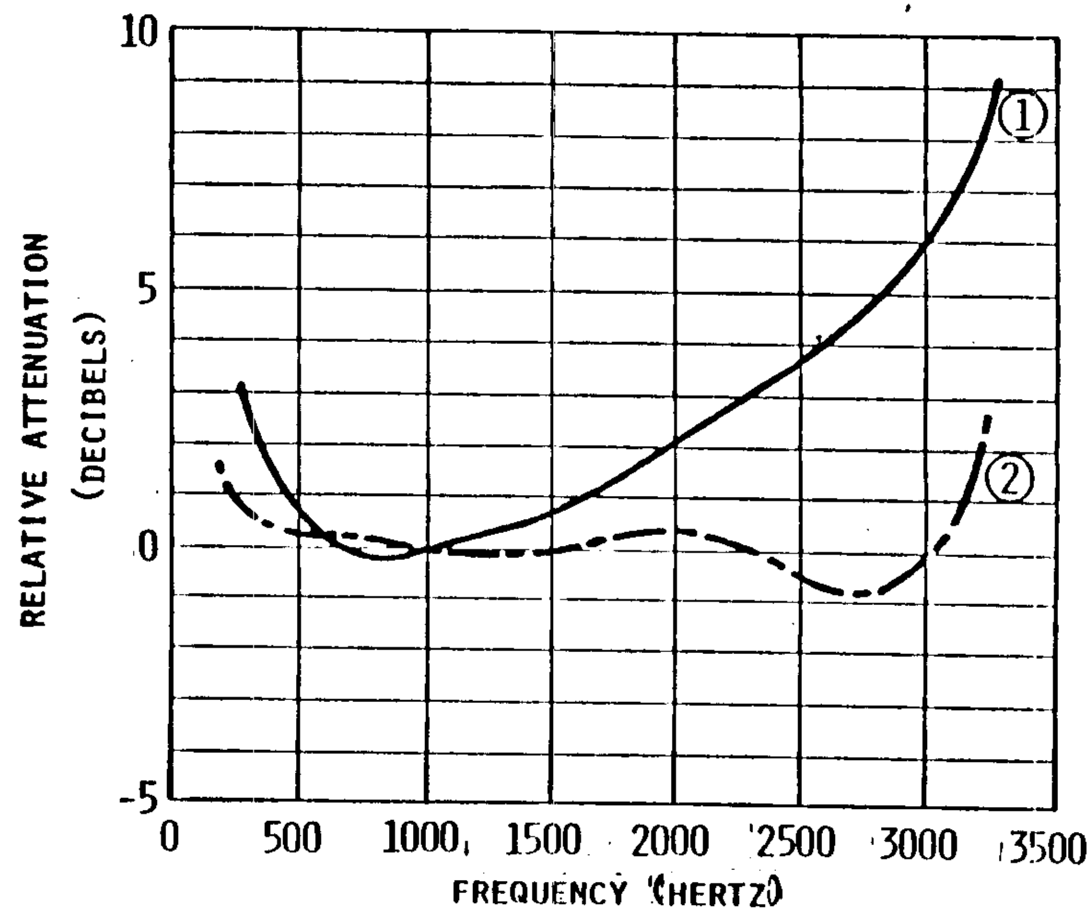
REPRESENTING A SIGNAL





VARIATION IN ENVELOPE DELAY WITH FREQUENCY

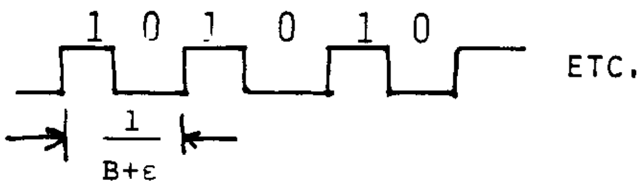


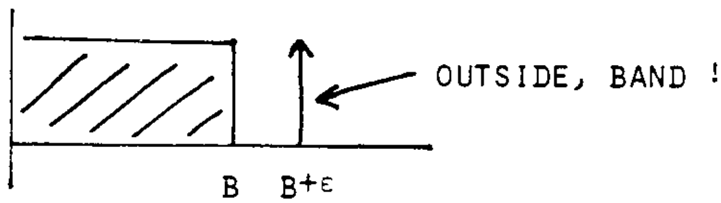
VARIATION OF ATTENUATION WITH FREQUENCY

NYQUIST THEOREM

GIVEN AN IDEAL LOW-PASS CHANNEL OF BANDWIDTH B, IT IS POSSIBLE TO SEND INDEPENDENT SYMBOLS AT A RATE $R<2B$ WITHOUT INTERSYMBOL INTERFERENCE. THIS IS NOT POSSIBLE IF $R>2B$

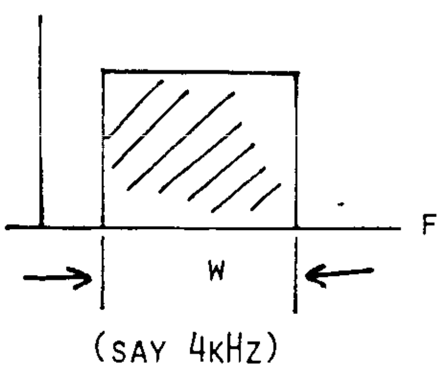
CONSIDER THE SEQUENCE 101010 TRANSMITTED AT RATE $2(B+\varepsilon)$:

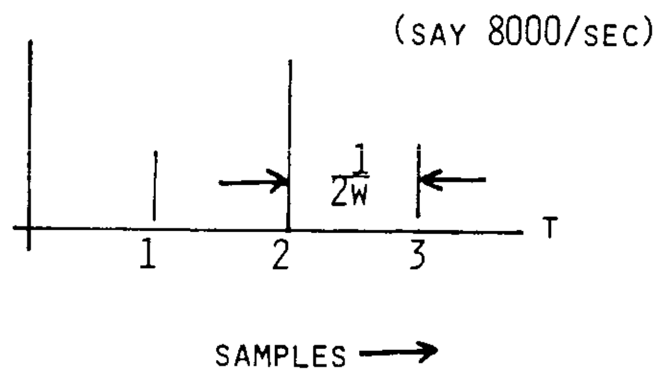




SAMPLING THEOREM

IF $F(T)$ IS BANDLIMITED IN W HZ, THEN $F(T)$ IS UNIQUELY DETERMINED BY A SERIES OF SAMPLES SPACED $\frac{1}{2W}$ APART.





- I.E.: WE HAVE TO SAMPLE AT LEAST AT A RATE OF TWICE THE BANDWIDTH.

SHANNON-HARTLEY THEOREM

$C = W \log_2 \frac{S+N}{N}$

C = CHANNEL CAPACITY (BITS/SEC)

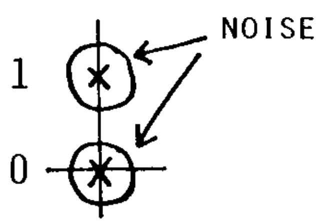
S = SIGNAL POWER

N = NOISE POWER

W = BANDWIDTH

SIGNAL LEVELS (BANDWIDTH CONST.)

