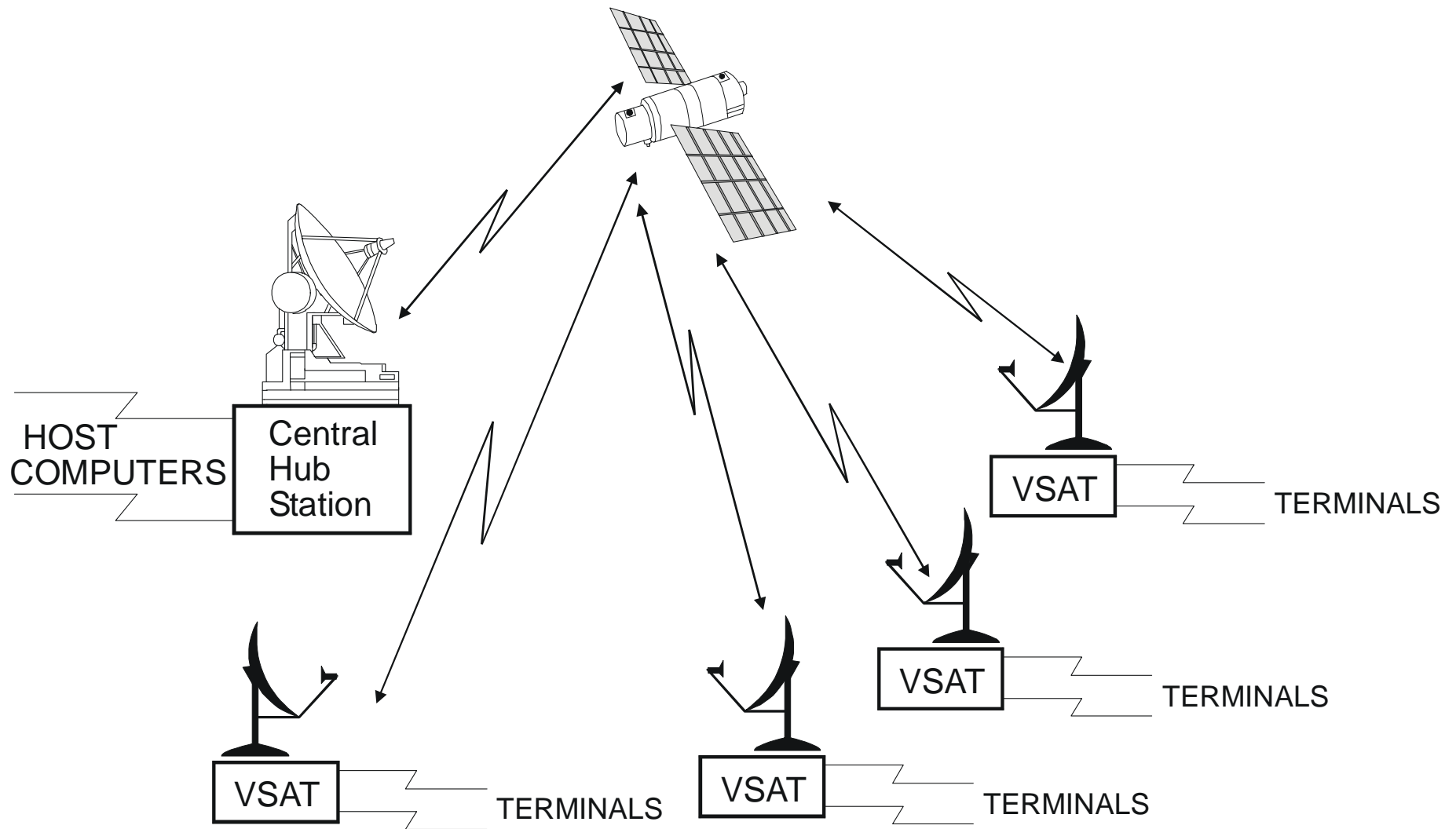
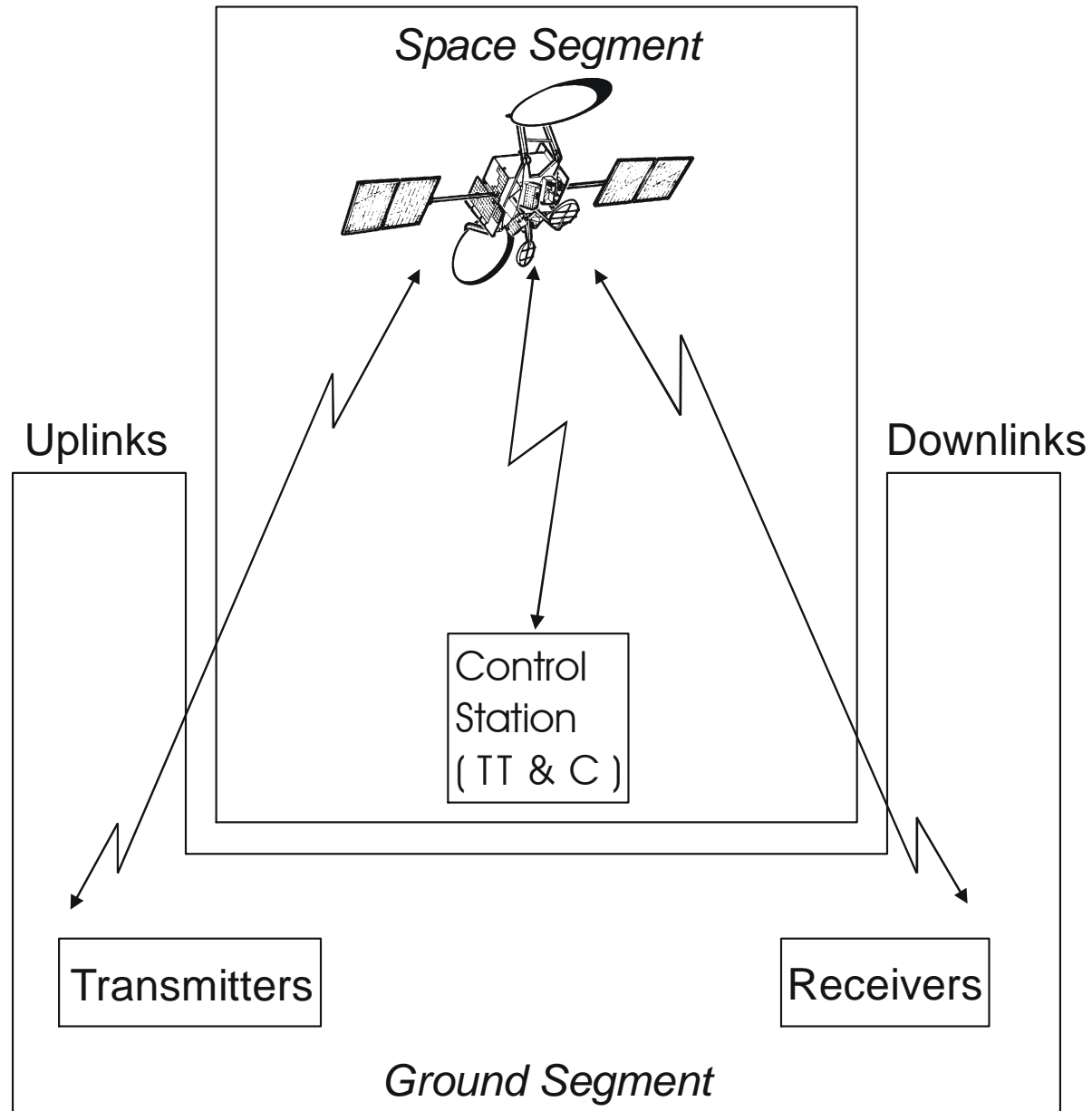


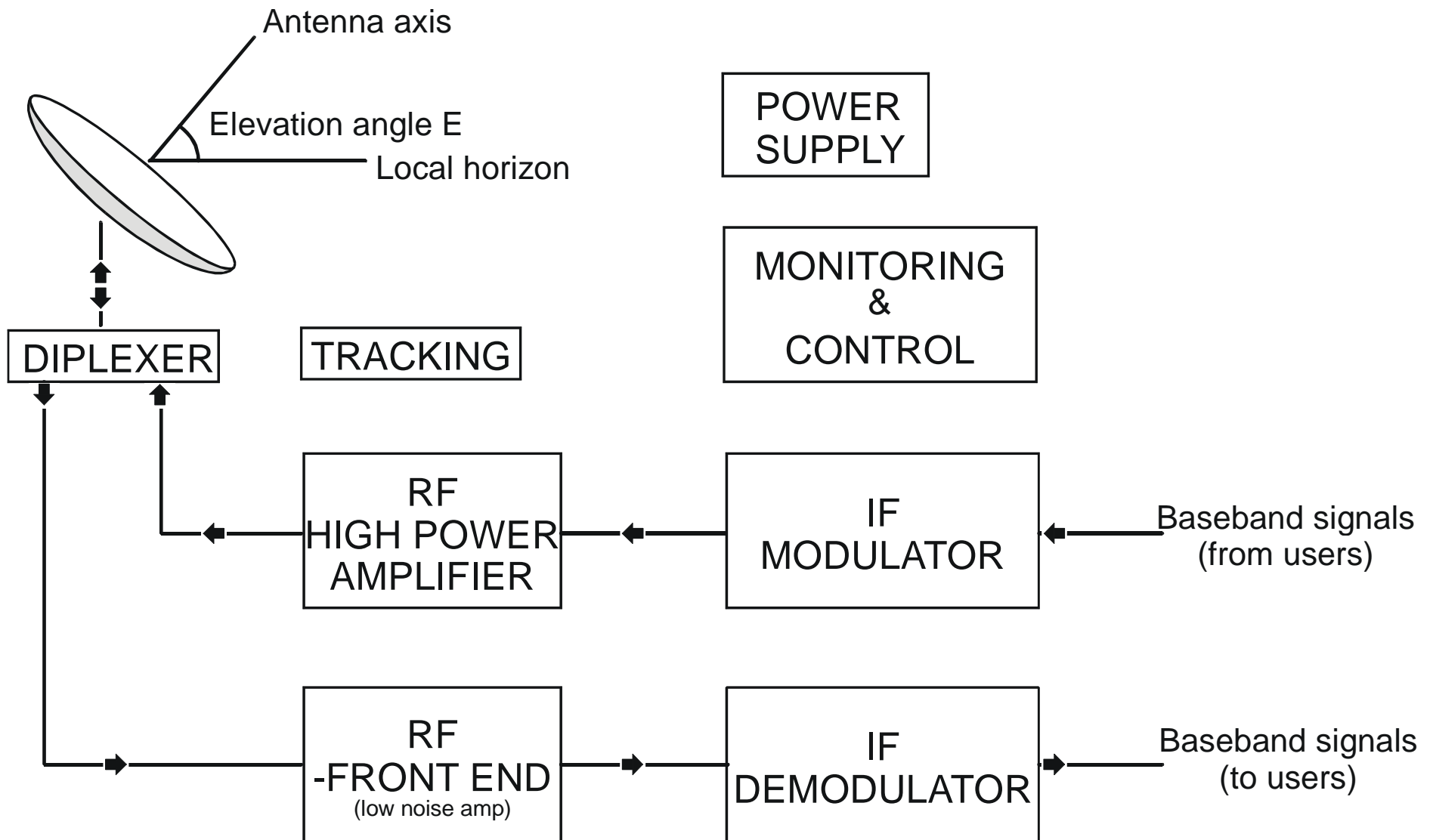
**Fig. 1-1:** Long distance communications



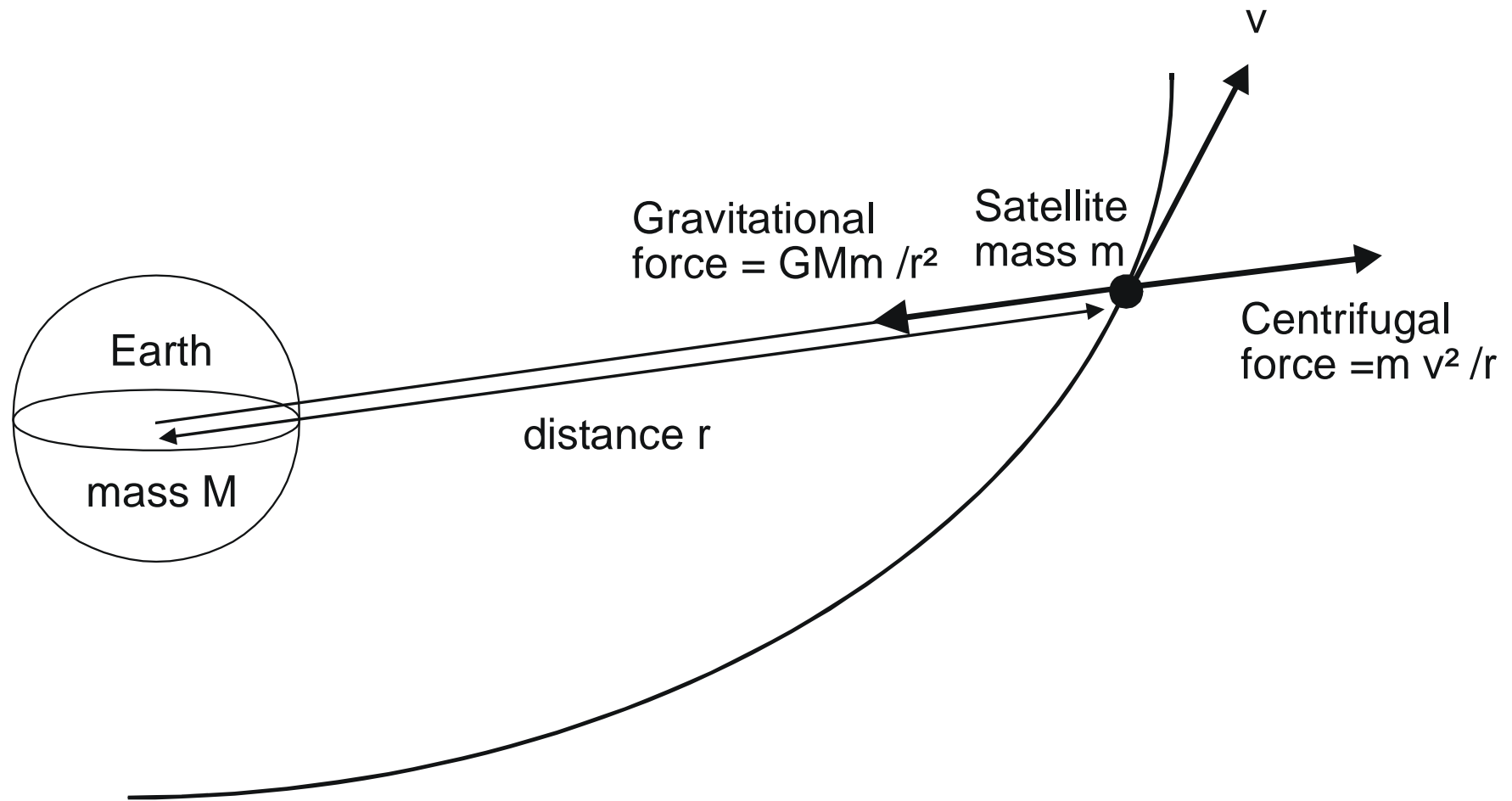
**Fig. 1-2: VSAT in an interactive two-way network**



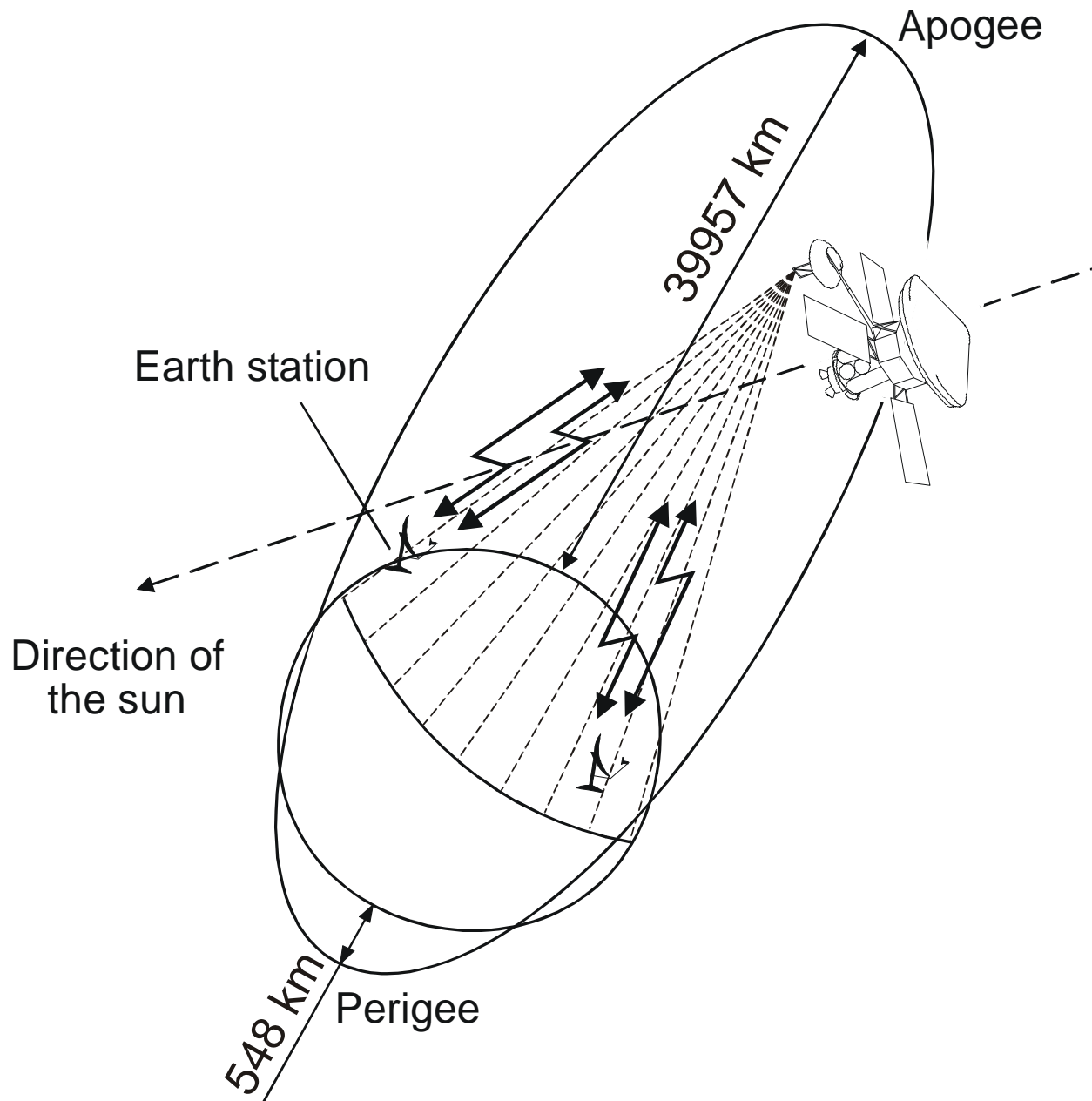
**Fig.1-3:** Main components of a SATCOM system



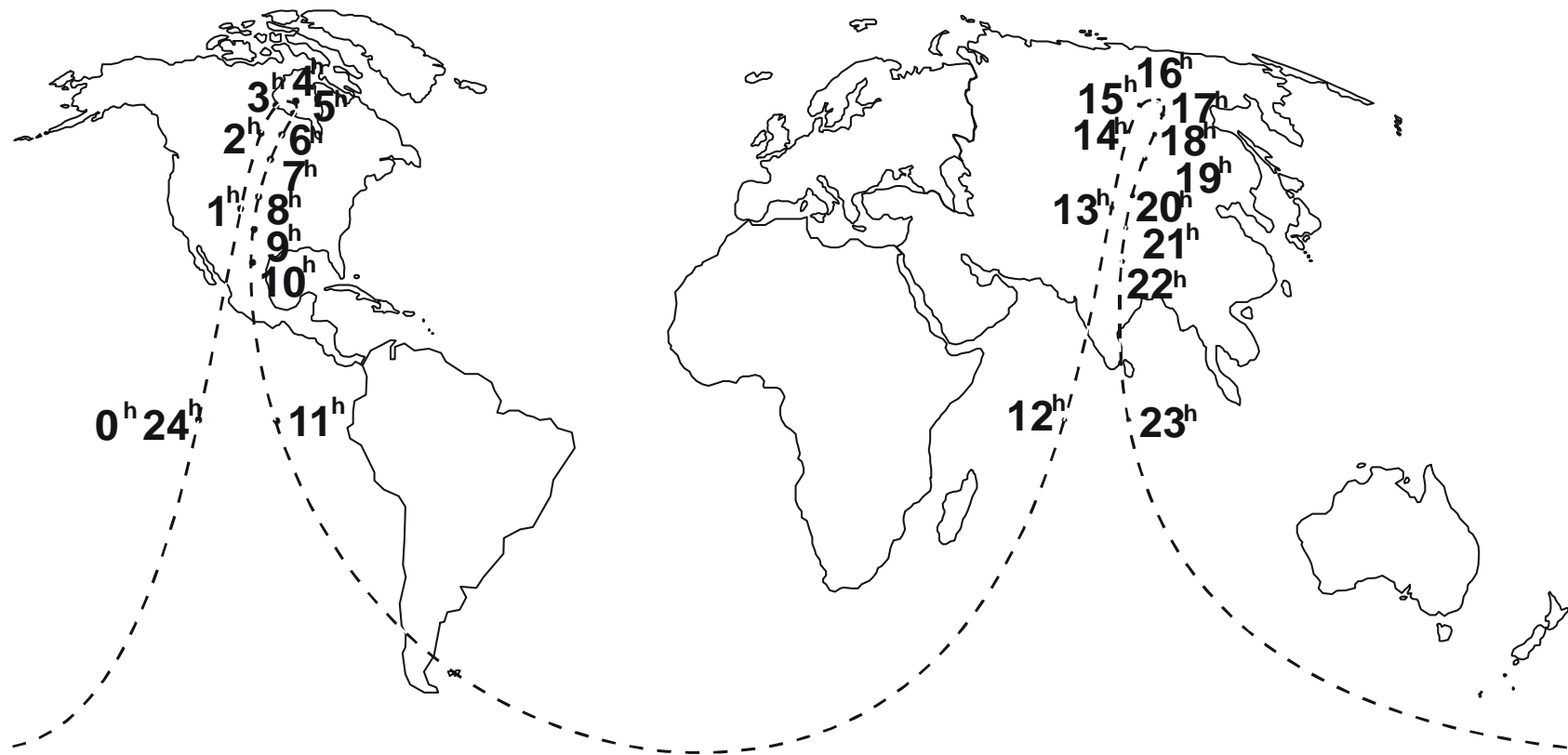
**Fig1-4:** Ground station architecture



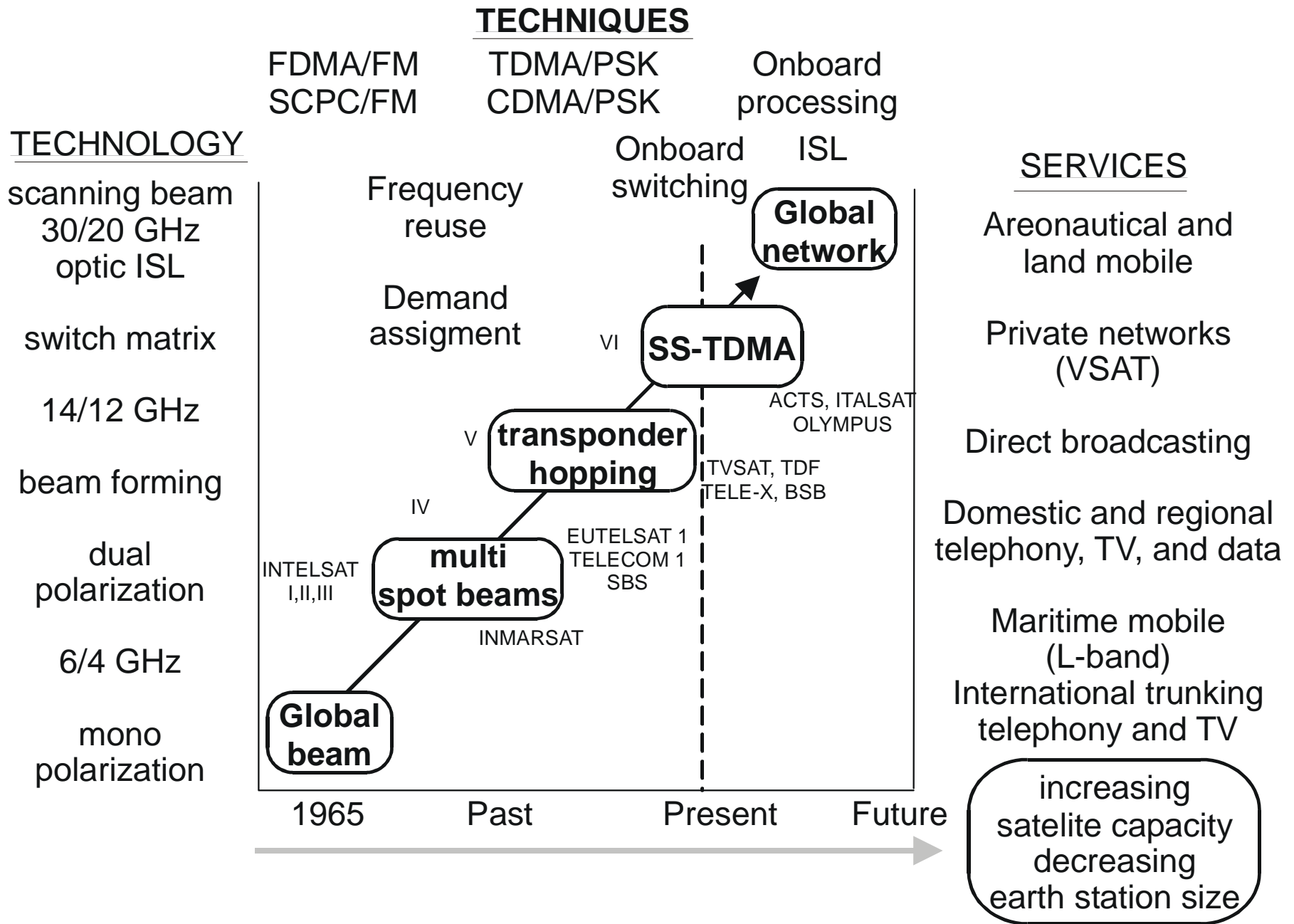
**Fig. 1-5:** Forces effecting a satellite