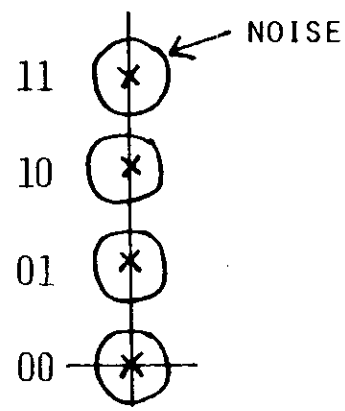
2 LEVELS:



2 SYMBOLS

1 BIT

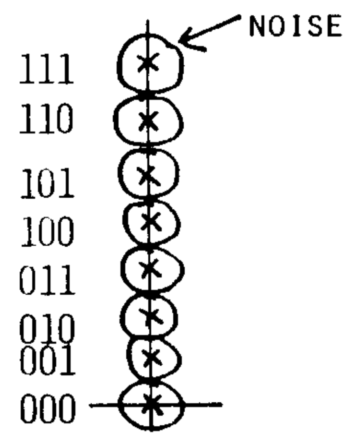
4 LEVELS



4 SYMBOLS

2 BITS

8 LEVELS



8 SYMBOLS

3 BITS

CONCLUDE $C \sim \log_2 \frac{S}{N}$

NOTE LIMITS

A) AS S>>N: $CN \sim W \log \frac{S}{N}$

B) AS S<<N: $C \sim W \log 1 \to 0.$

ON TYPICAL CIRCUITS

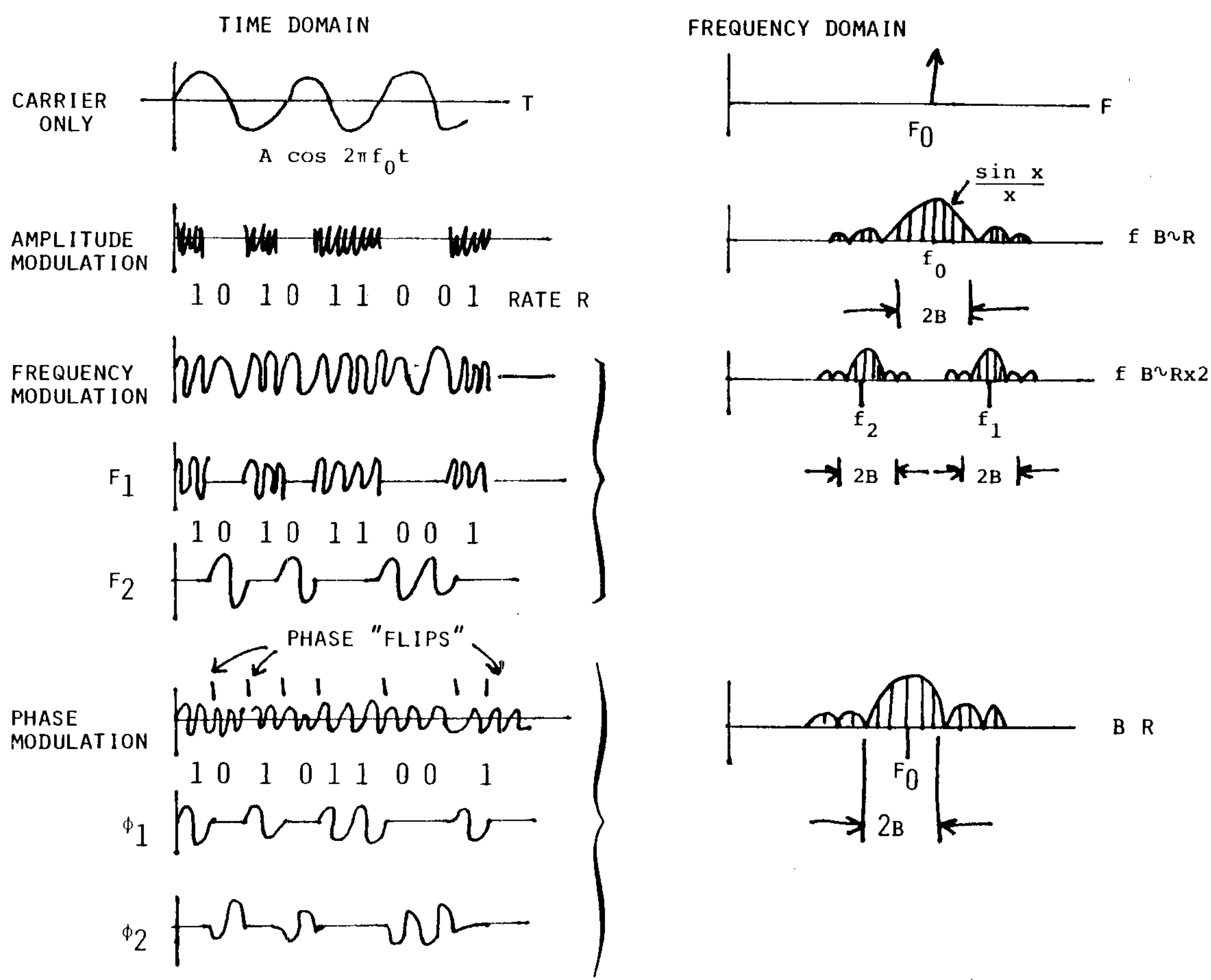
$W = 2500$ Hz

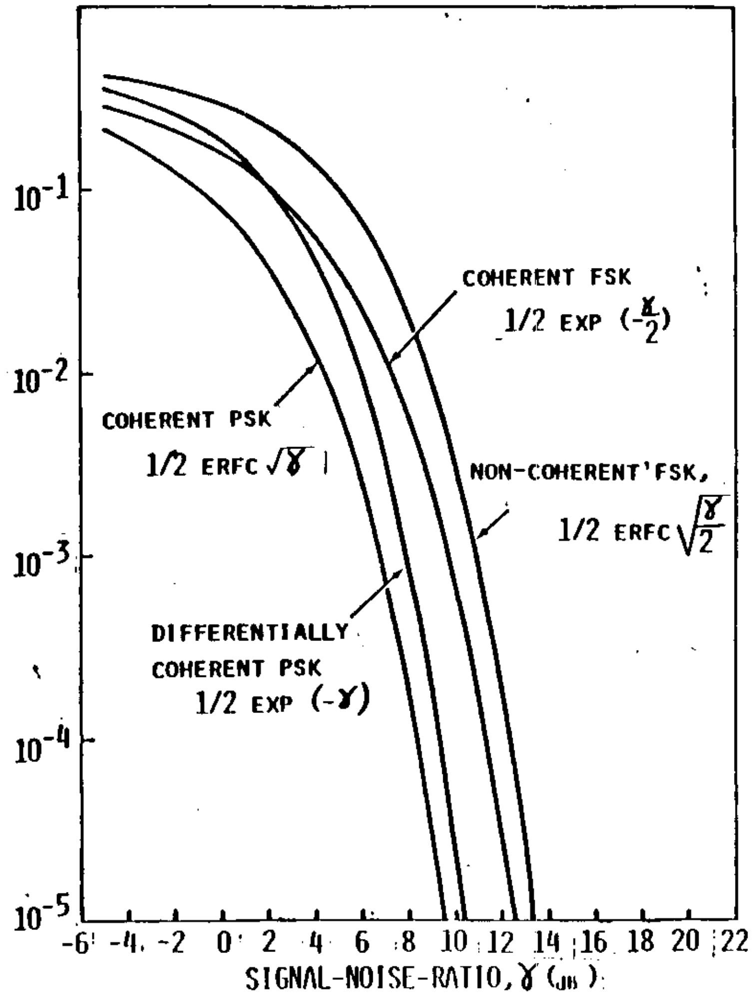
$\frac{S+N}{N} \sim 40$ DB

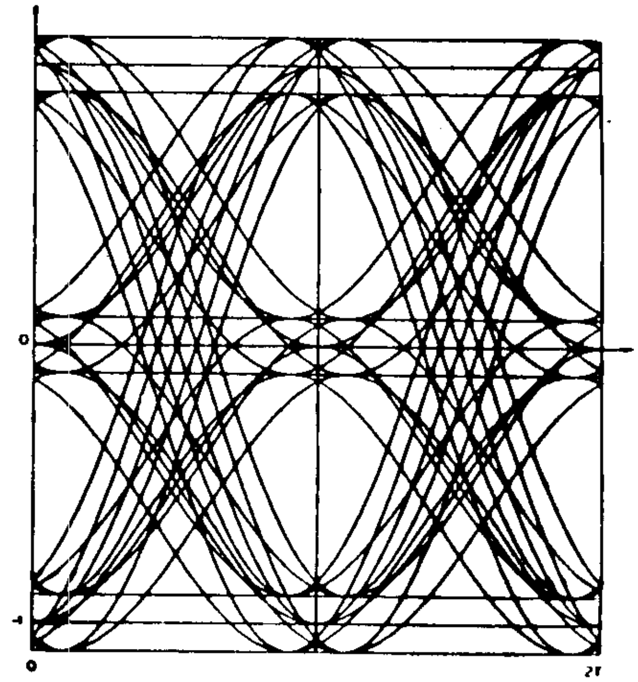
$C \sim 32000$ BAND

(THEORETICALLY!)