**Fig. 1-6:** Orbit of a MOLINYA satellite

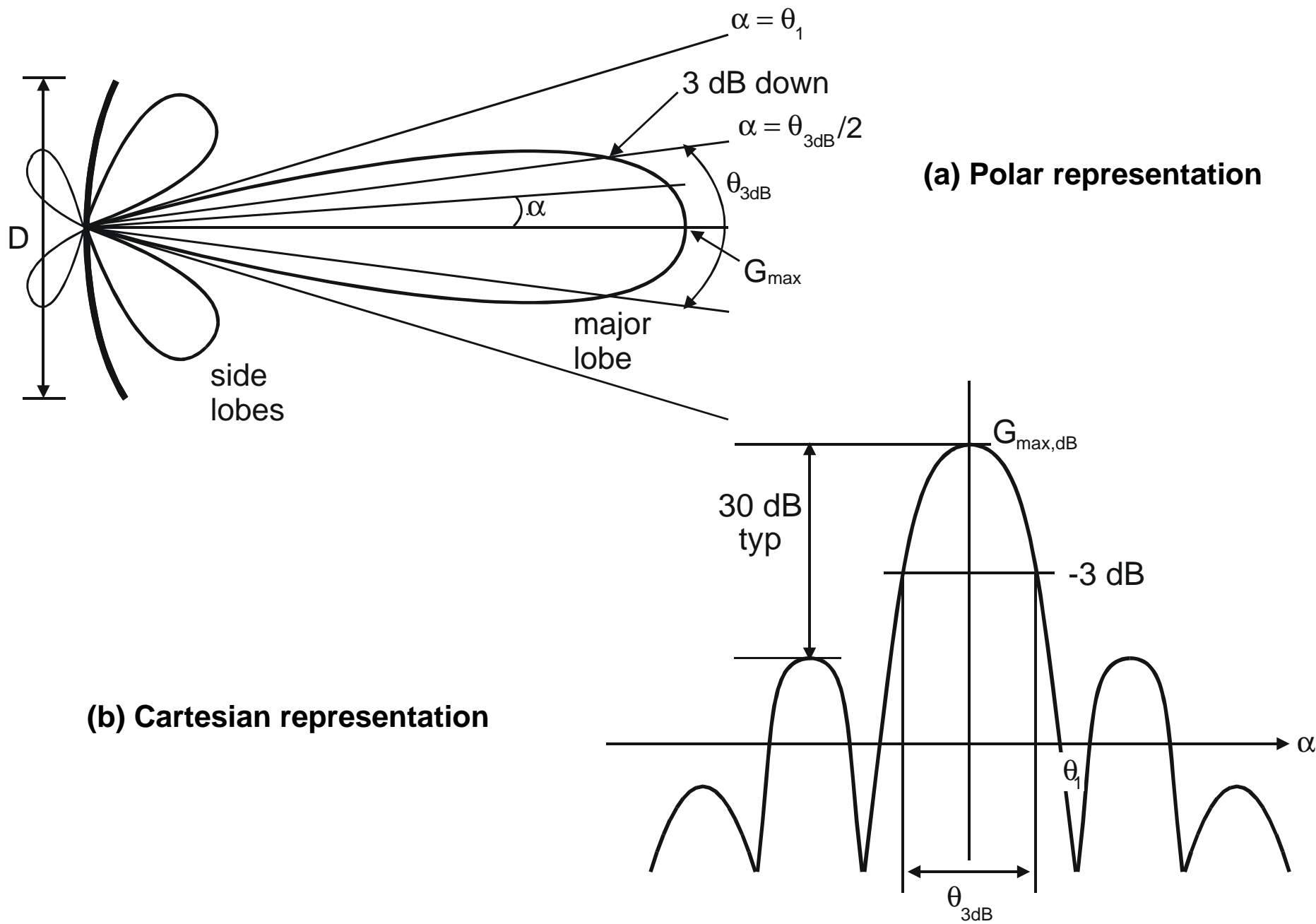


**Fig. 1-7:** Trace of a MOLINYA satellite on the earth's surface

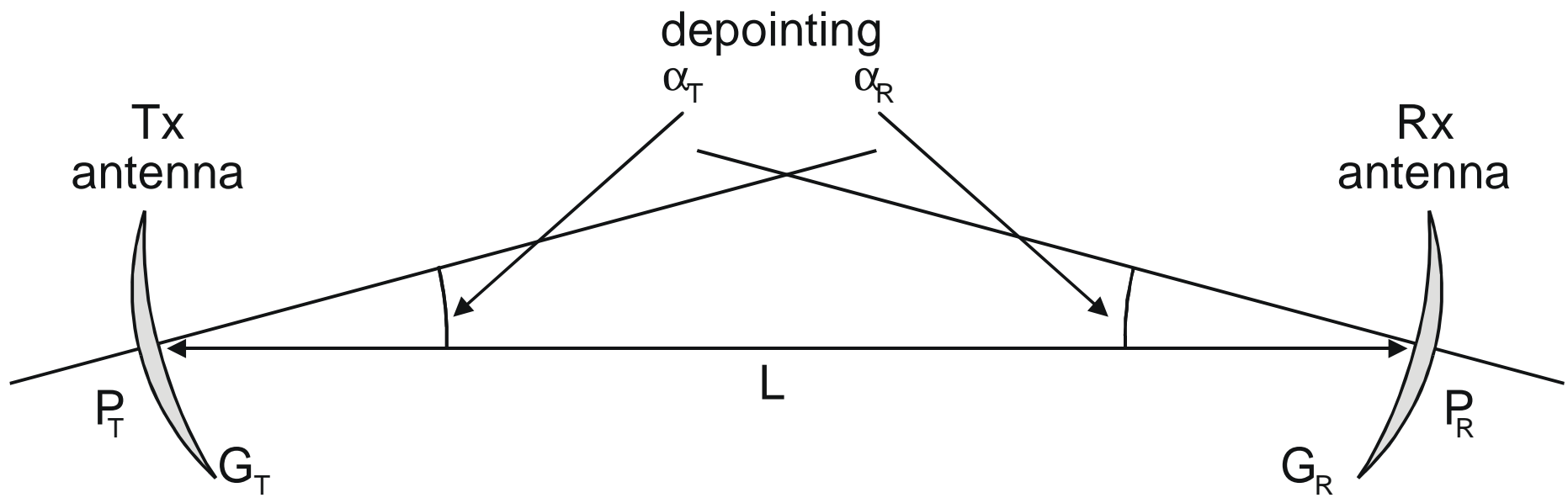


**Fig. 1-8: Development of SATCOM**

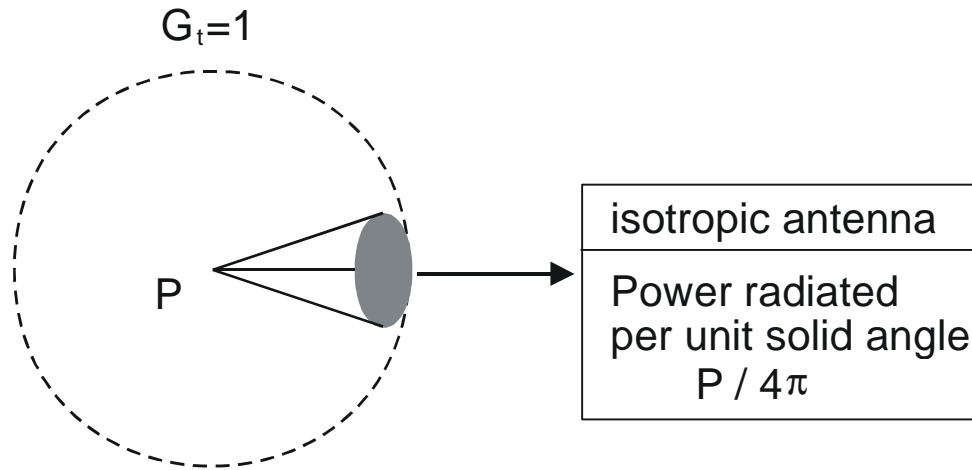




**Fig 2-1: Antenna radiation pattern**



**Fig. 2-2:** Antenna depointing error



(a) Isotropic antenna

(b) Actual antenna

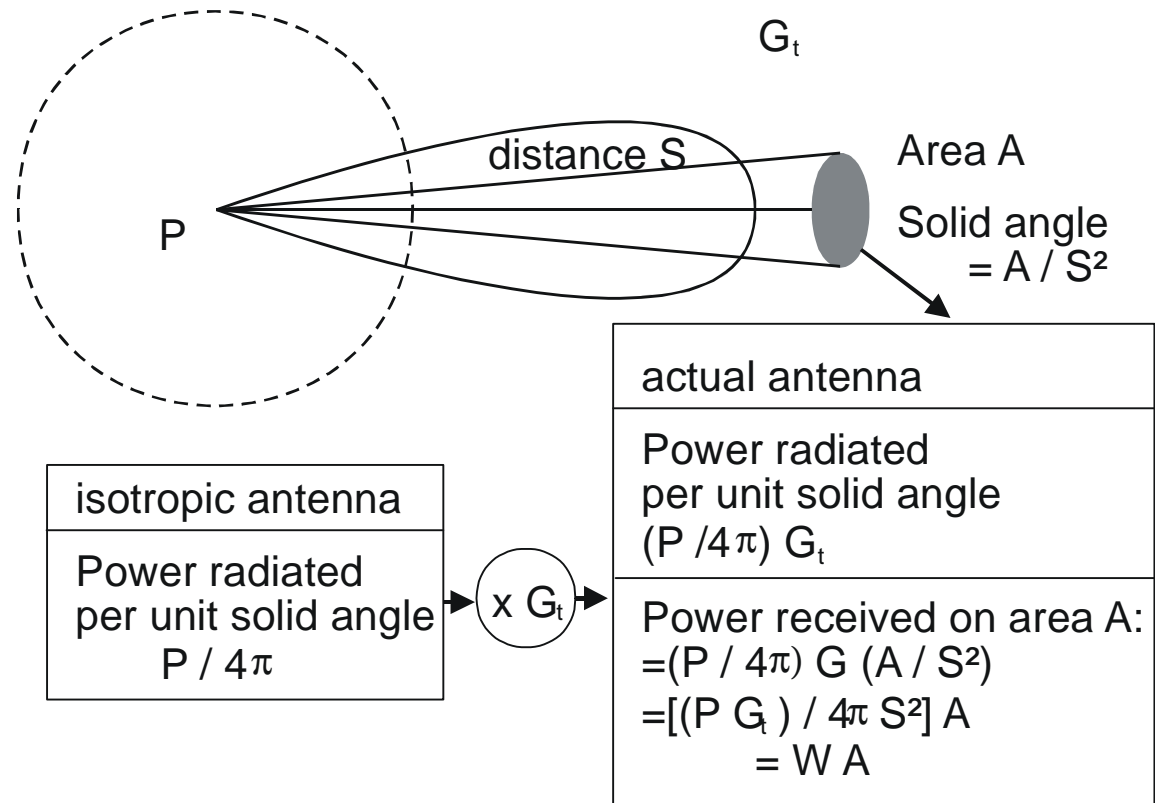
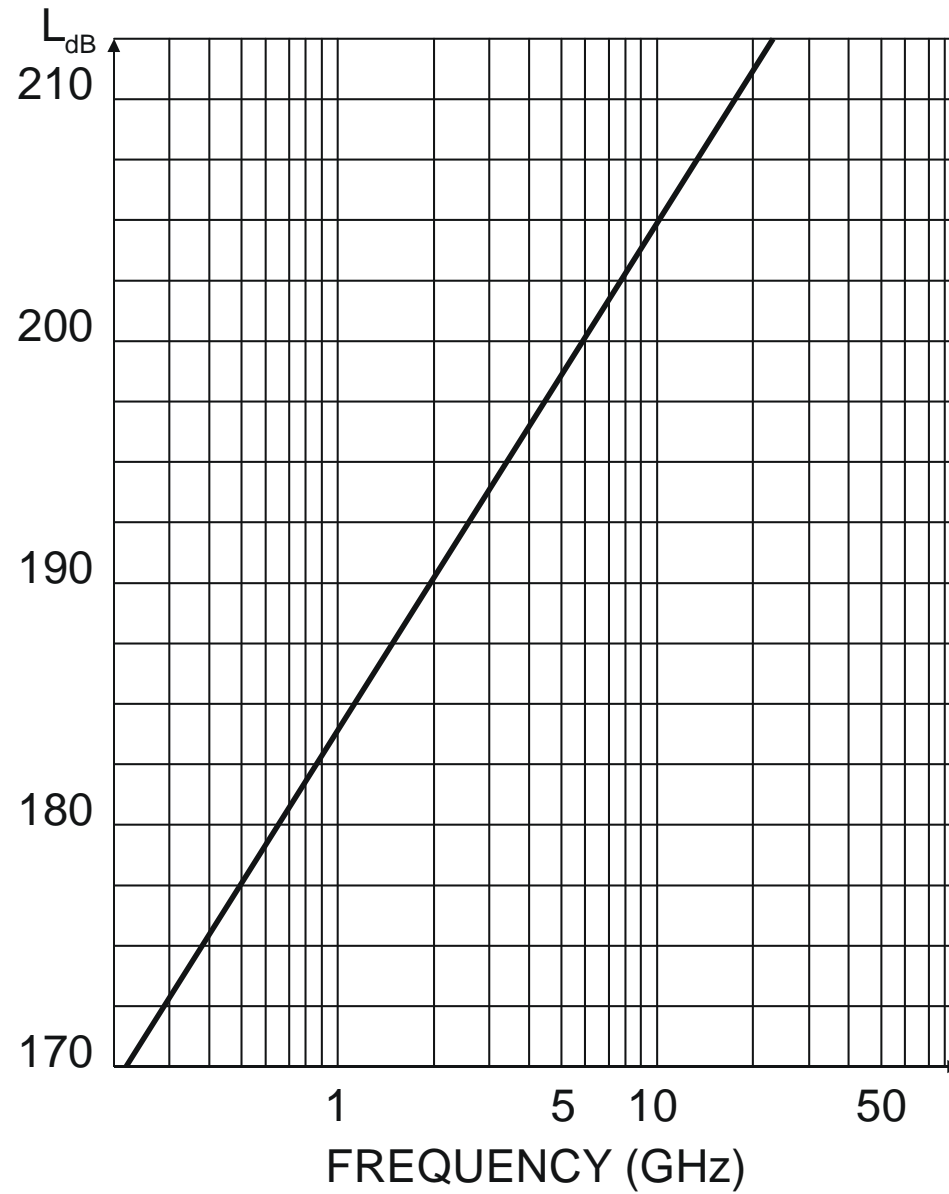
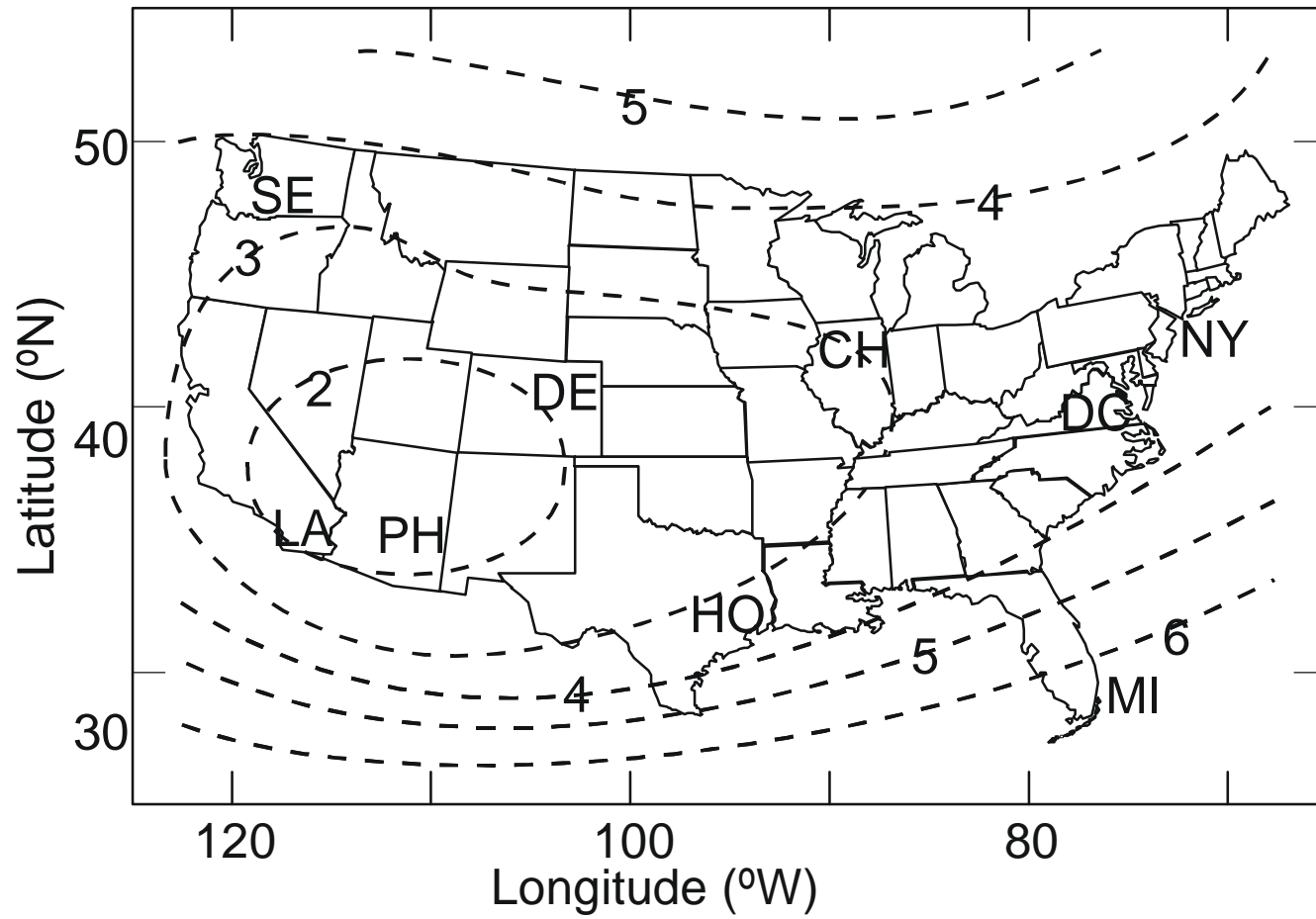


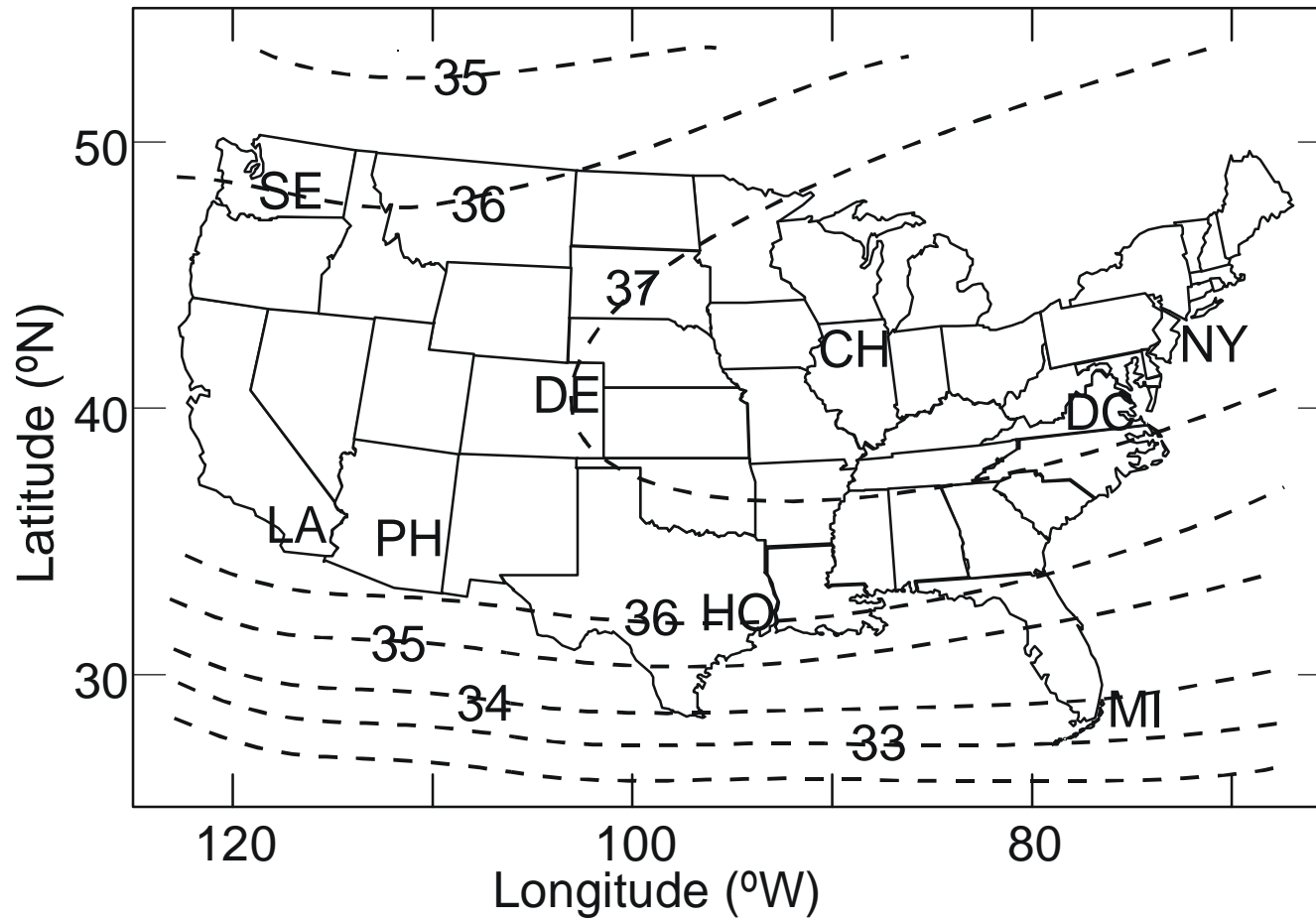
Fig. 2-3: Illumination level  $W$



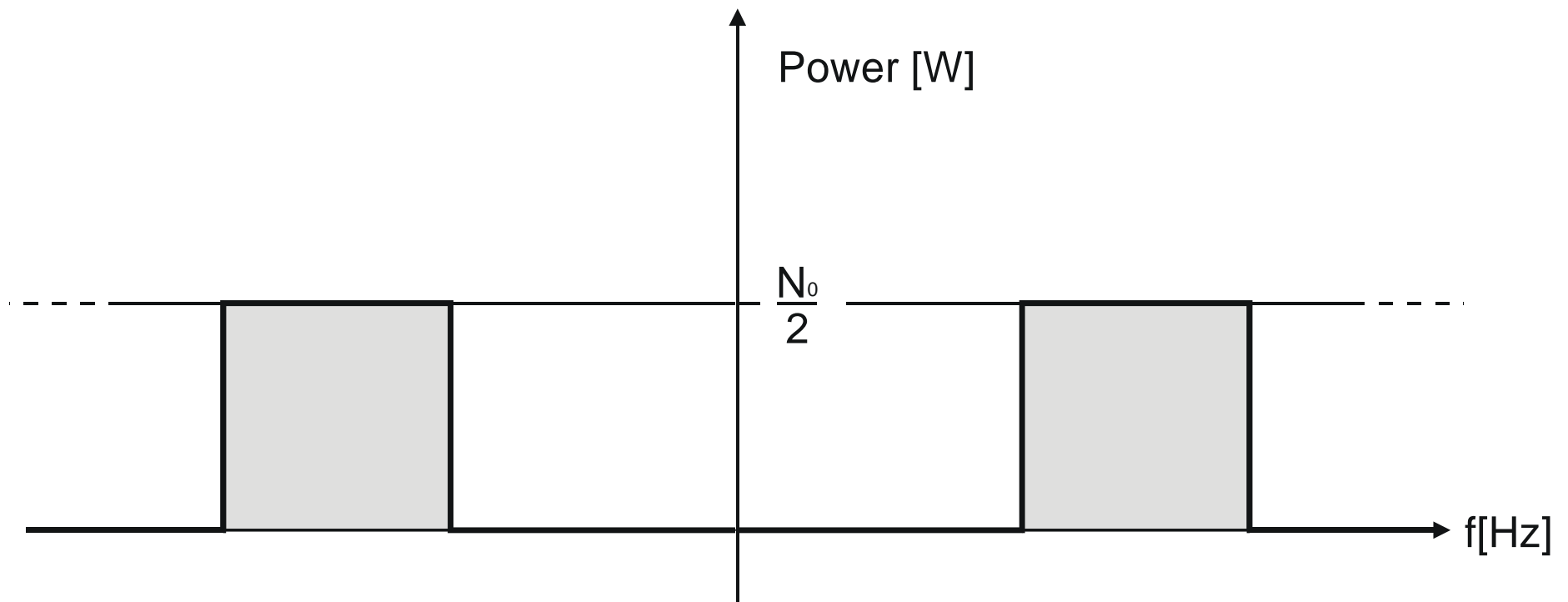
**Fig. 2-4:** Free space attenuation



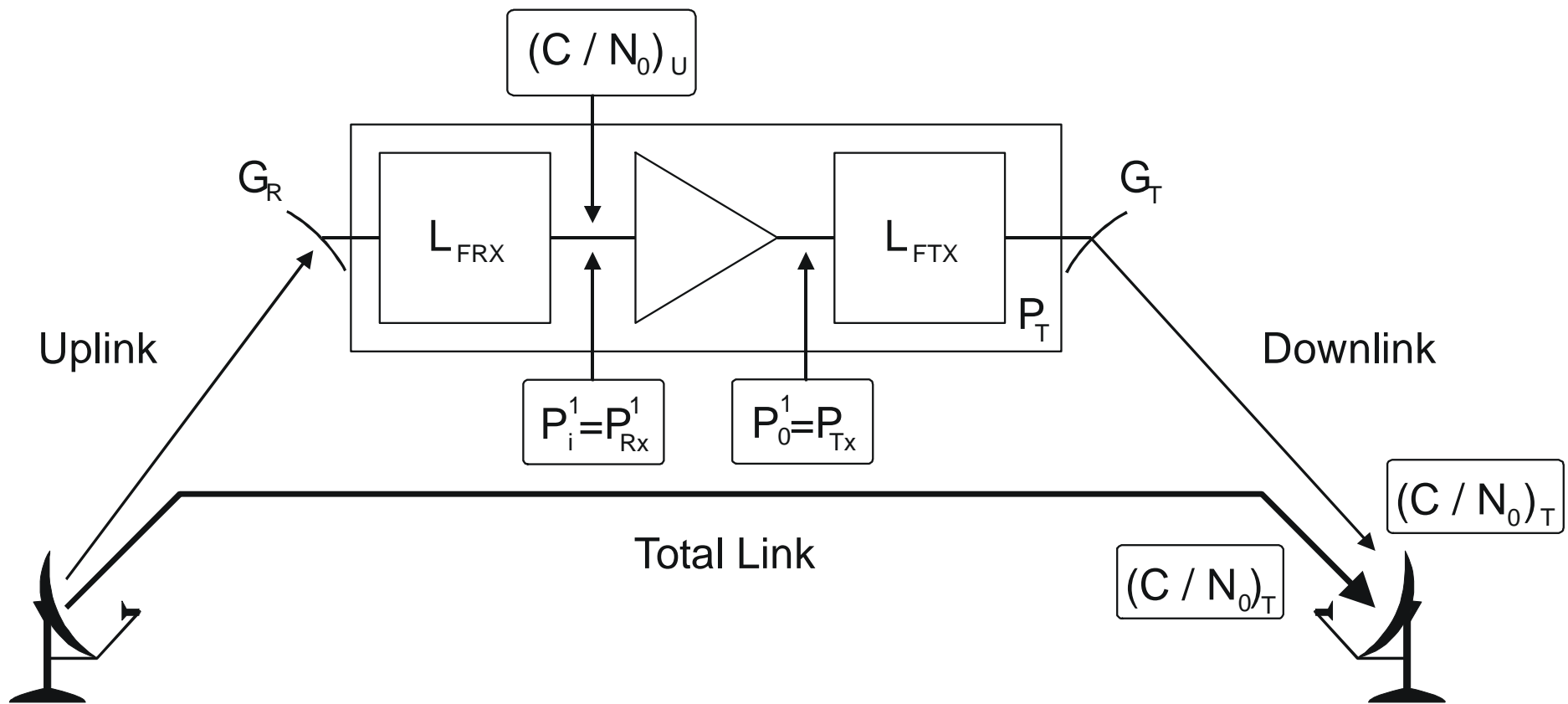
**Fig. 2-5:** Countour lines of  $G/T_s$  in dBi/K (uplink)



**Fig. 2-6:** Countour lines of EIRP in dBW (downlink)

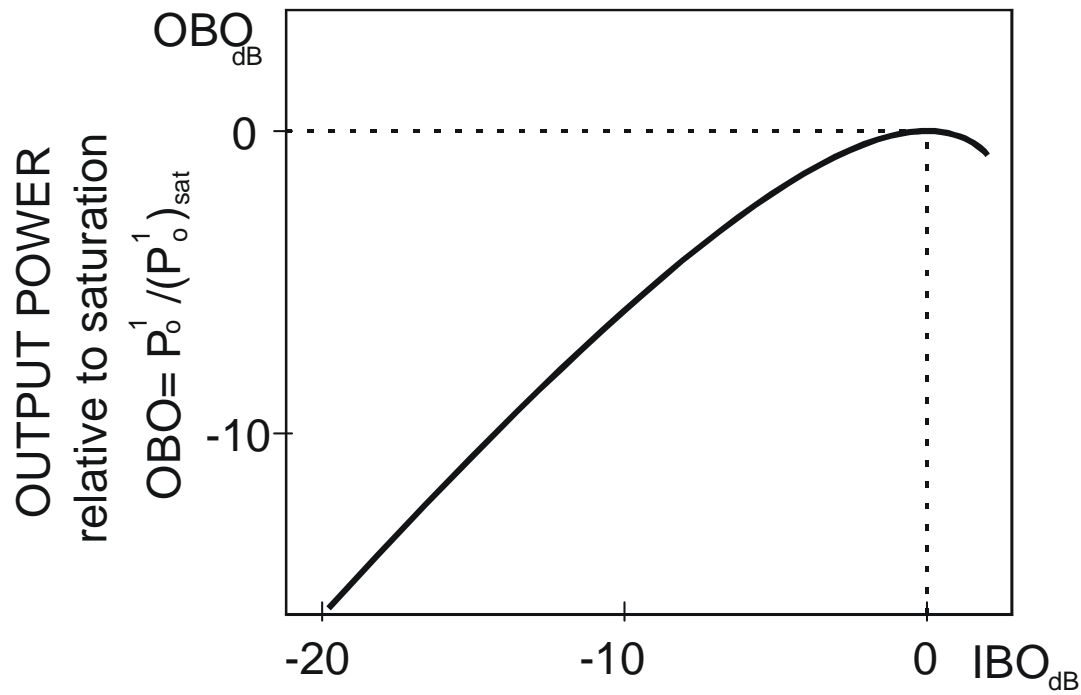


**Fig. 2-7:** Noise power passing through a receiver filter ( two-sided )



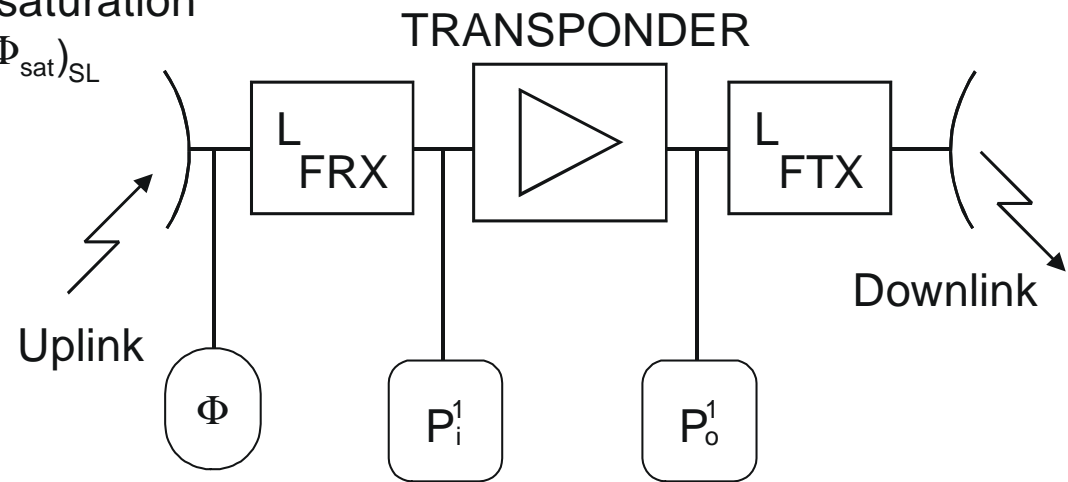
**Fig. 2-8:** Earth-satellite-earth link



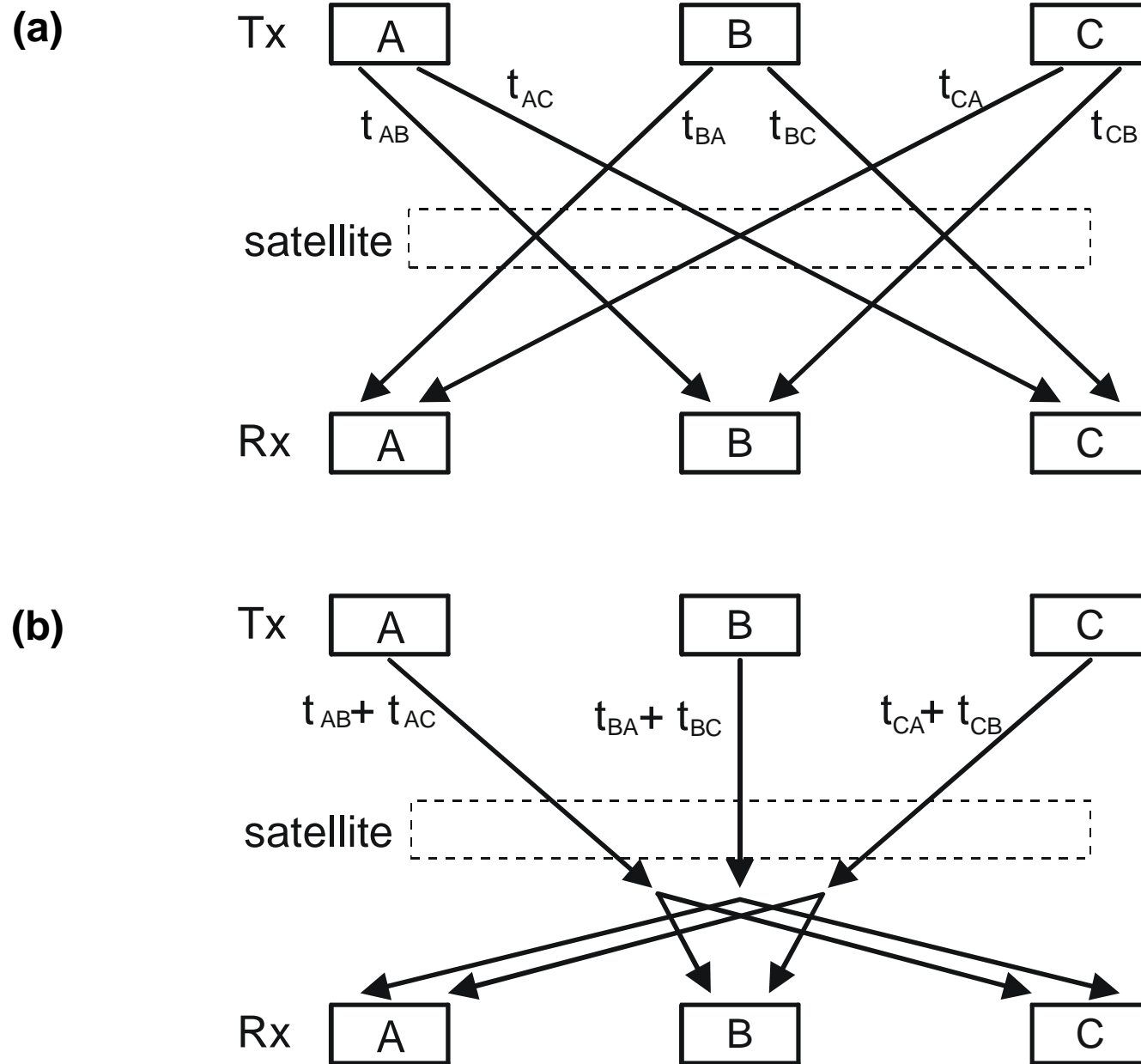


INPUT POWER relative to saturation

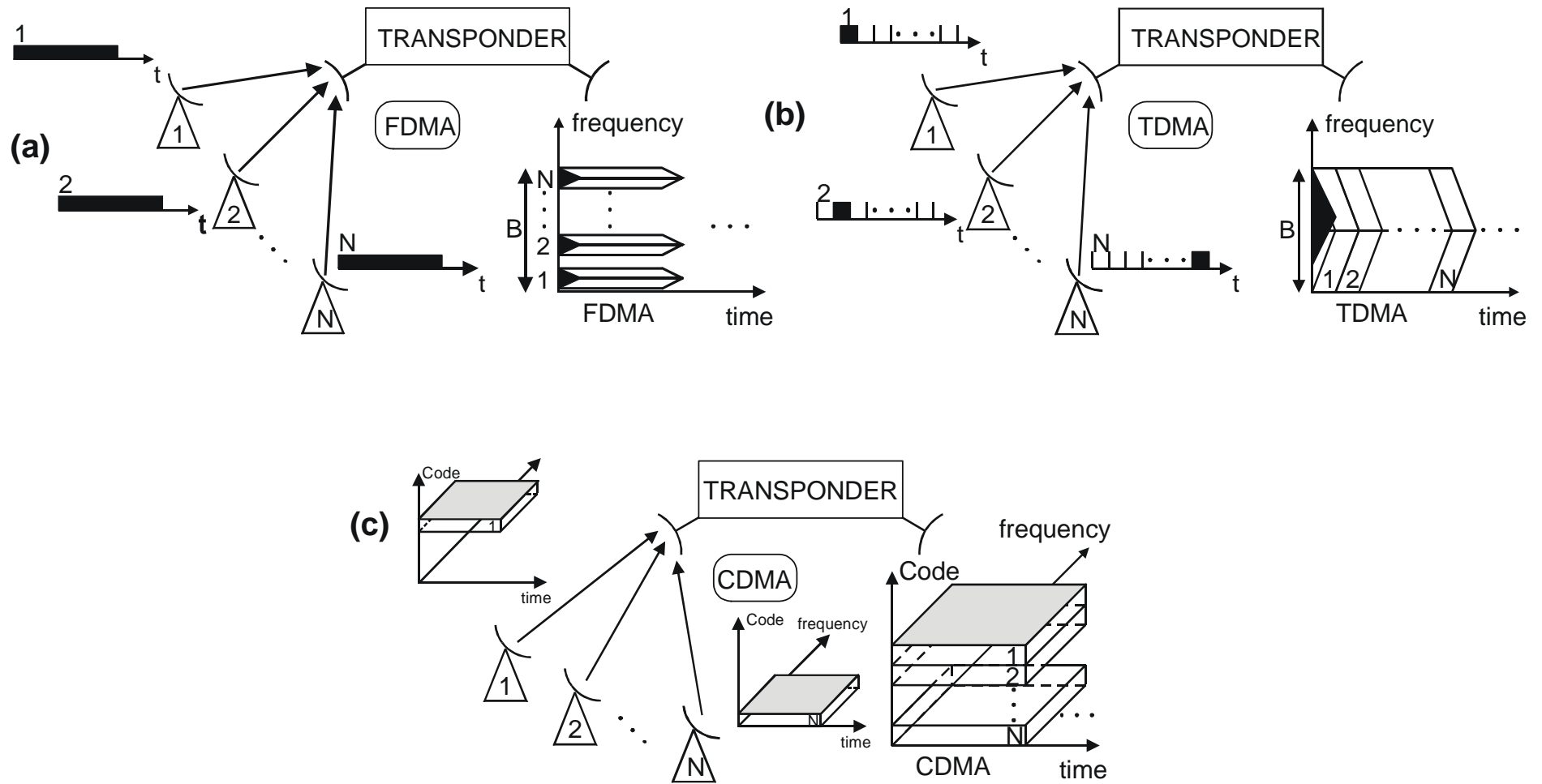
$$IBO = P_i^1 / (P_i^1)_{sat} = (\Phi)_{SL} / (\Phi_{sat})_{SL}$$



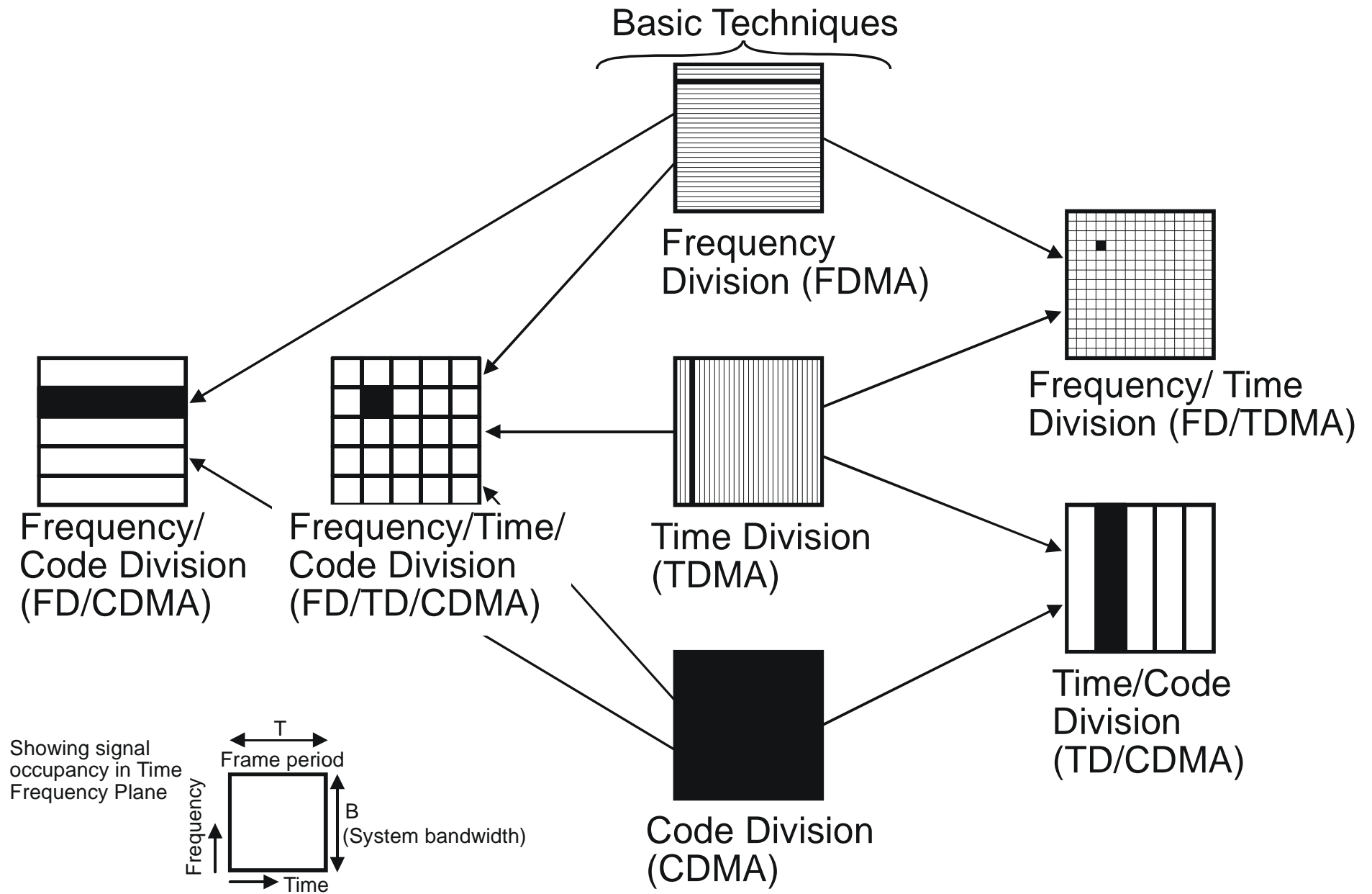
**Fig.2-9:** Power transfer characteristic of a satellite transponder (single carrier operation)