MODULATION SYSTEMS



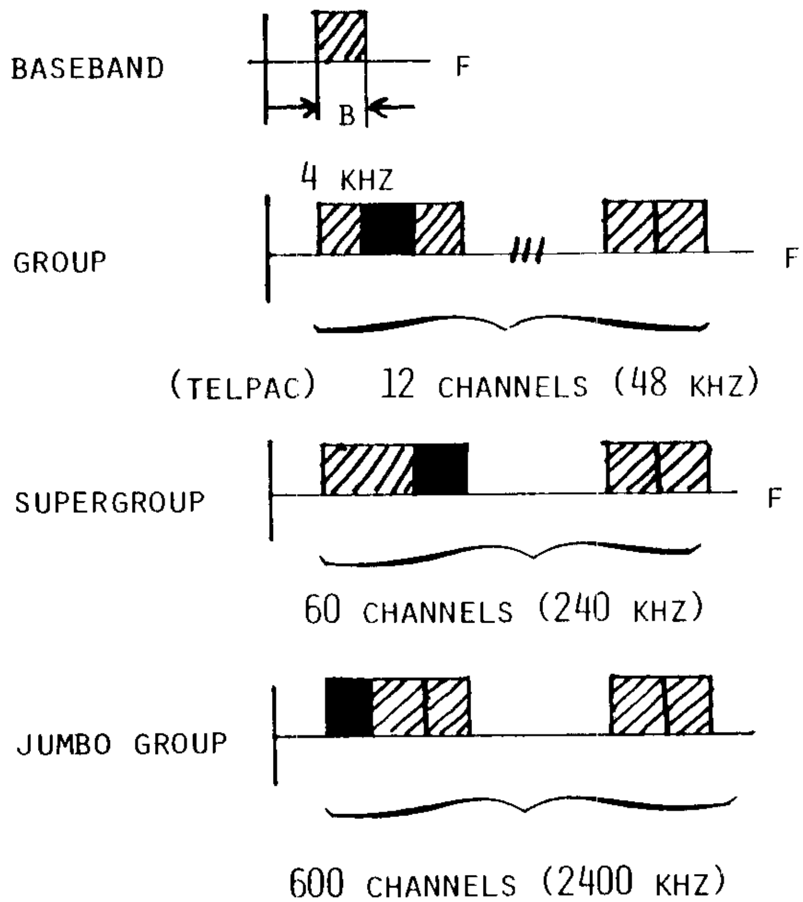


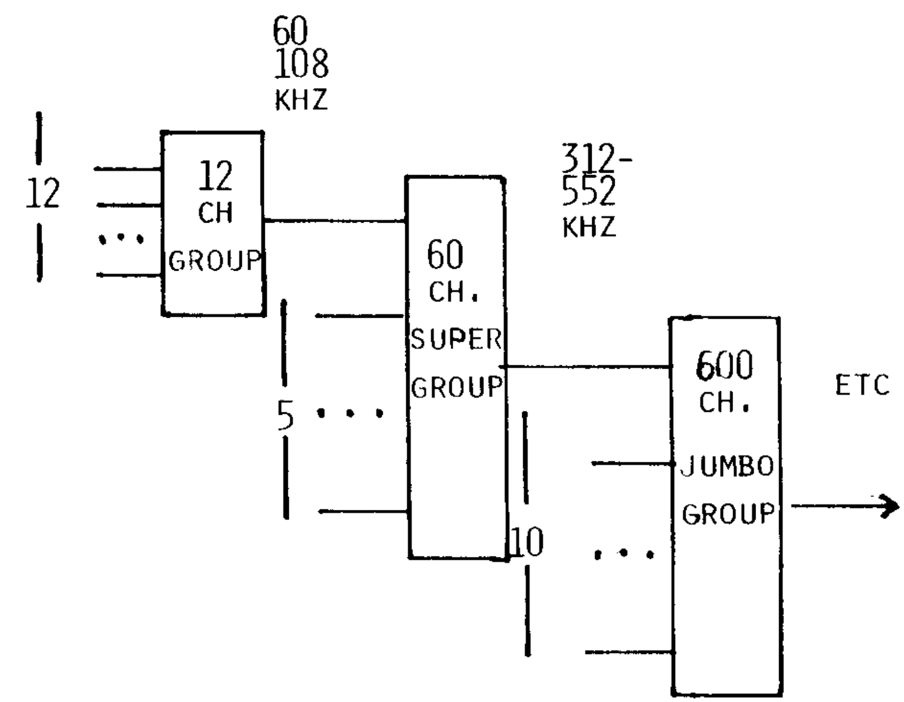


EYE DIAGRAM WITH AMPLITUDE ERROR AND TIMING ERROR

(AMPLITUDE ERROR = ± 0.1, TIMING ERROR = ± 0.1T)

MULTIPLEXING (FREQUENCY)