**Fig. 3-1:** Routing (a) One carrier per link (b) One carrier per station

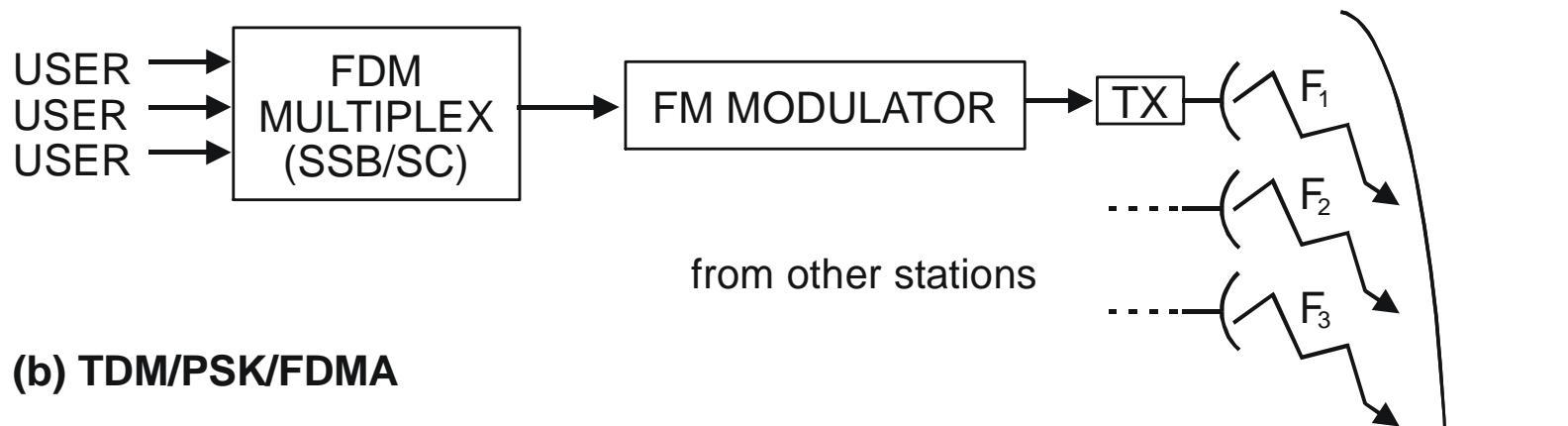


**Fig. 3-2: Multiple Access (a) FDMA (b) TDMA (c) CDMA**

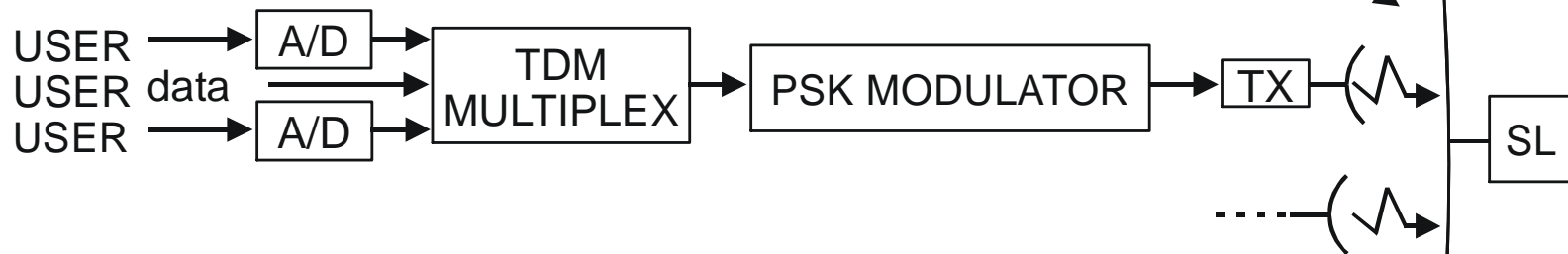


**Fig. 3-3:** Types of multiple access over the time-frequency plane

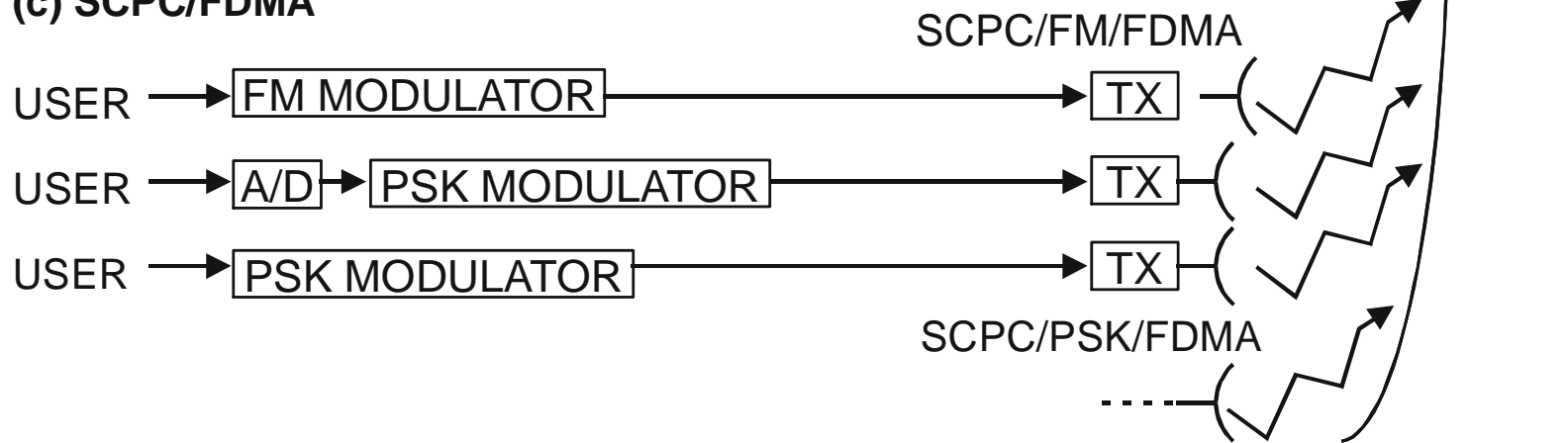
**(a) FDM/FM/FDMA**



**(b) TDM/PSK/FDMA**

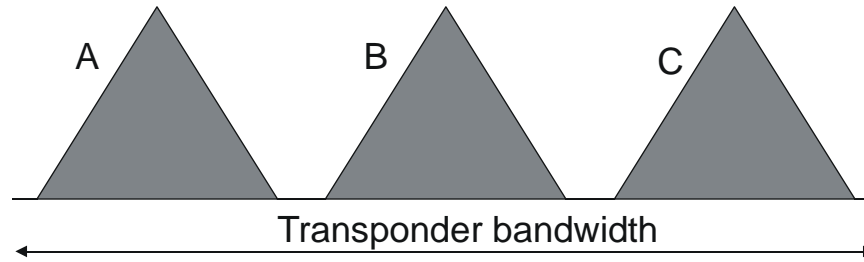


**(c) SCPC/FDMA**

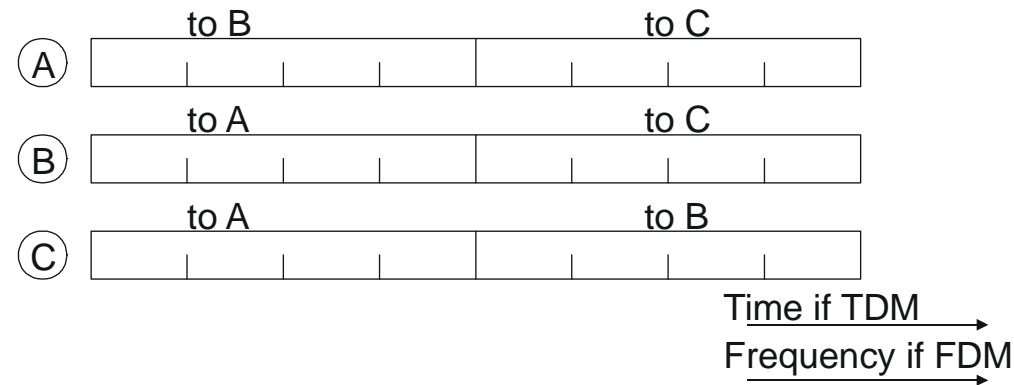


**Fig.3-4: FDMA transmission schemes**

(a) Transmitted carriers



(b) Baseband signal multiplex (FDM or TDM)



(c) Earth station A block diagramm

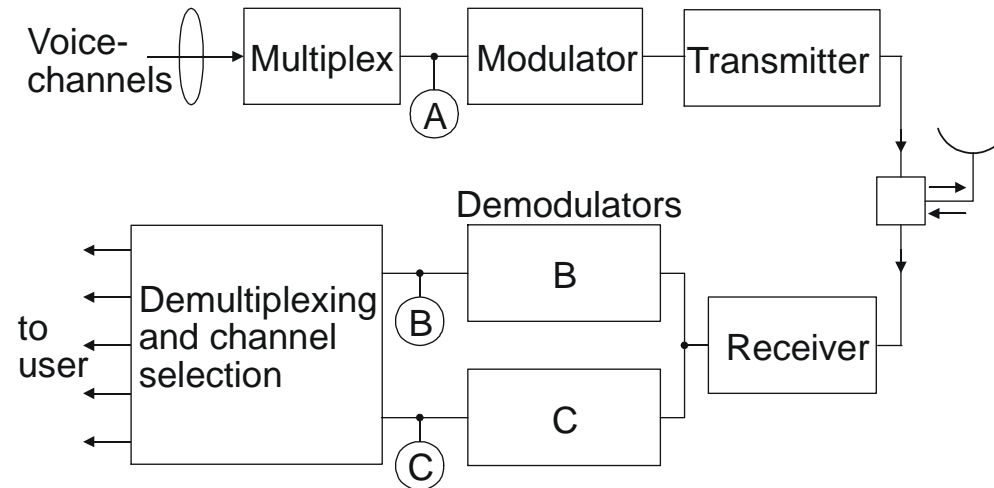
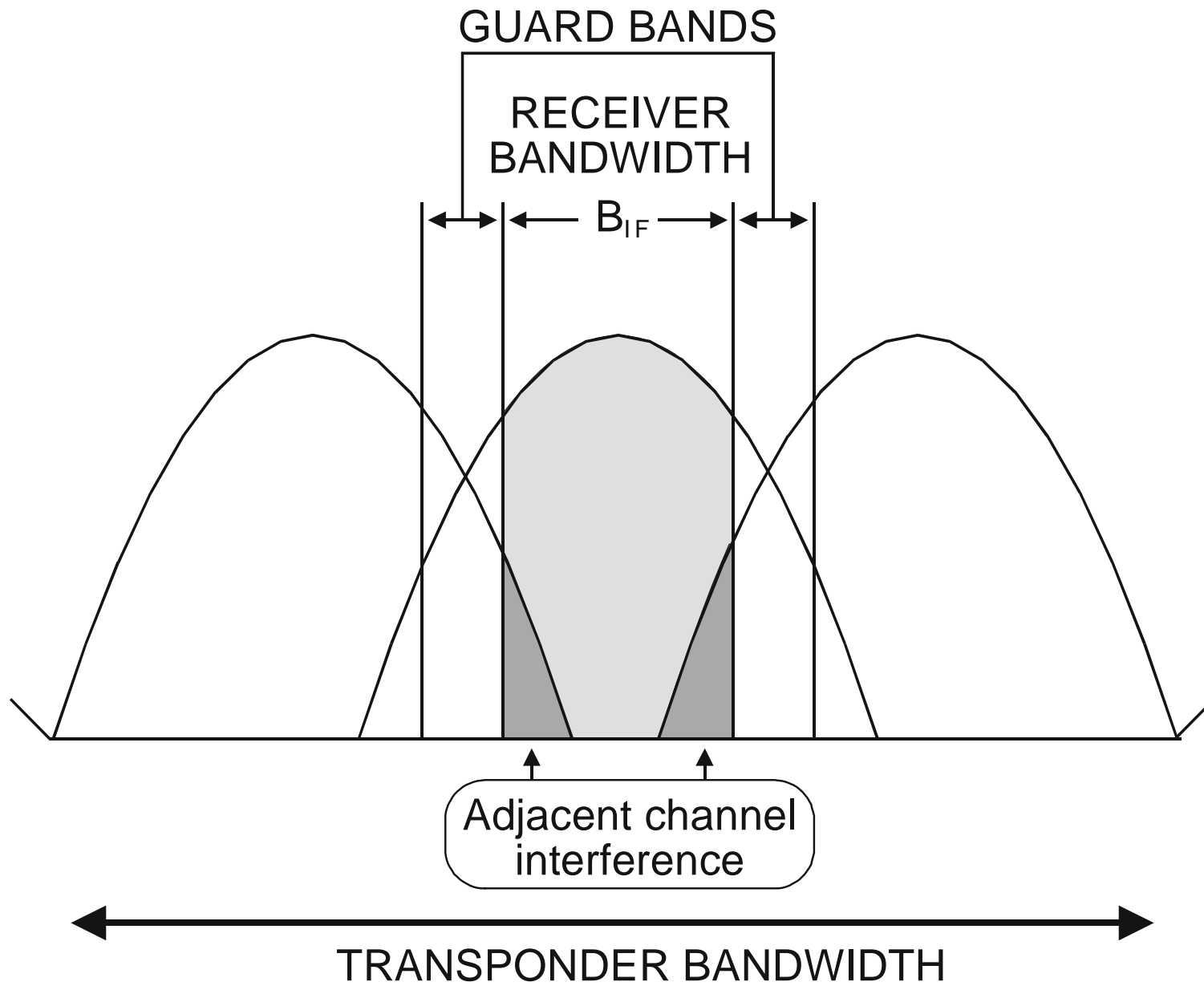
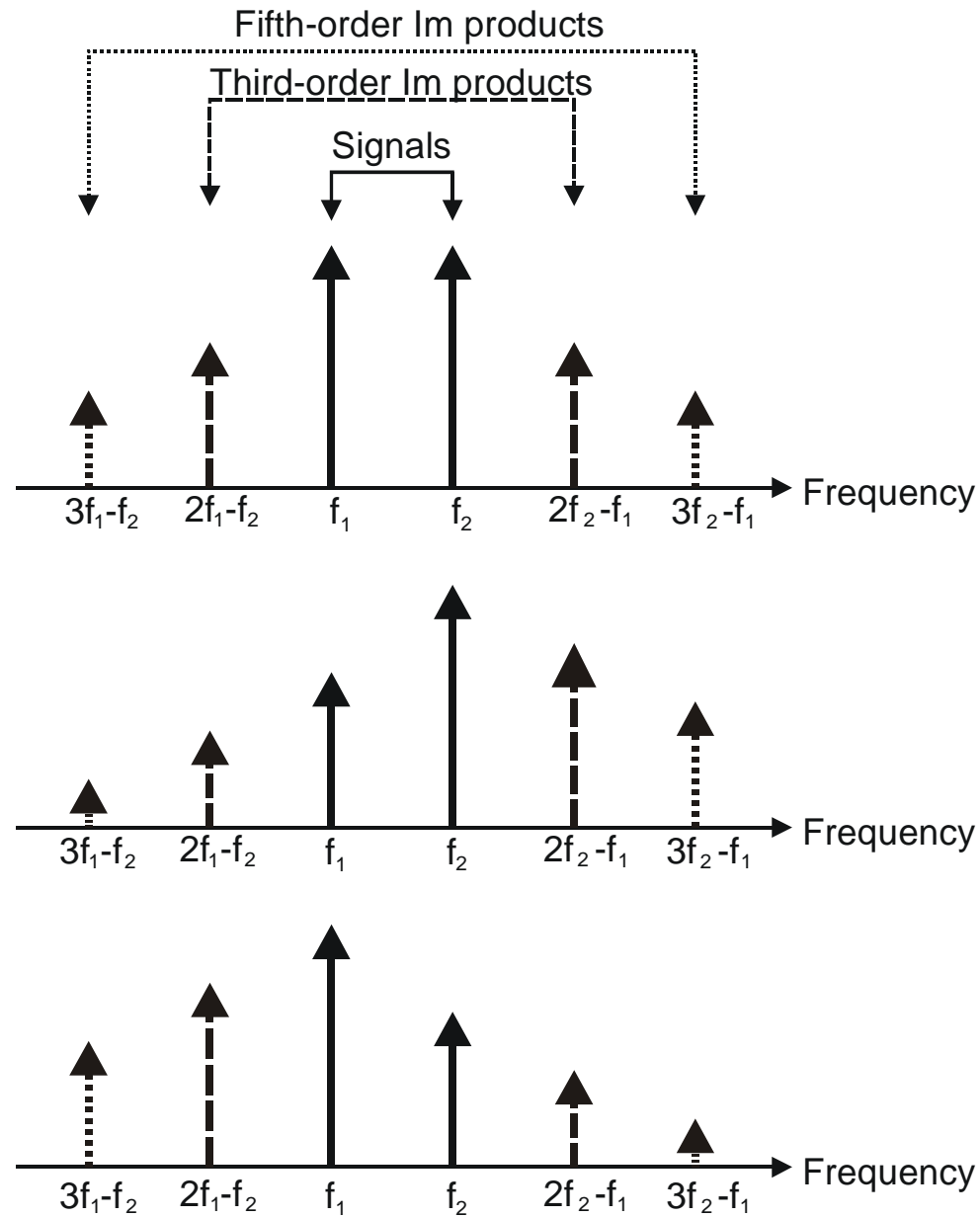


Fig. 3-5: FDMA with „one carrier station“ for three stations

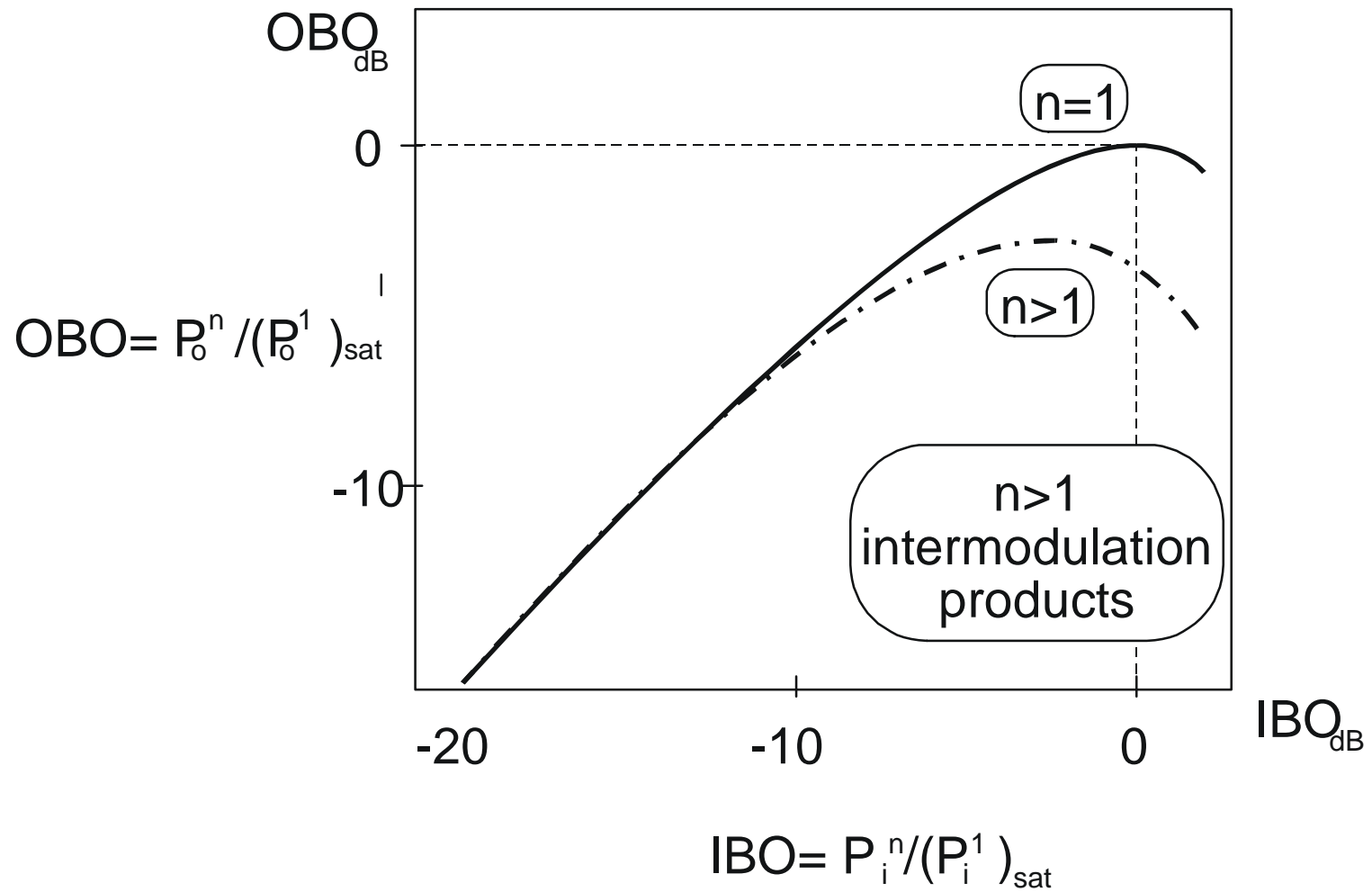


**Fig. 3-6:** Adjacent channel interference

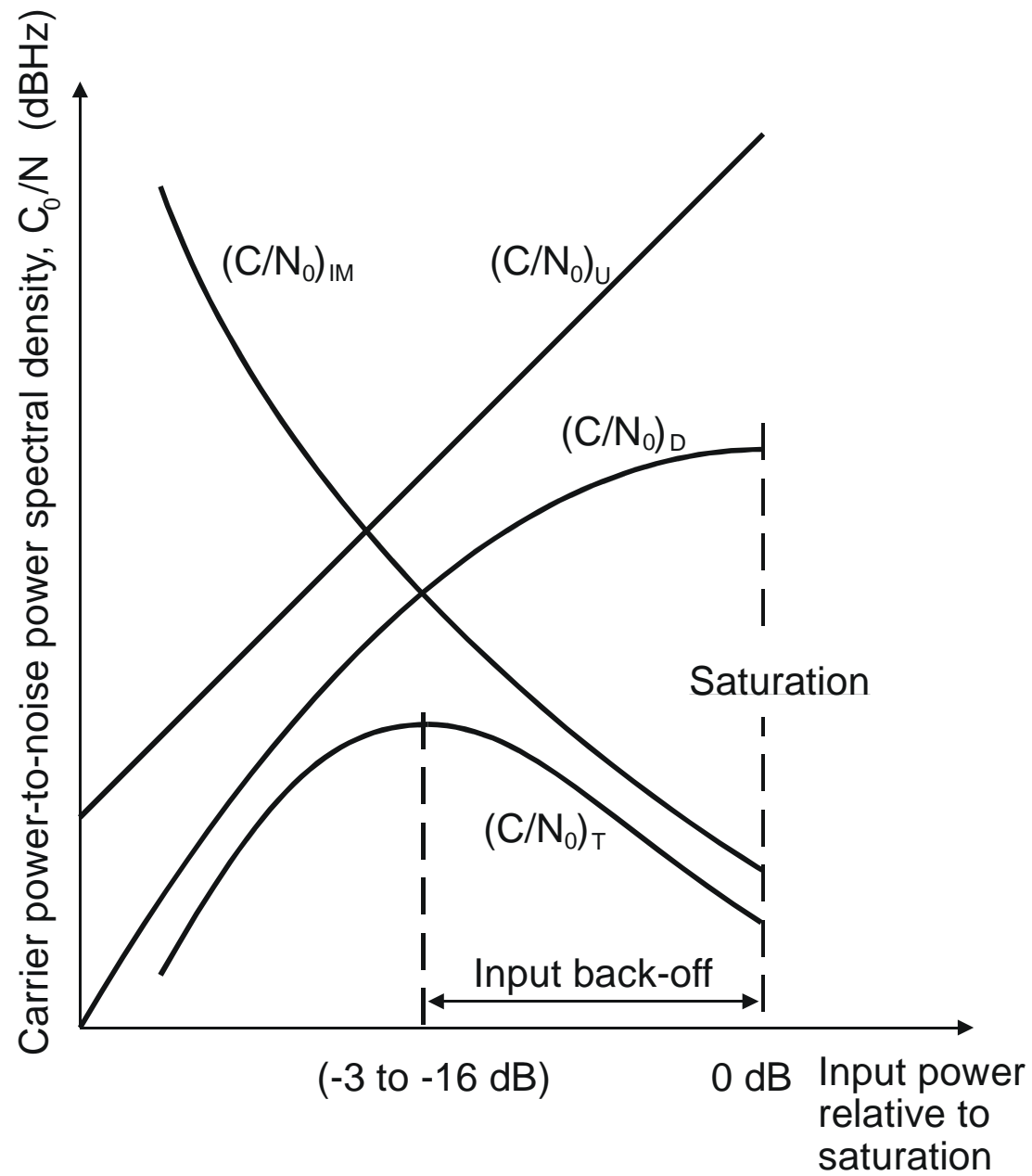


**Fig. 3-7:** Intermodulation (two sinusoidal signals) (a) equal amplitudes, (b), (c) unequal amplitudes

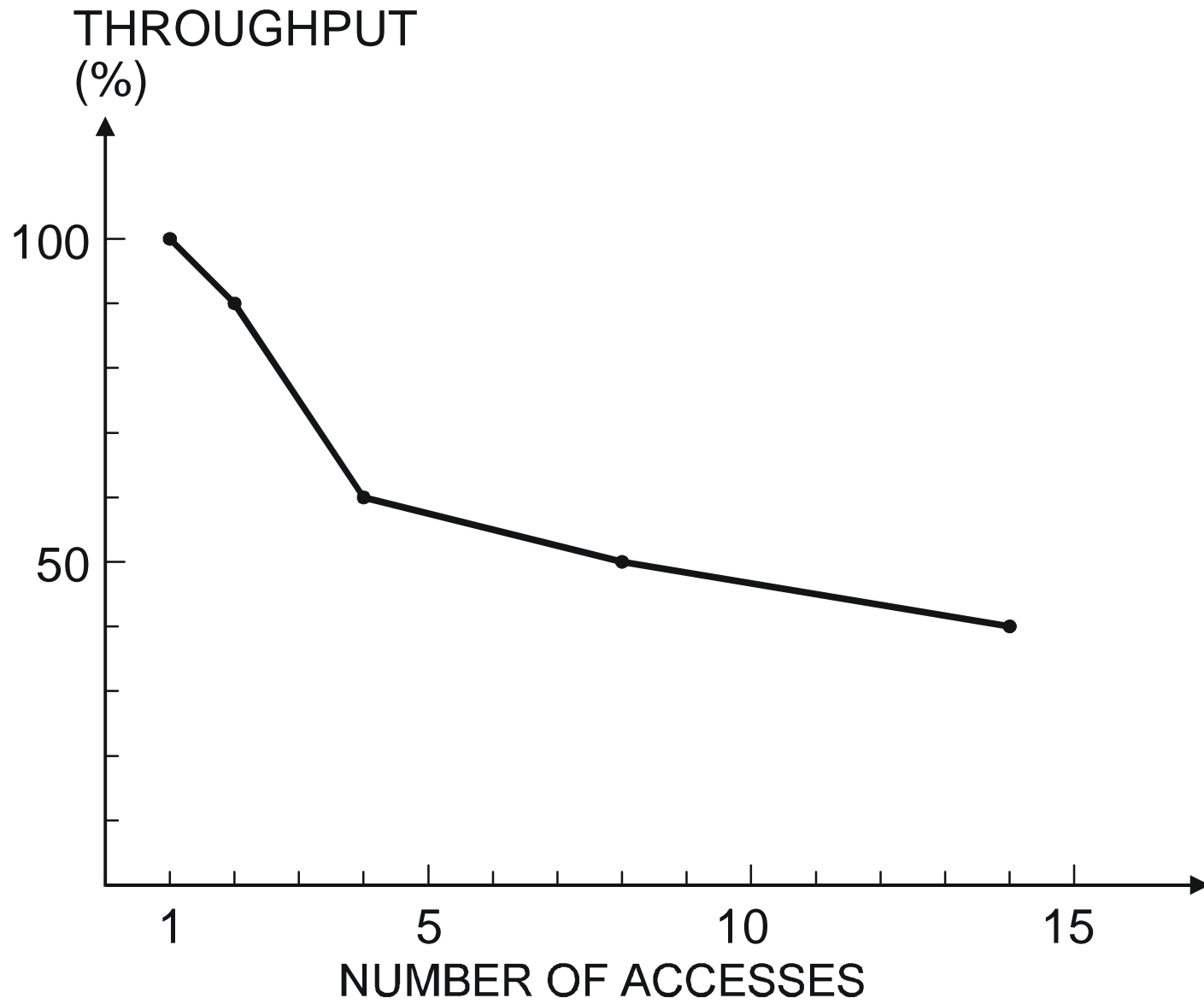




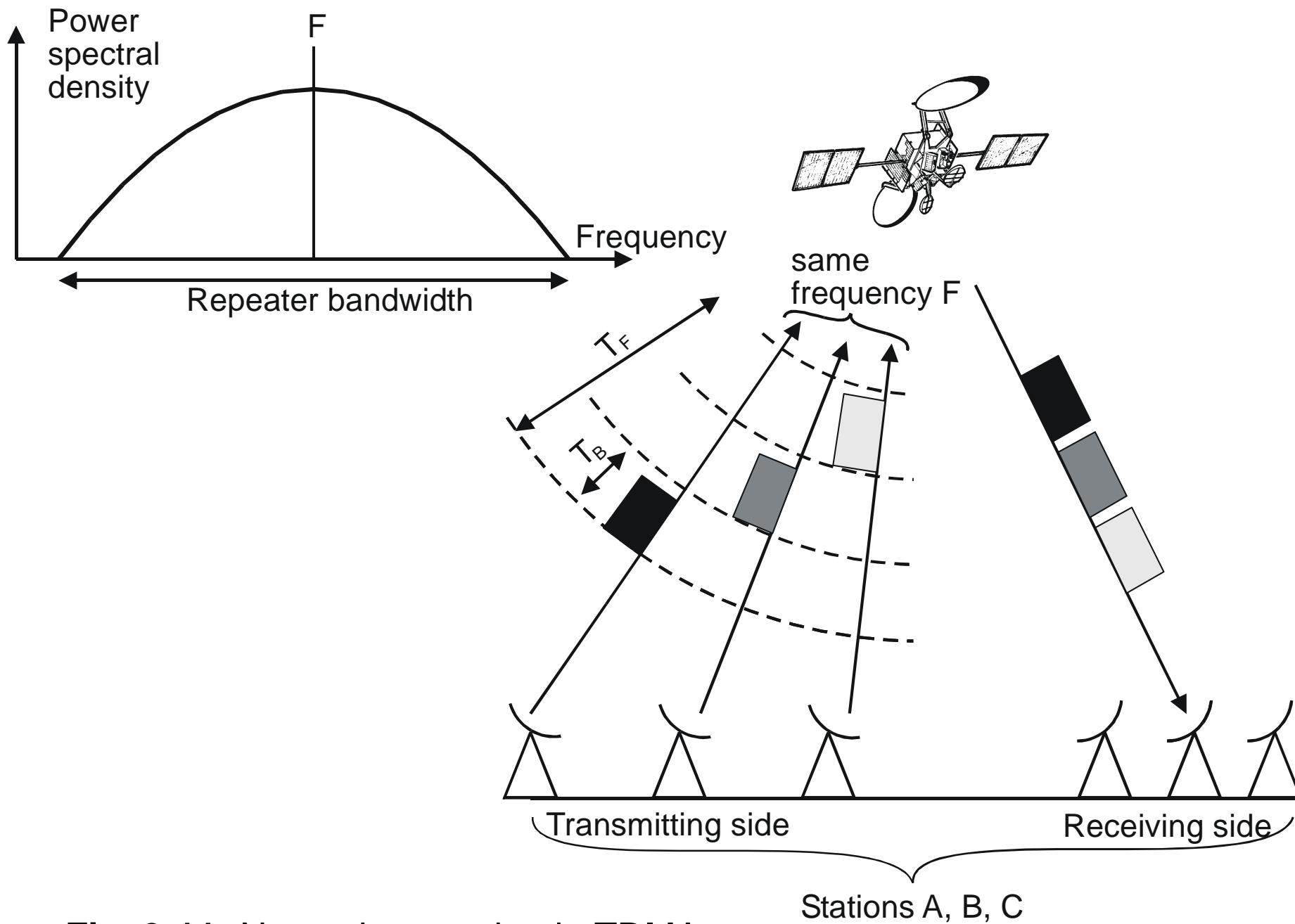
**Fig.3-8:** Transfer characteristics of a non-linear amplifier in multicarrier operation



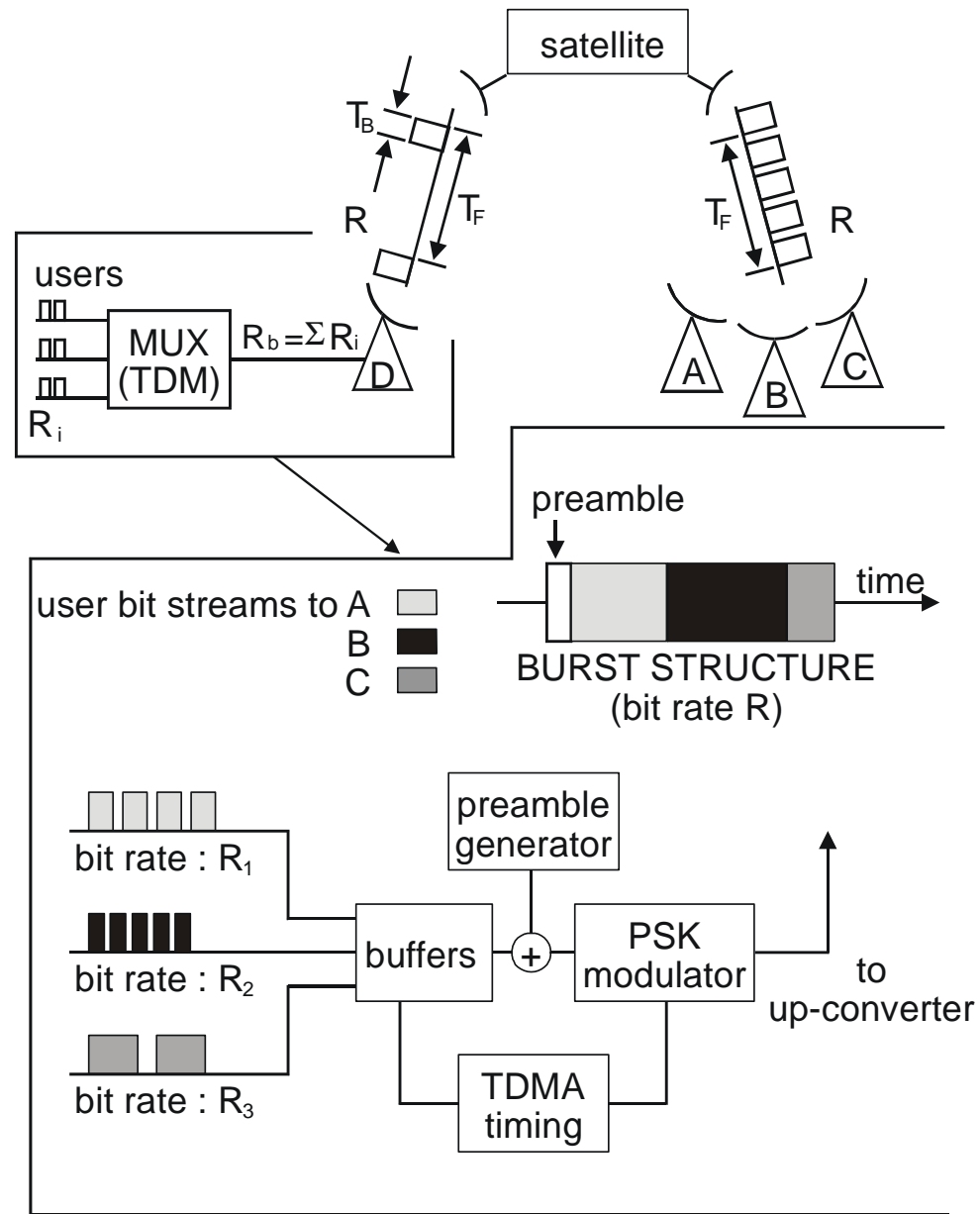
**Fig. 3-9:** Variation of  $(C/N_0)_T$ ,  $(C/N_0)_D$ ,  $(C/N_0)_U$ ,  $(C/N_0)_{IM}$