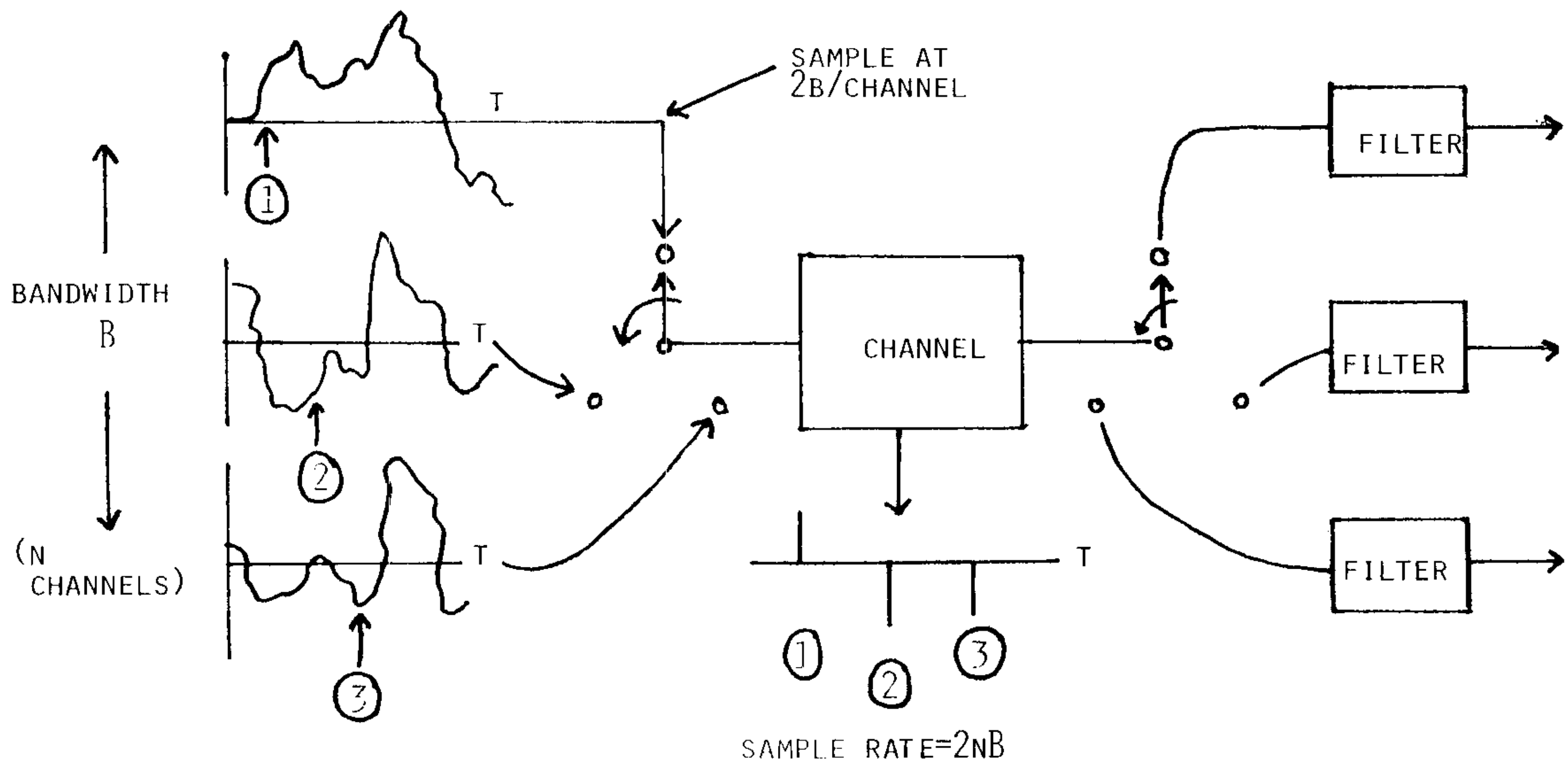




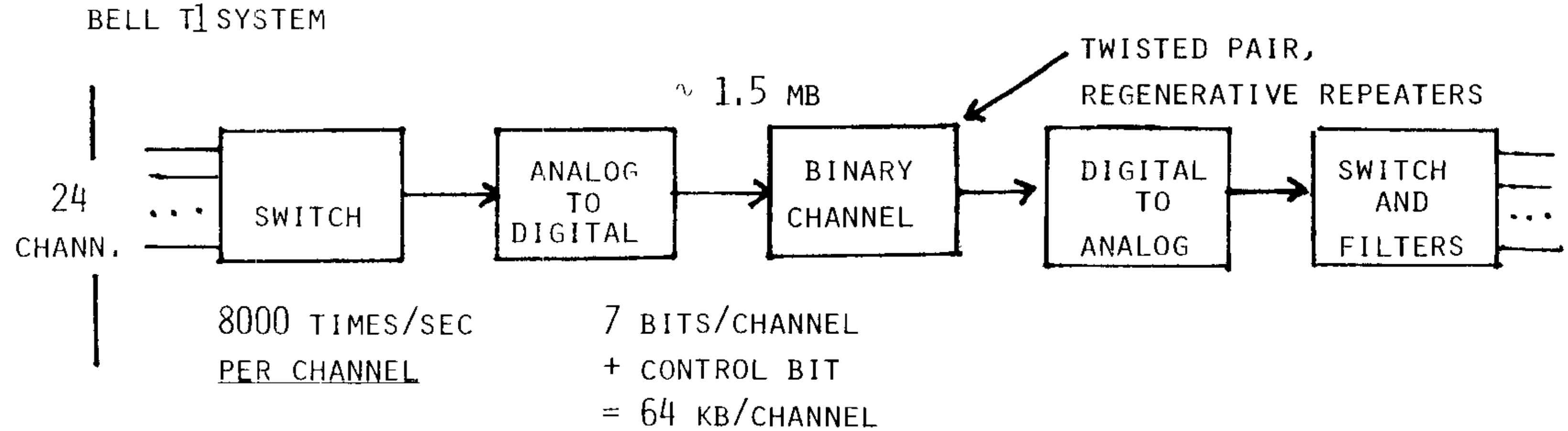
MICROWAVE RADIO, COAXIAL CABLE

- 3 JUMBO GROUPS ON 9 MHZ <u>OR</u>
- 2 JUMBO GROUPS AND 1 TV CHANNEL <u>ETC.</u>

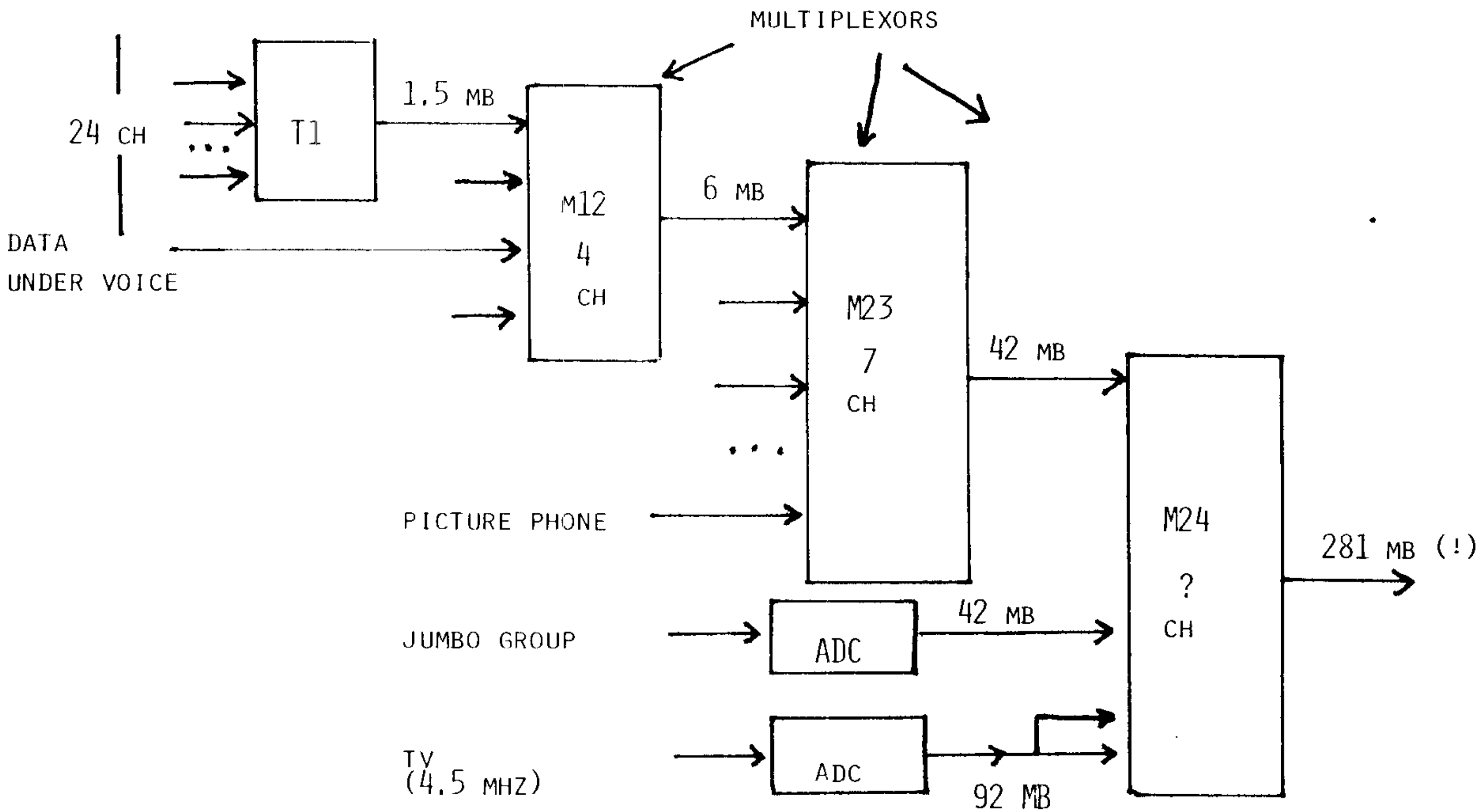
MULTIPLEXING (TIME)