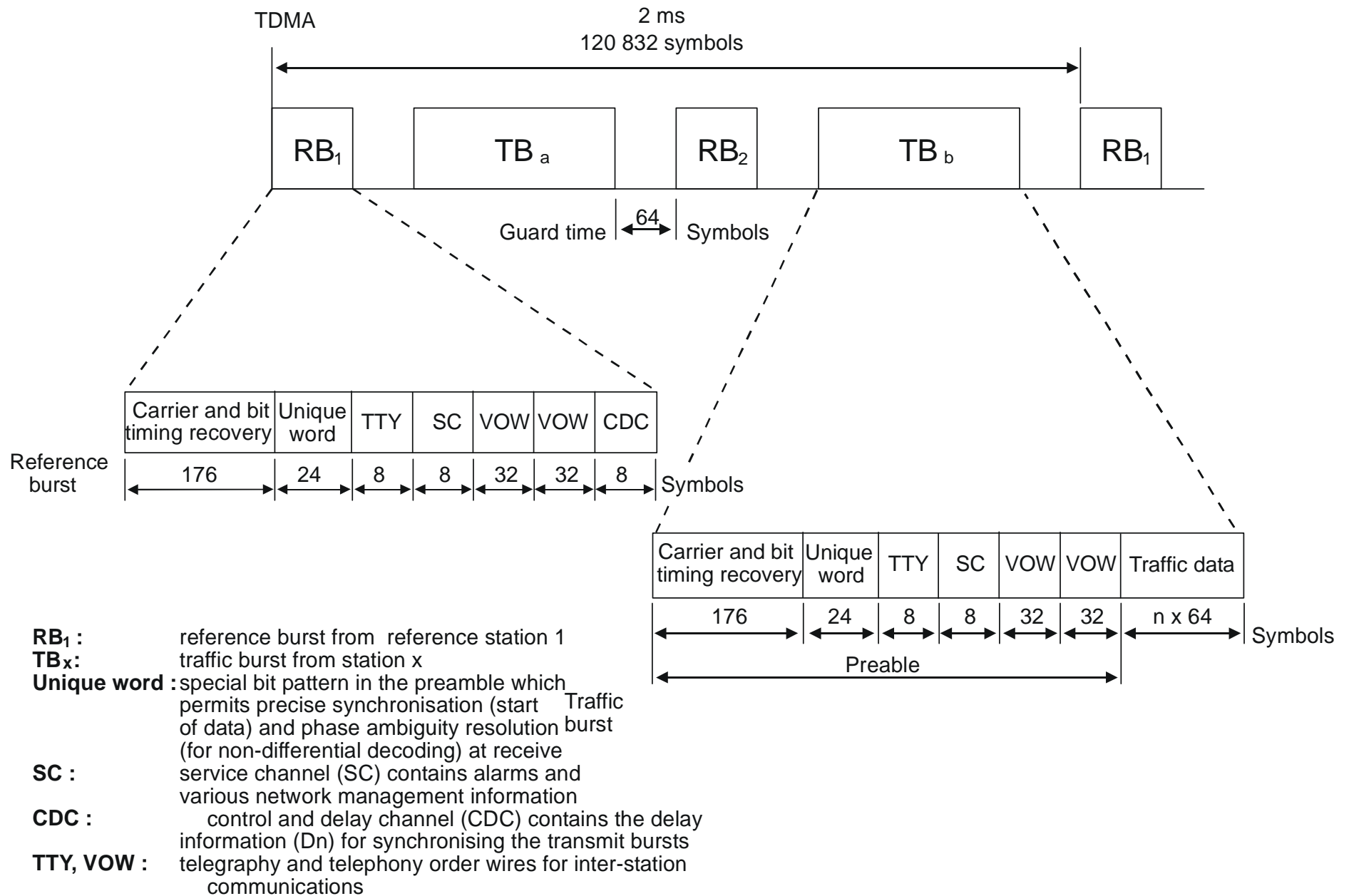
**Fig. 3-10:** FDMA:Throughput



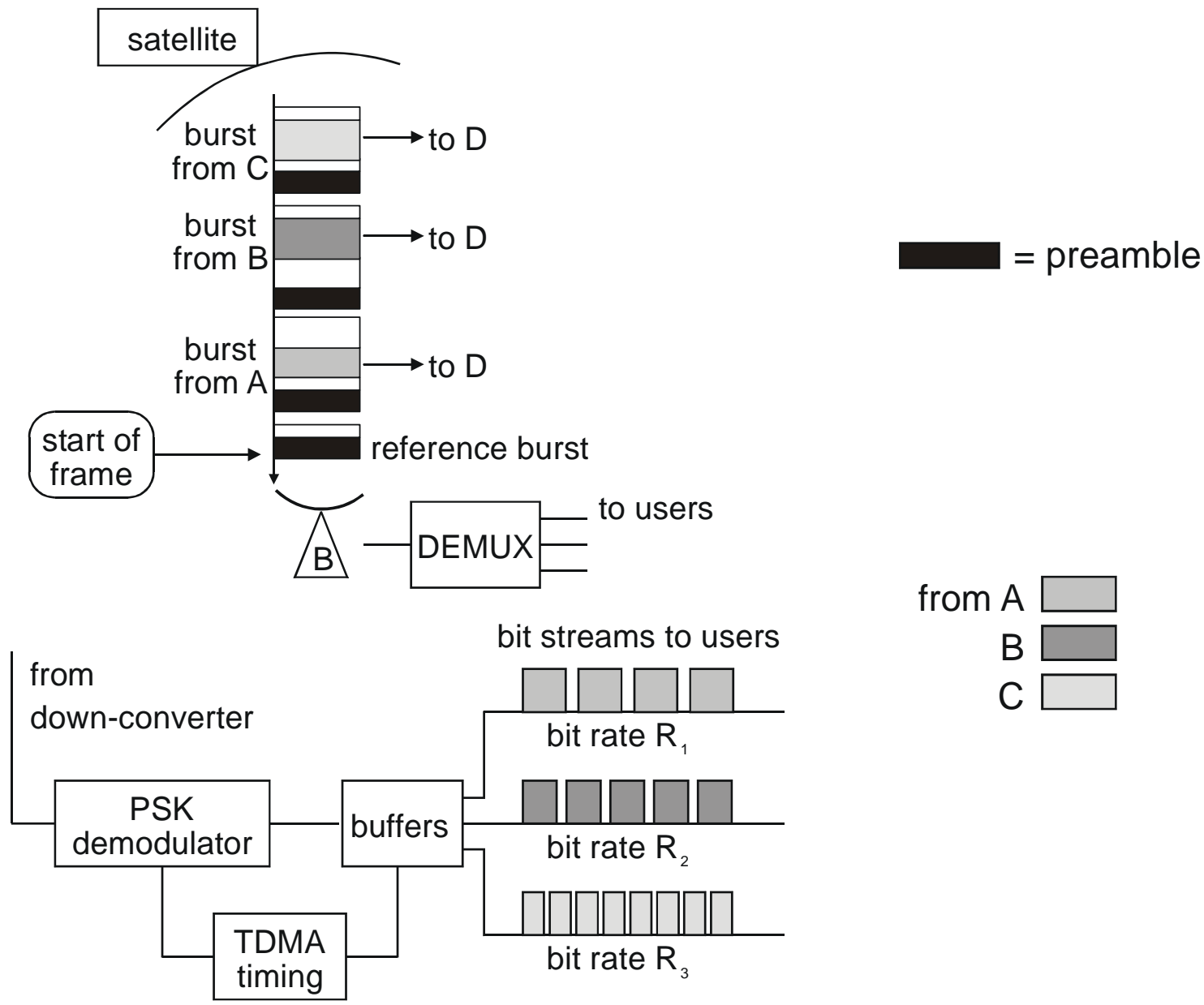
**Fig. 3-11:** Network operating in TDMA