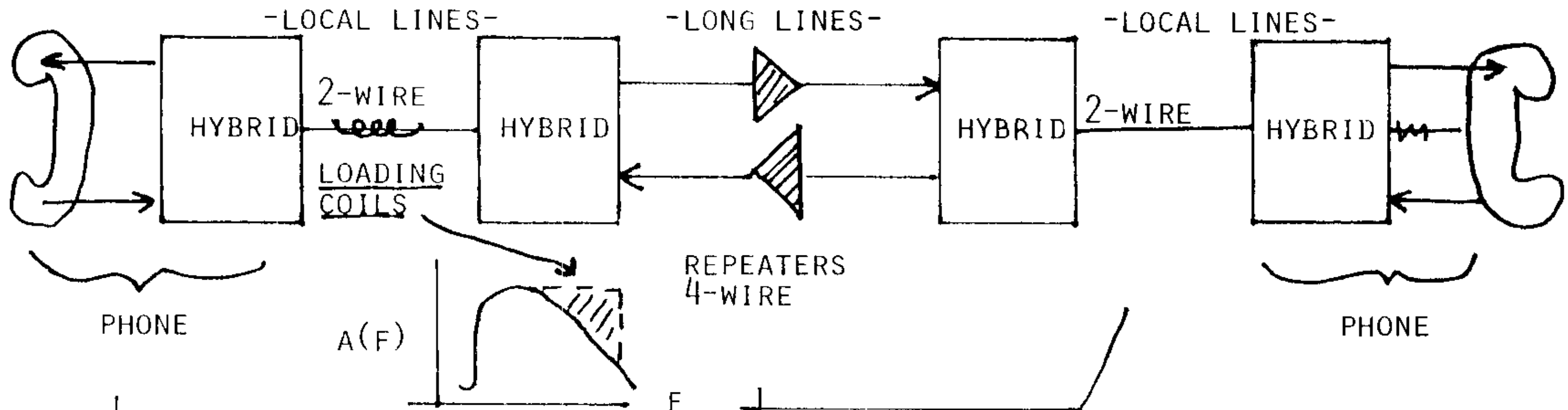
BELL T1 SYSTEM



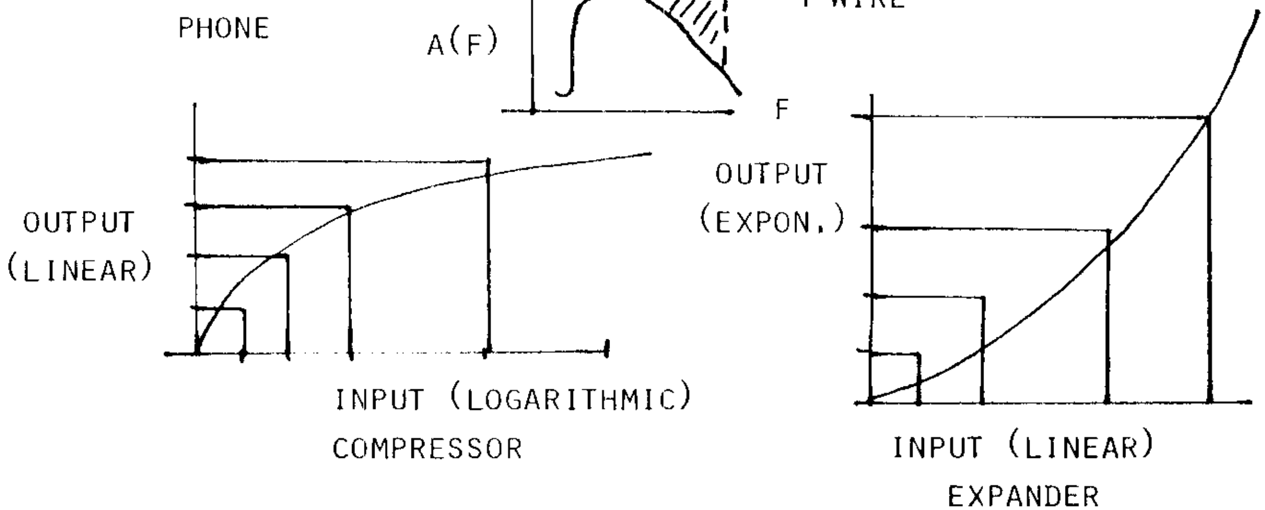
TIME DIVISION HIERARCHY



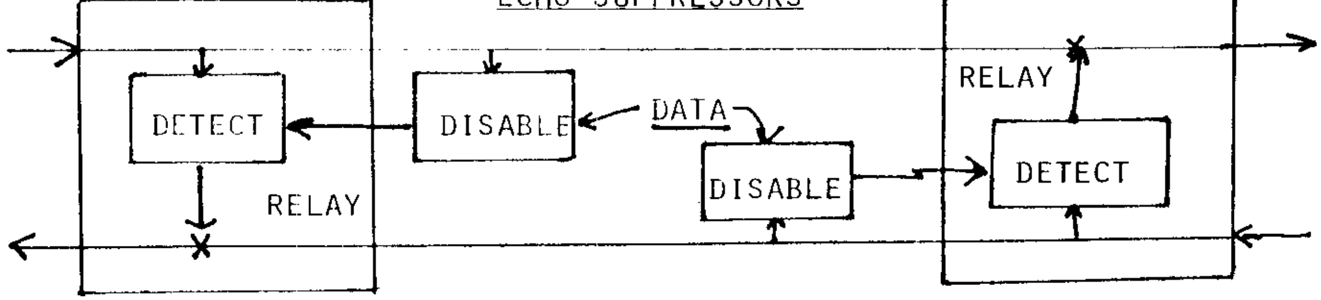
POTS TRANSMISSION



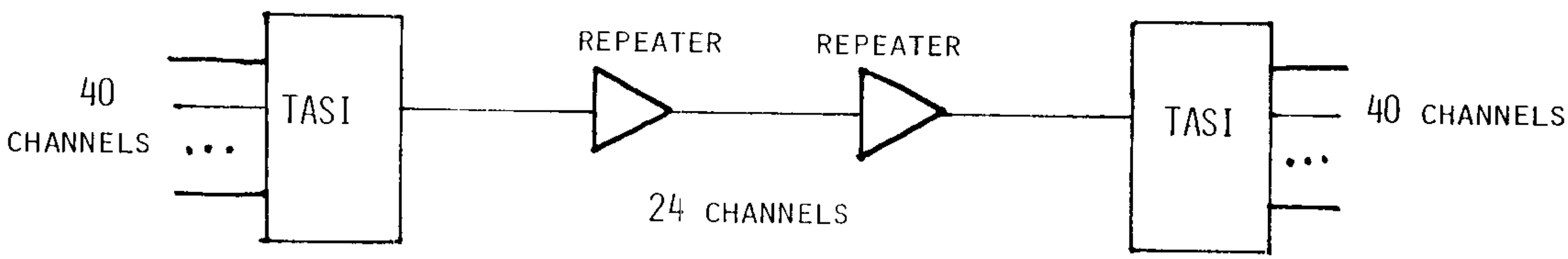
COMPANDERS



ECHO SUPPRESSORS



UNDERSEA CABLE



Cable-laying techniques

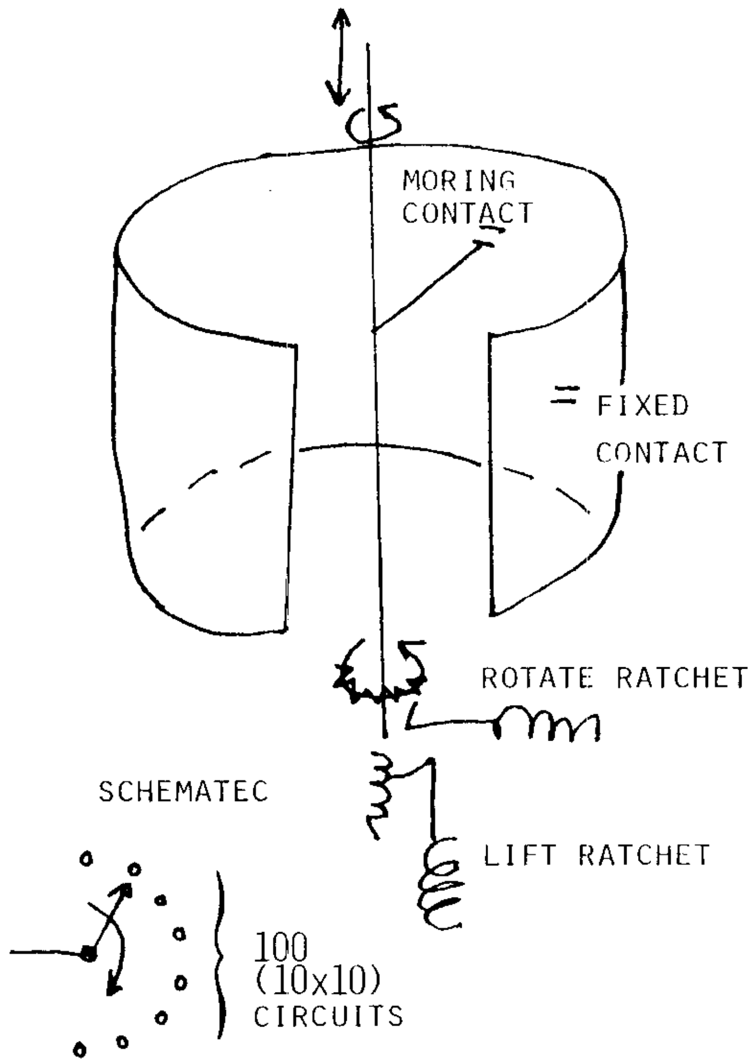
Multiplexing

Repeaters

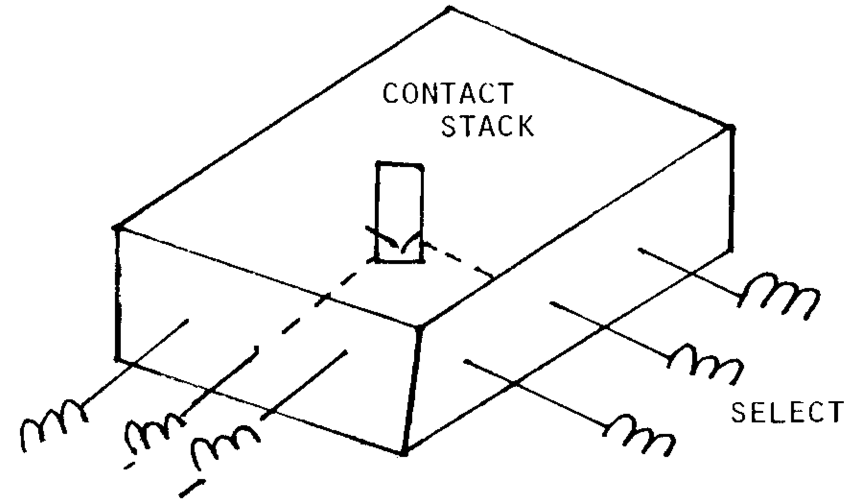
Fiber-optics

TASI A/B, SPECI

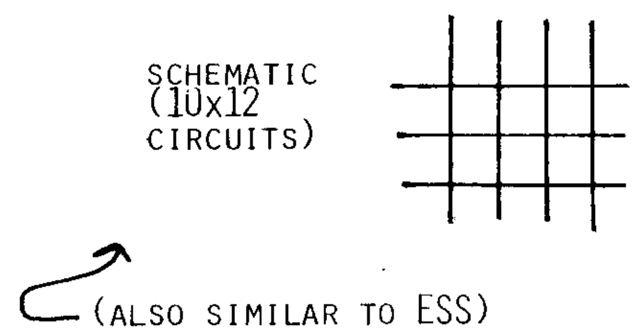
Bandwidth Compression

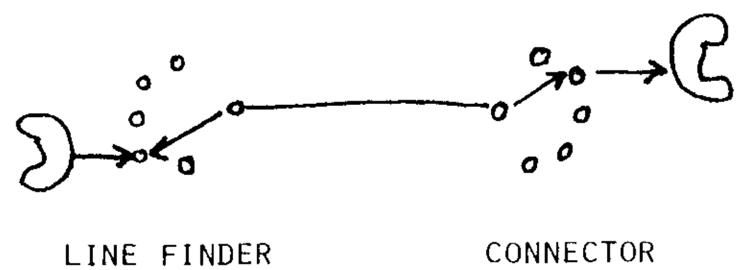


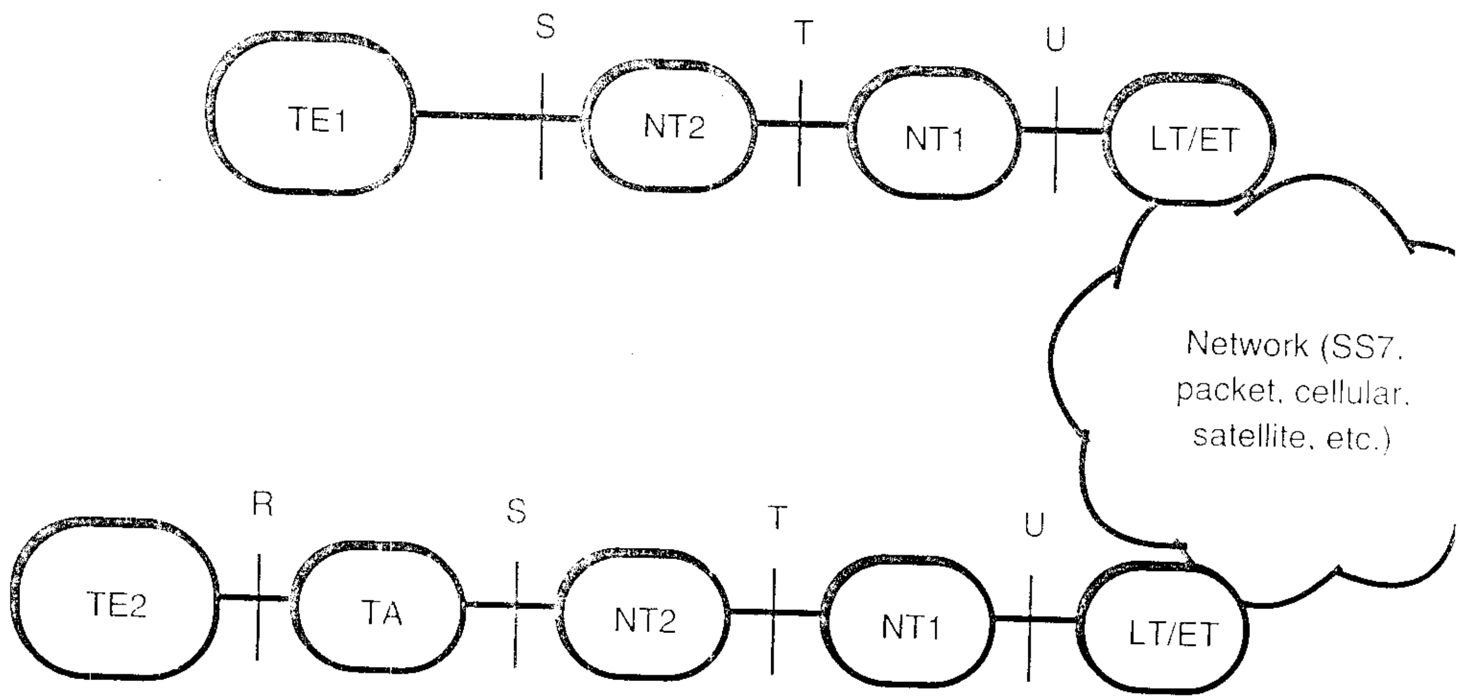
STROWGER SWITCH



LATCH CROSSBAR SWITCH







where:

ET	Exchange termination
LT	Line termination
NT	Network termination
TA	Terminal adapter
TE	Terminal equipment

Figure 3–2 ISDN model: Interfaces and functional groupings.

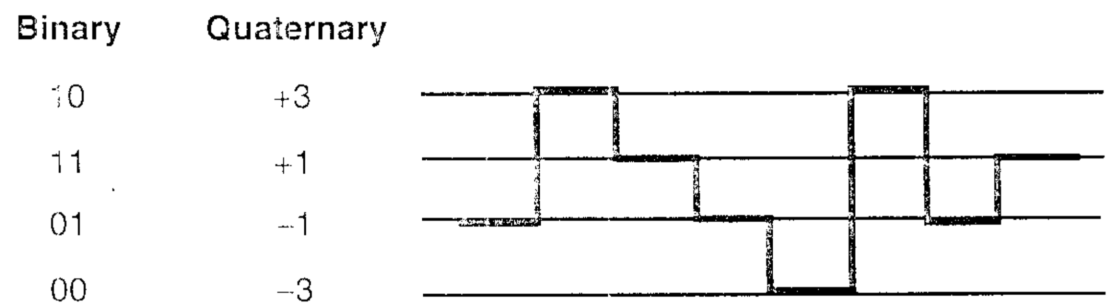
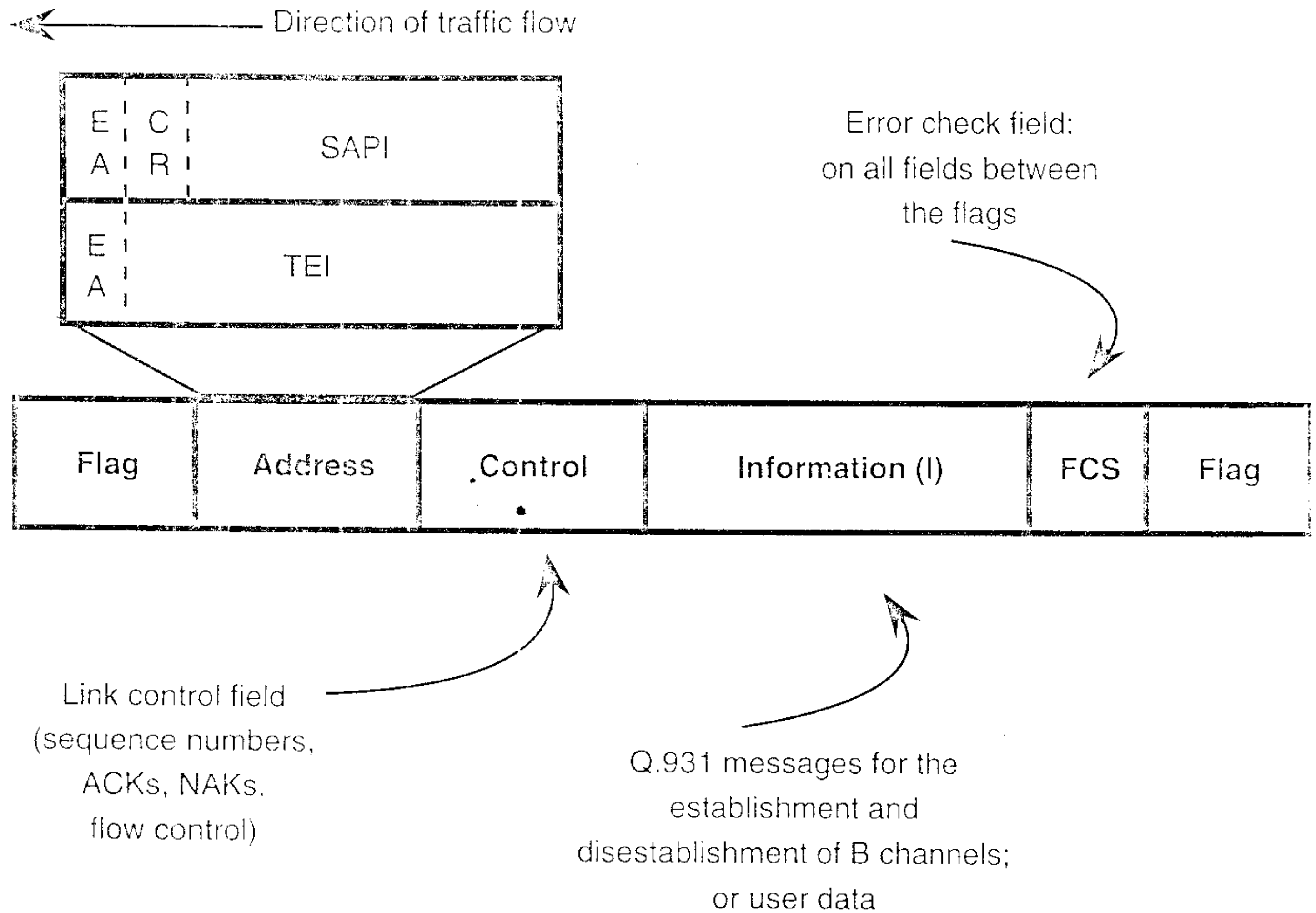


Figure 4–5 2B1Q line code.



where:

CR	Command/Response bit
EA	Extended address bits
FCS	Frame check sequence
SAPI	Service access point identifier
TEI	Terminal endpoint identifier

Figure 4–7 The LAPD frame.

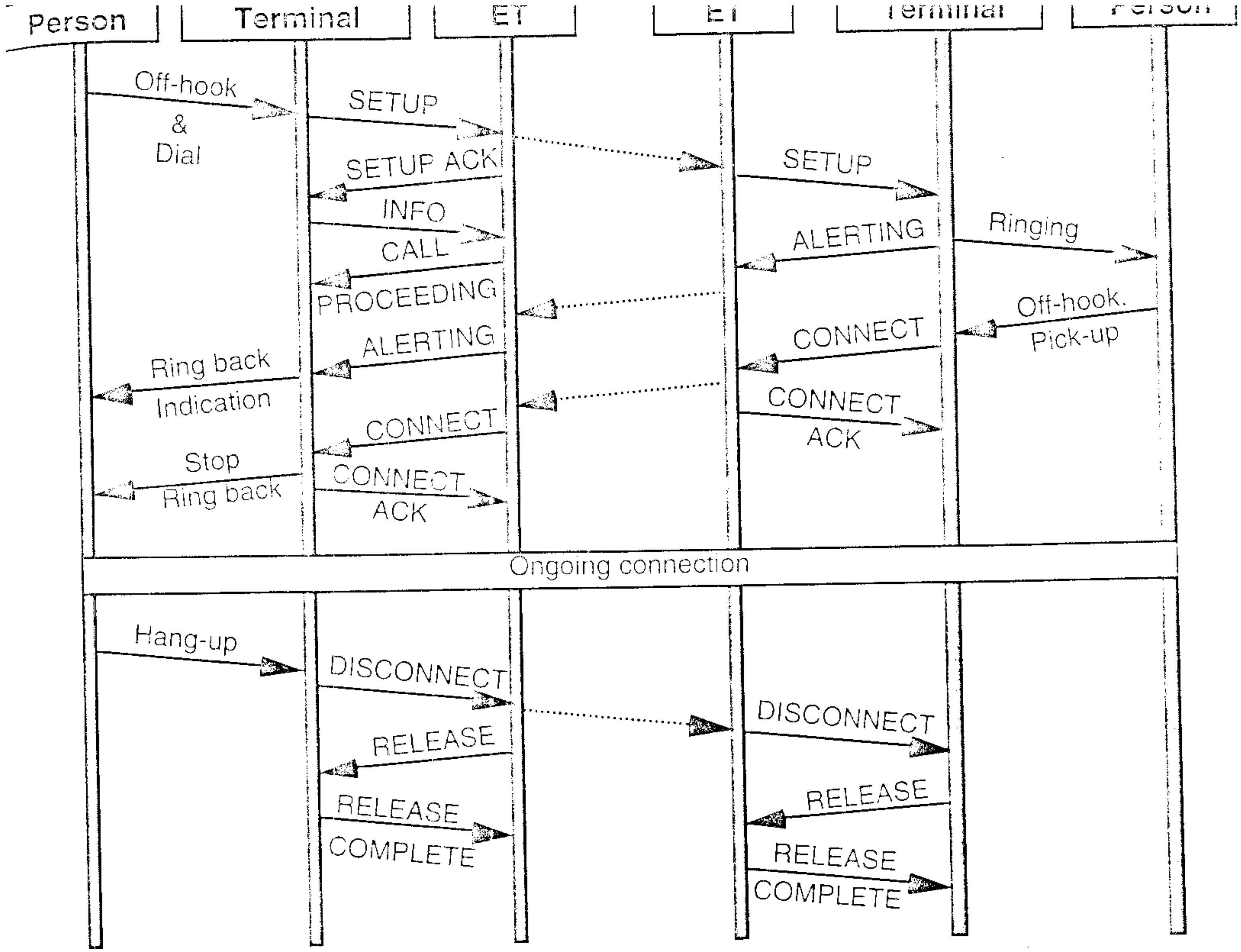
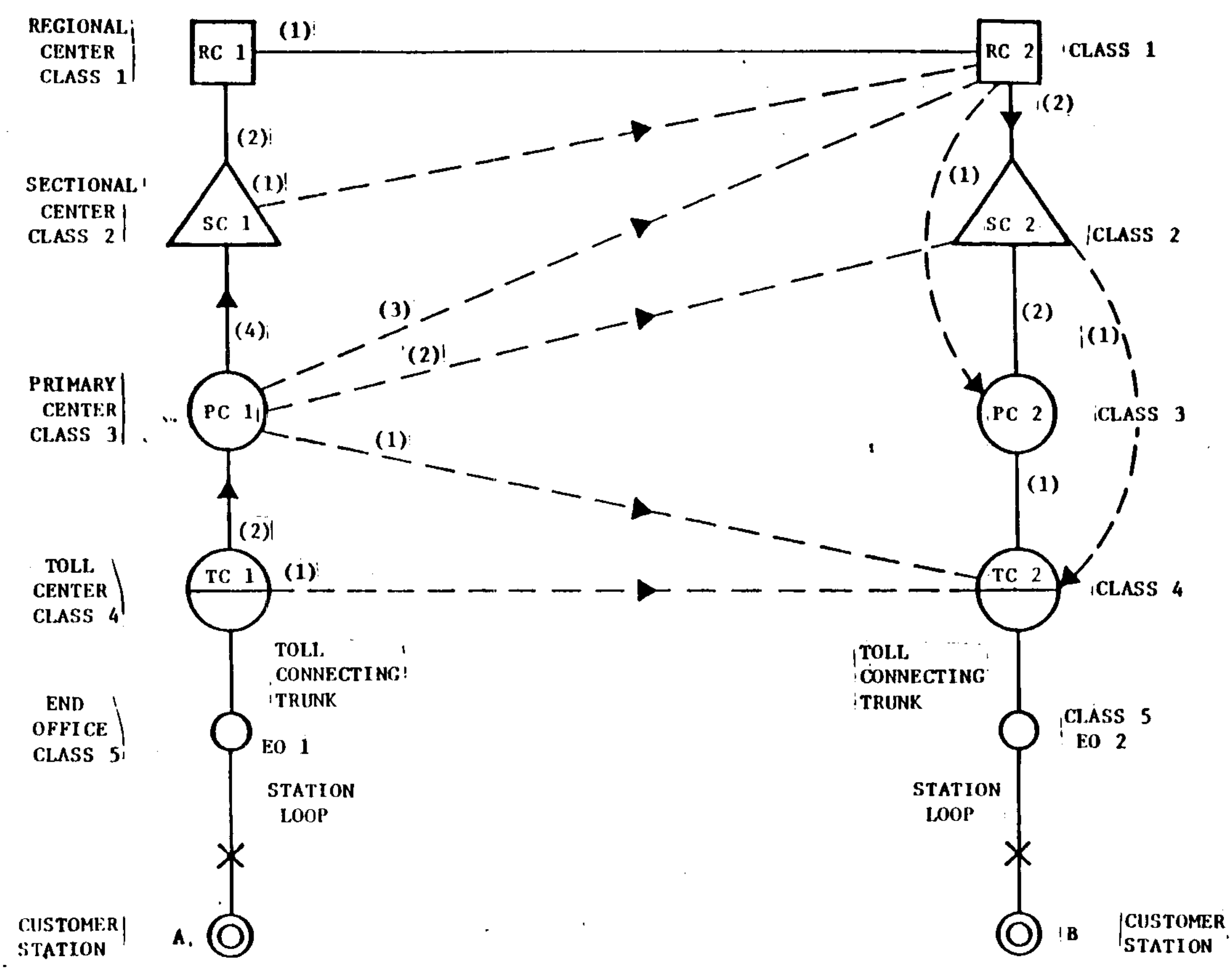


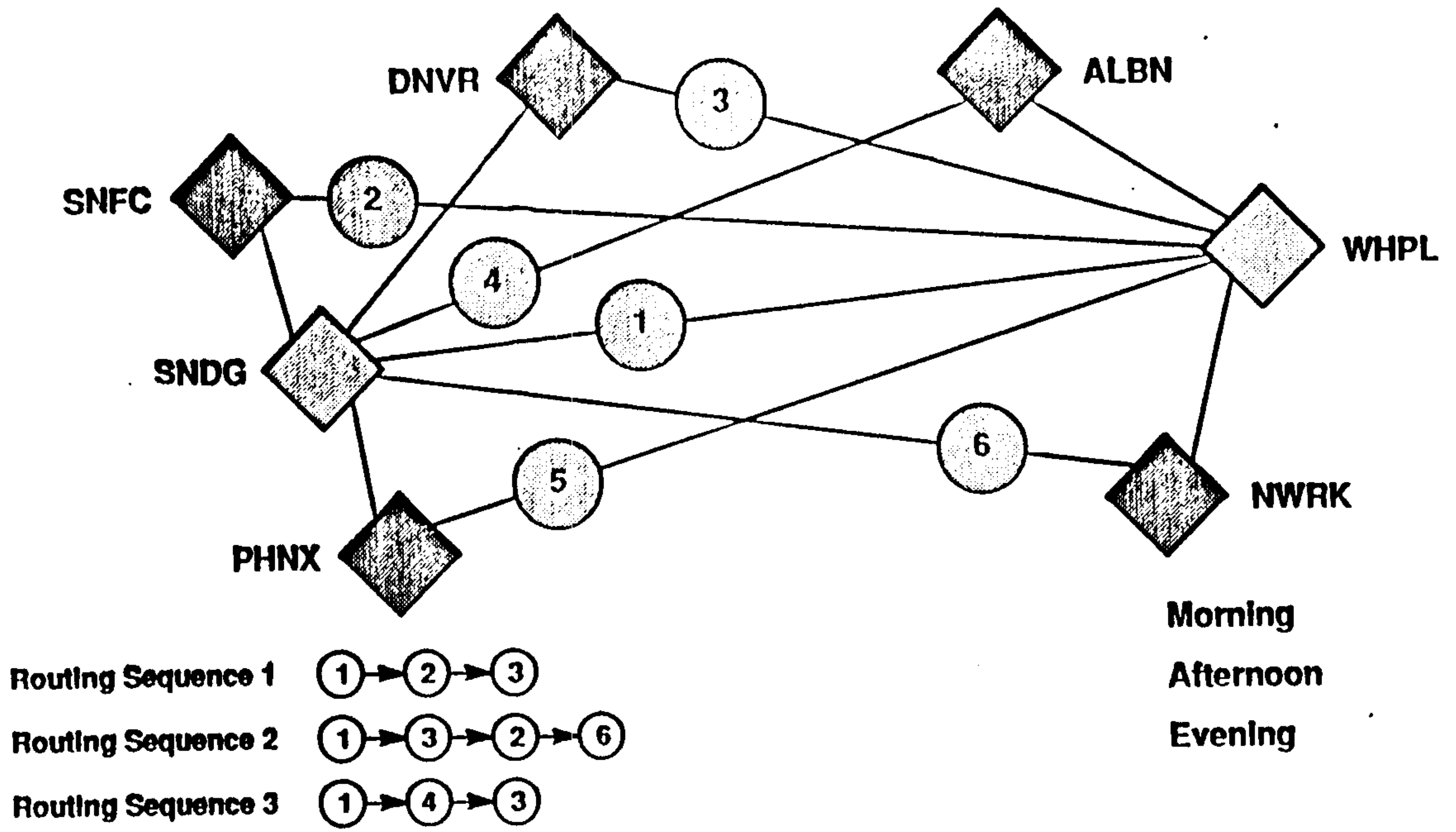
Figure 5–5 Example of an ISDN connection establishment and termination.

CHOICE OF ROUTES ON ASSUMED CALL



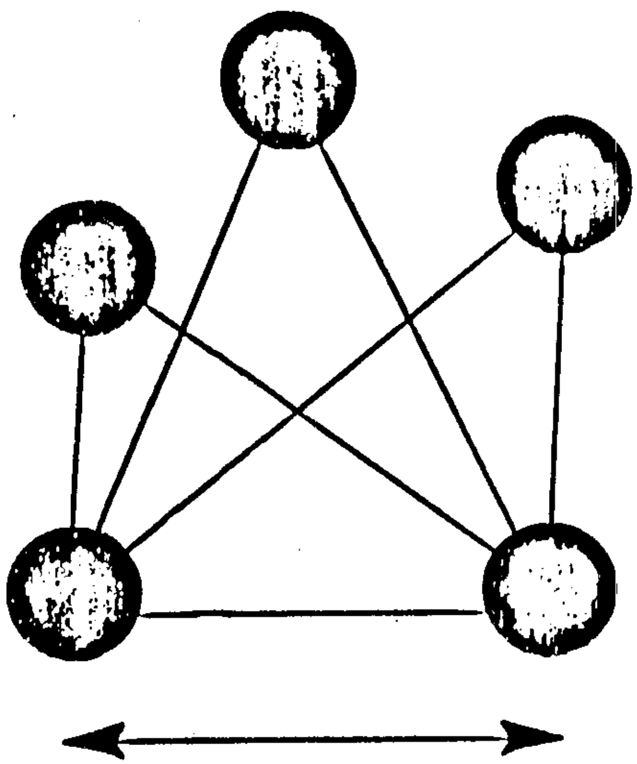
NUMBERS IN ( ) INDICATE ORDER OF CHOICE OF ROUTE AT EACH CENTER.

DYNAMIC NONHIERARCHICAL ROUTING



AT&T - Proprietary
Use pursuant to Company Instructions

REAL TIME NETWORK ROUTING



Idle Status Query

- Replaces DNHR
- Adaptive
  - No Preset Routing List
  - Route Chosen Based On Current Network Status
  - Automatically Responds To Failures And Overloads
- Simplifies 4ESS
  - Memory
  - Allows SAFER
- Reduces Network Admin Cost
  - "Self" Servicing
  - Uses All Available Capacity

AT&T - Proprietary
Use pursuant to Company Instructions

R90167a ab