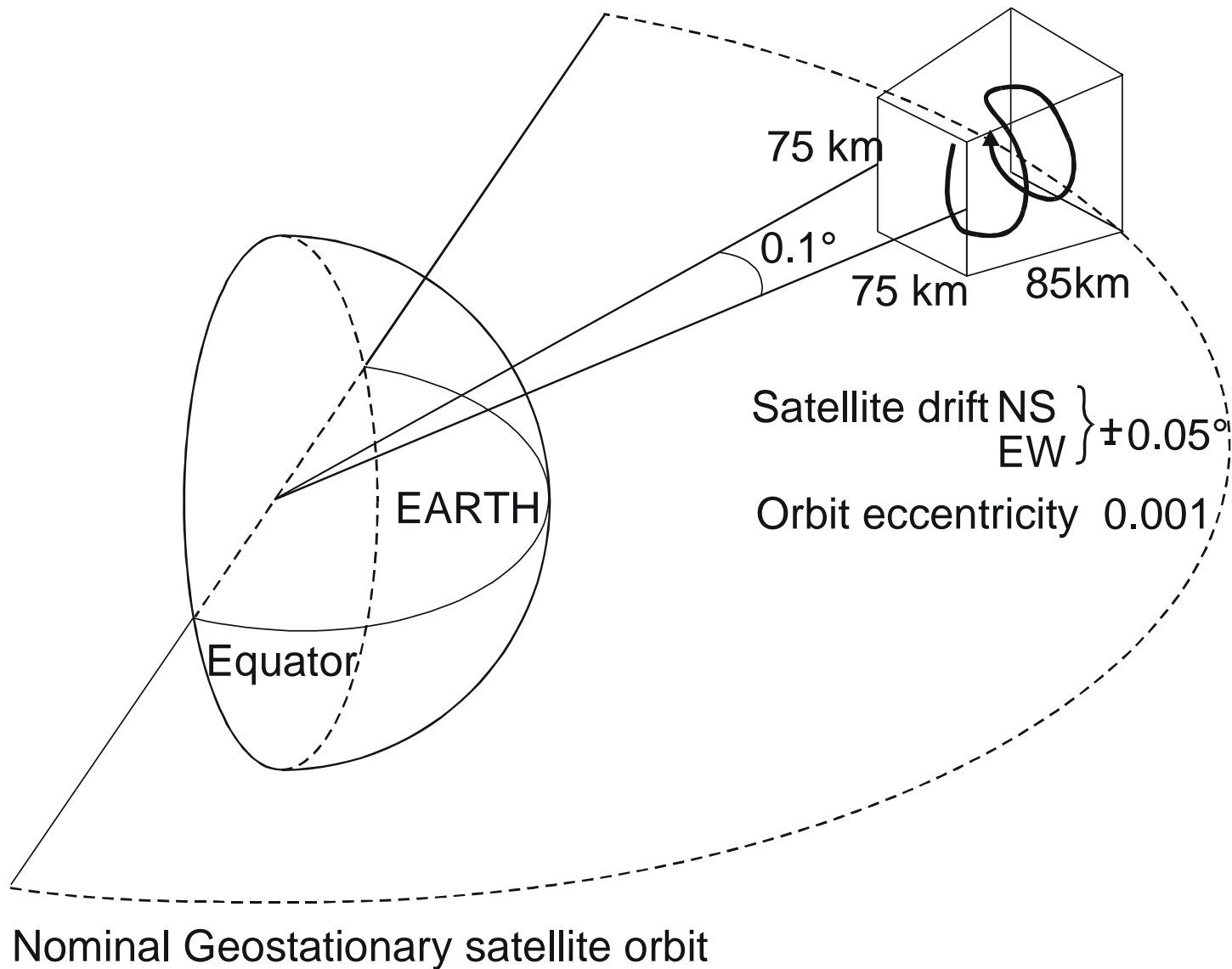
**Fig. 3-12: Burst generation**



**Fig.3-13: Frame structure (INTELSAT/ EUTELSAT standard)**

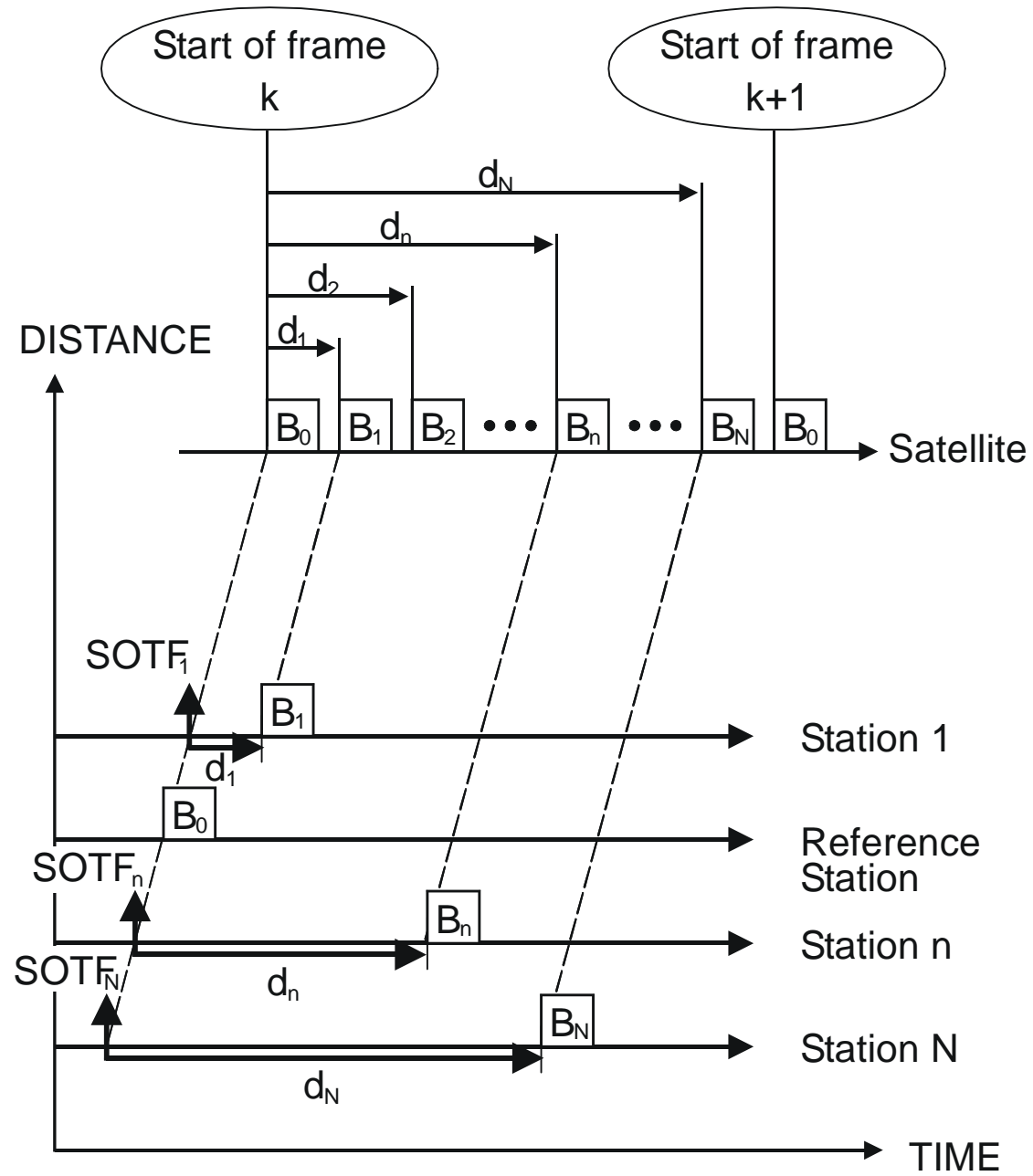


**Fig. 3-14: Burst reception**

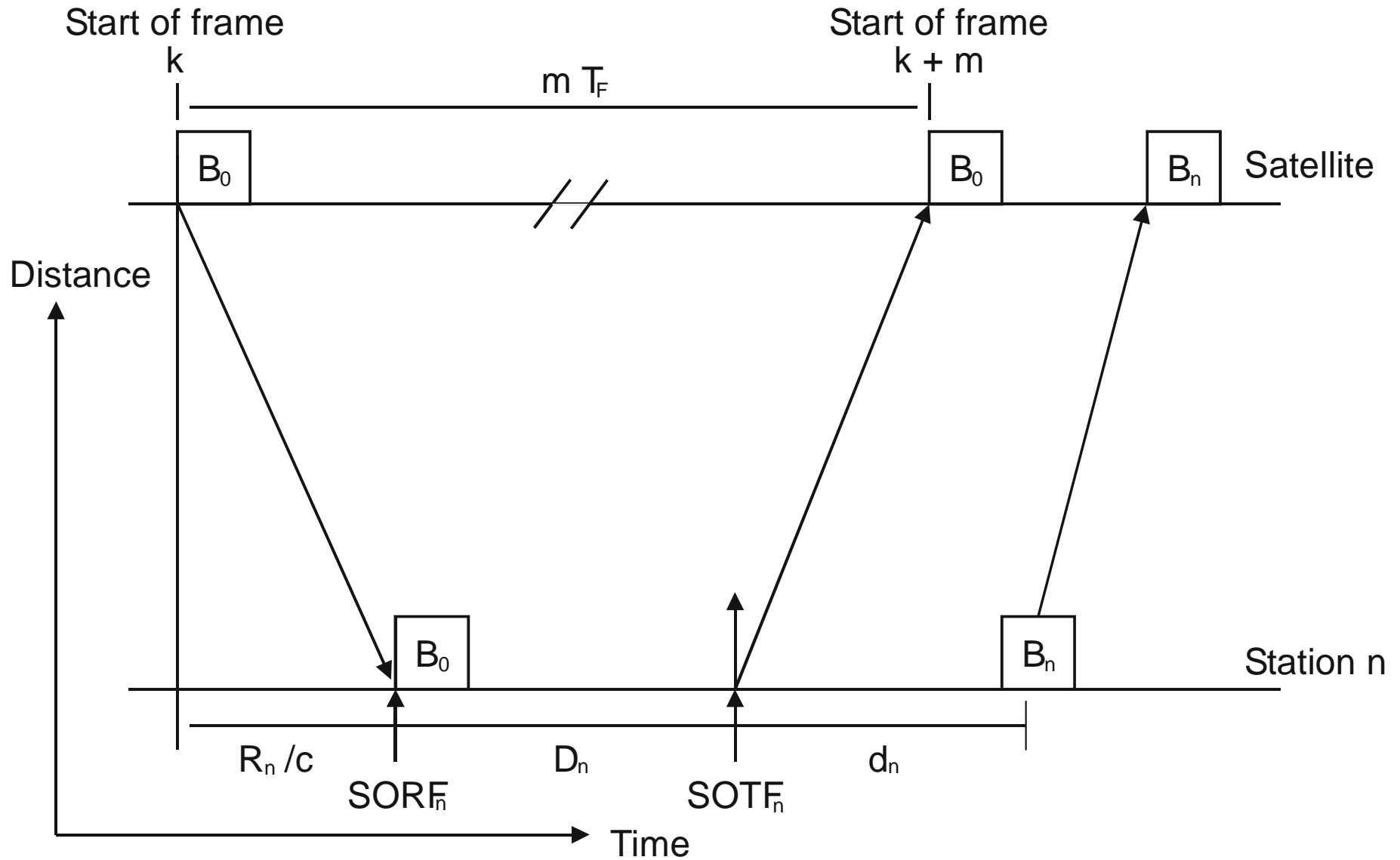


**Fig. 3-15:** Evolution of the volume occupied by a geostationary satellite in the course of an orbital period (24h)

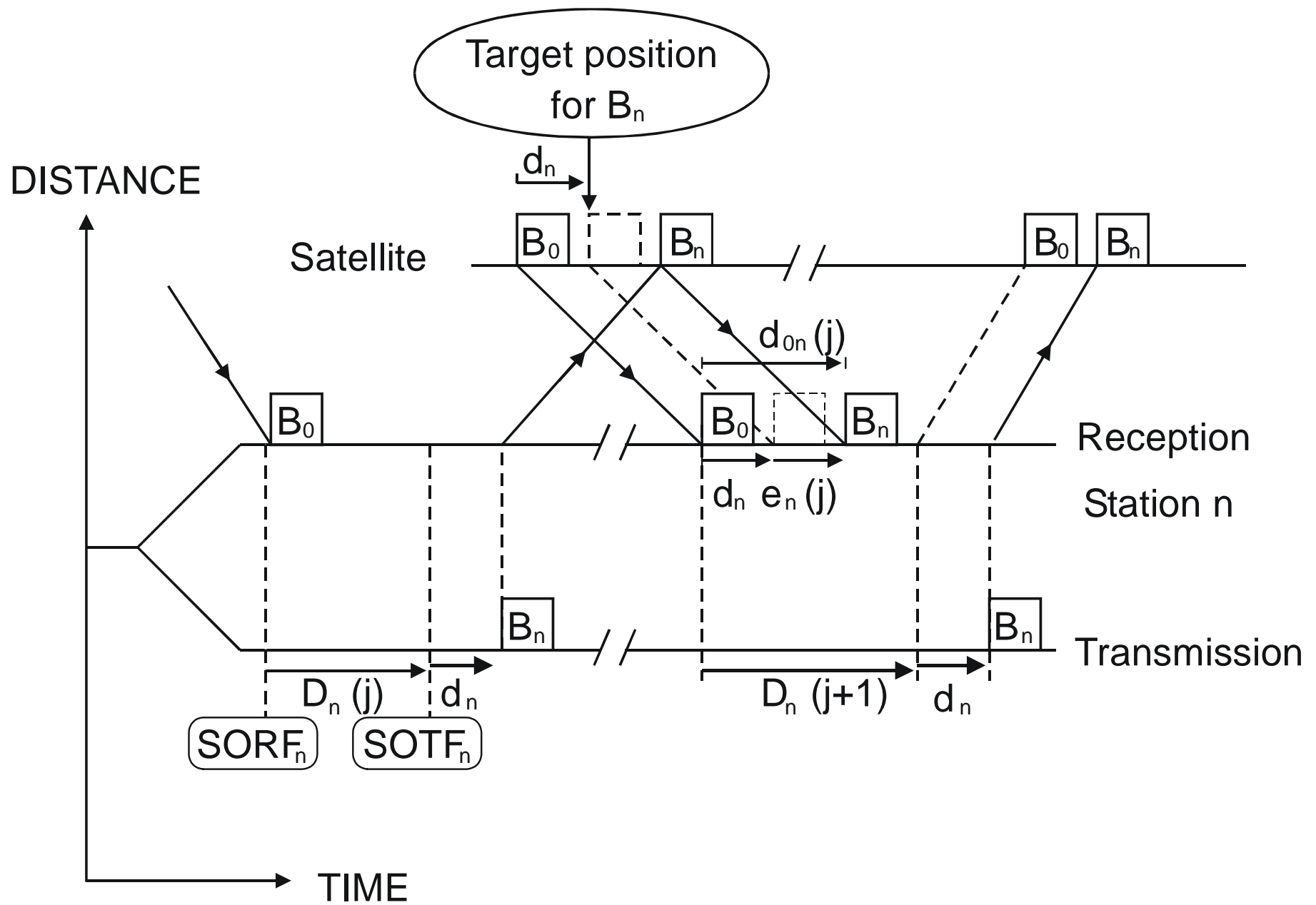




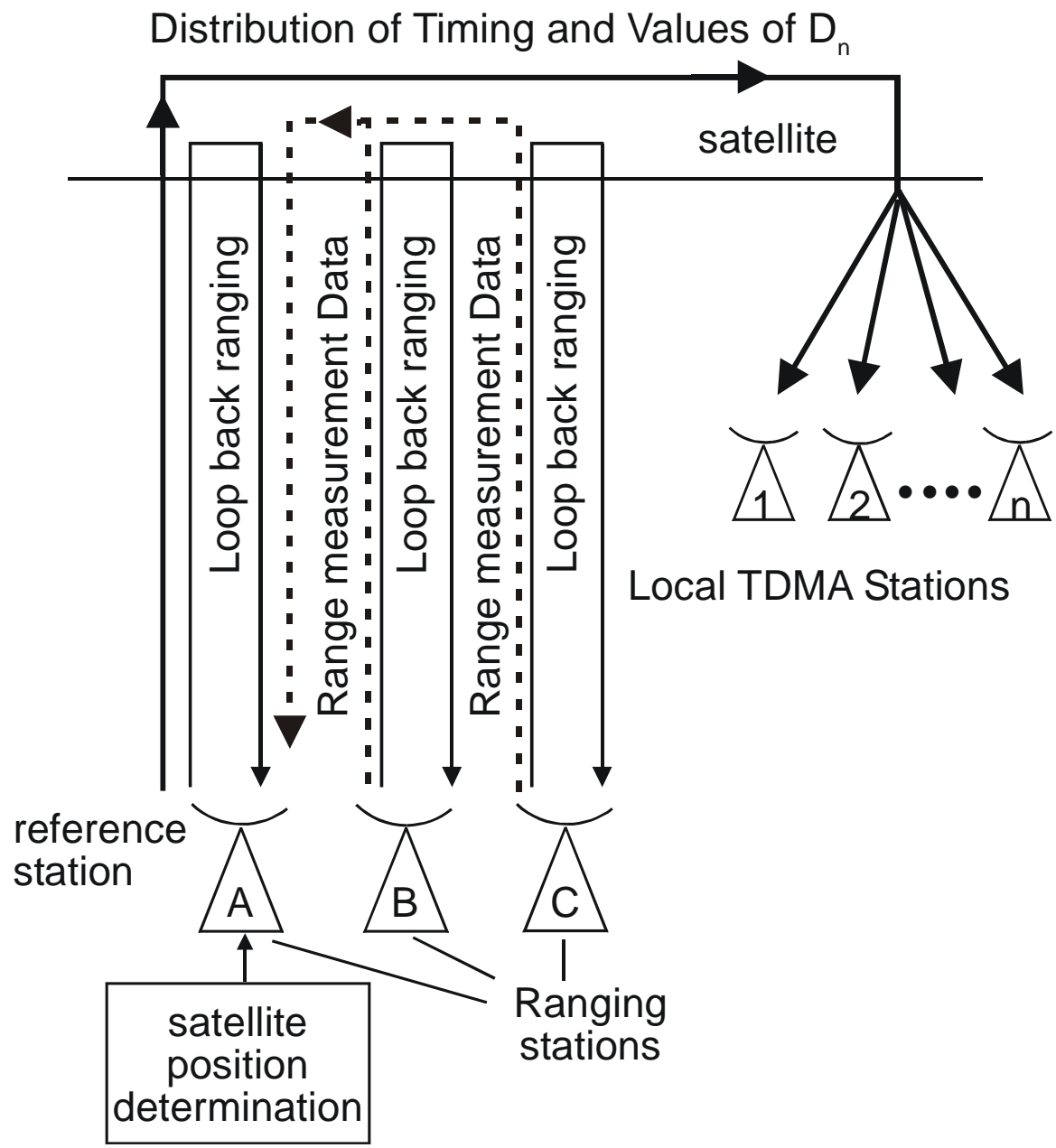
**Fig. 3-16:** Burst assignment within the frame



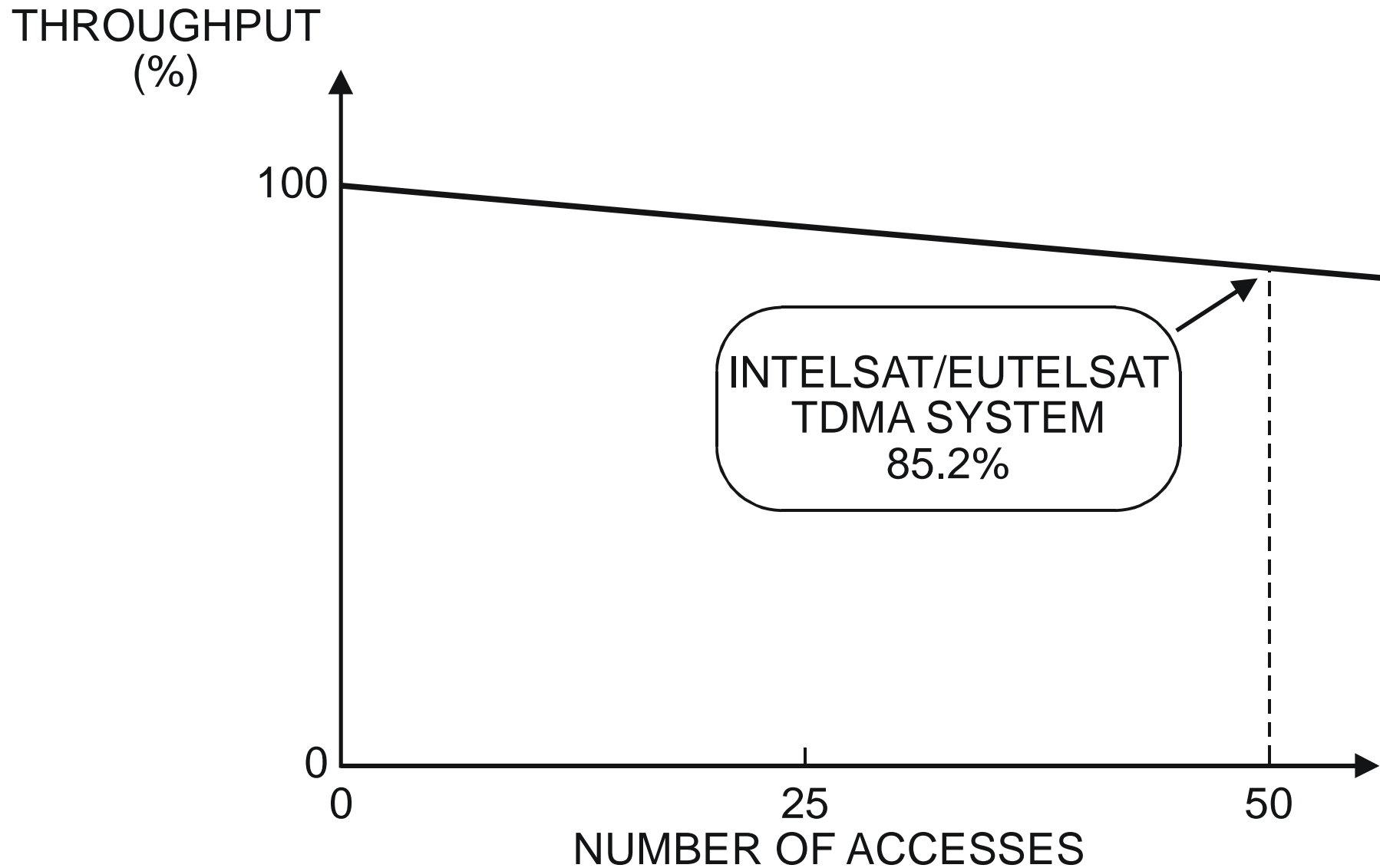
**Fig. 3-17:** The relation between the start time on transmission  $SOTF_n$  and the start time on reception  $SORF_n$  for station  $n$



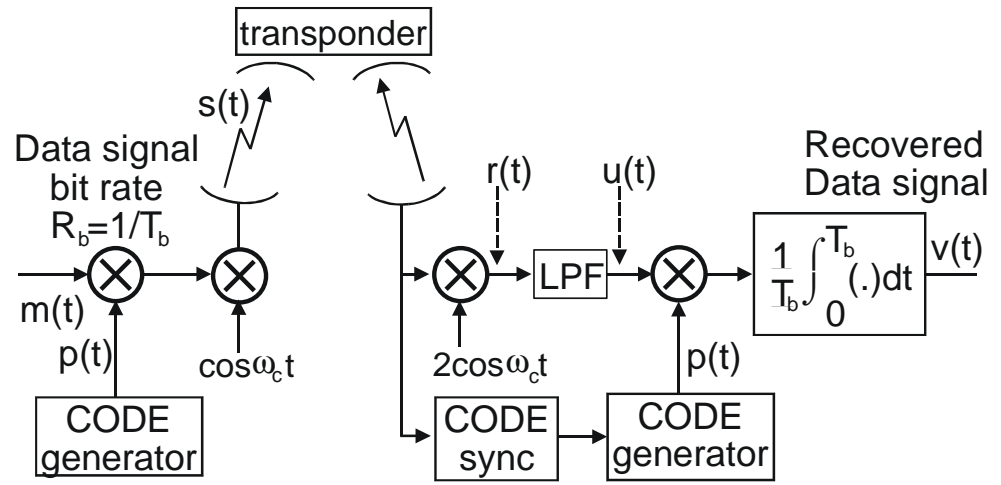
**Fig. 3-18:** Closed loop synchronisation



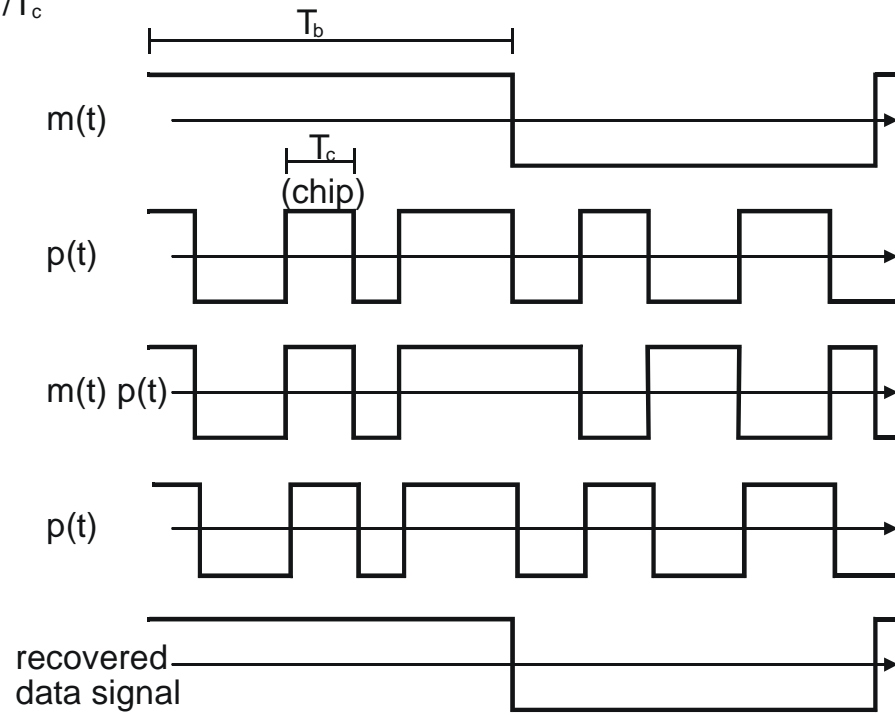
**Fig. 3-19:** Open loop synchronisation



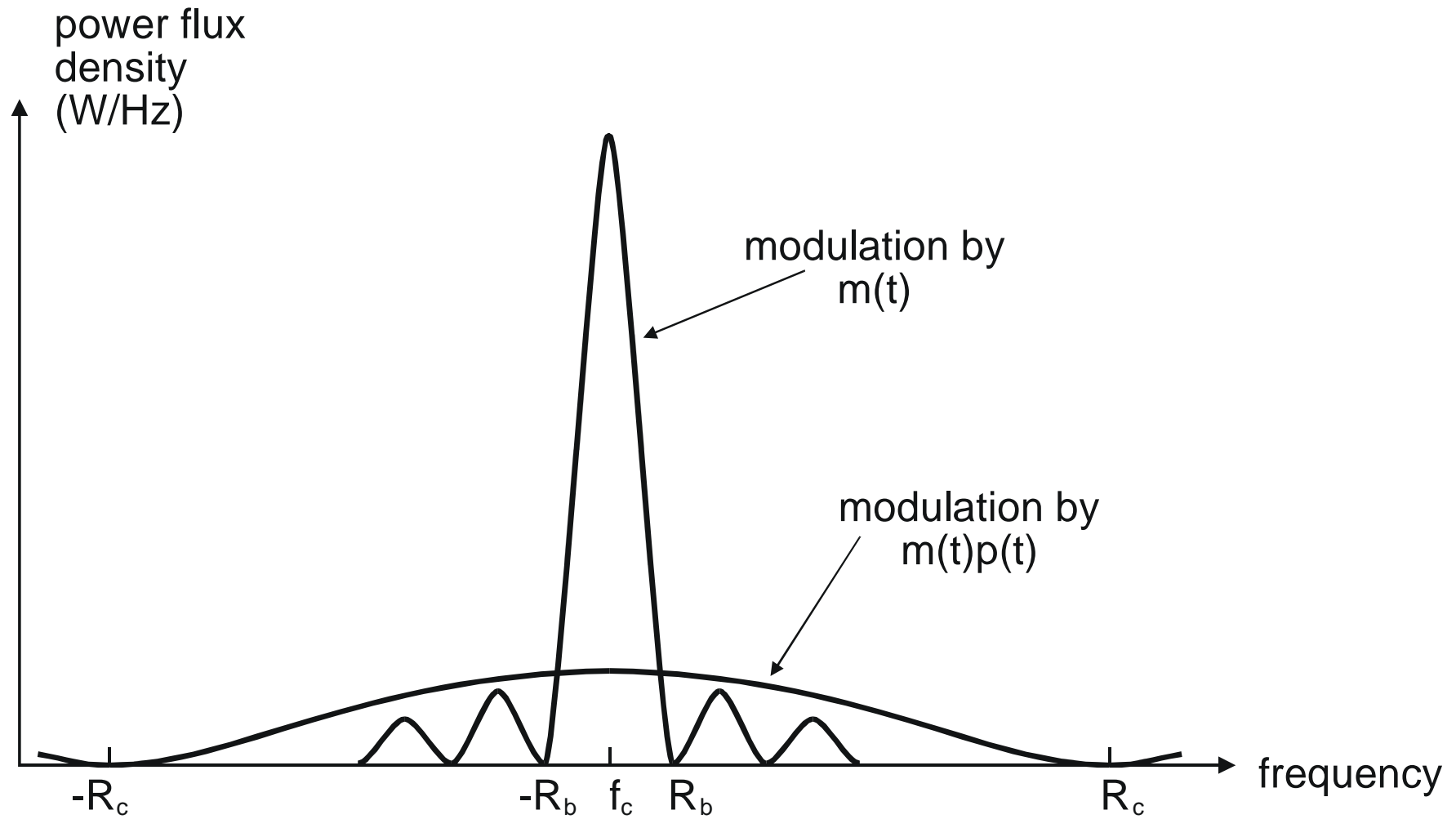
**Fig. 3-20:** The efficiency of the INTELSAT / EUTELSAT TDMA System



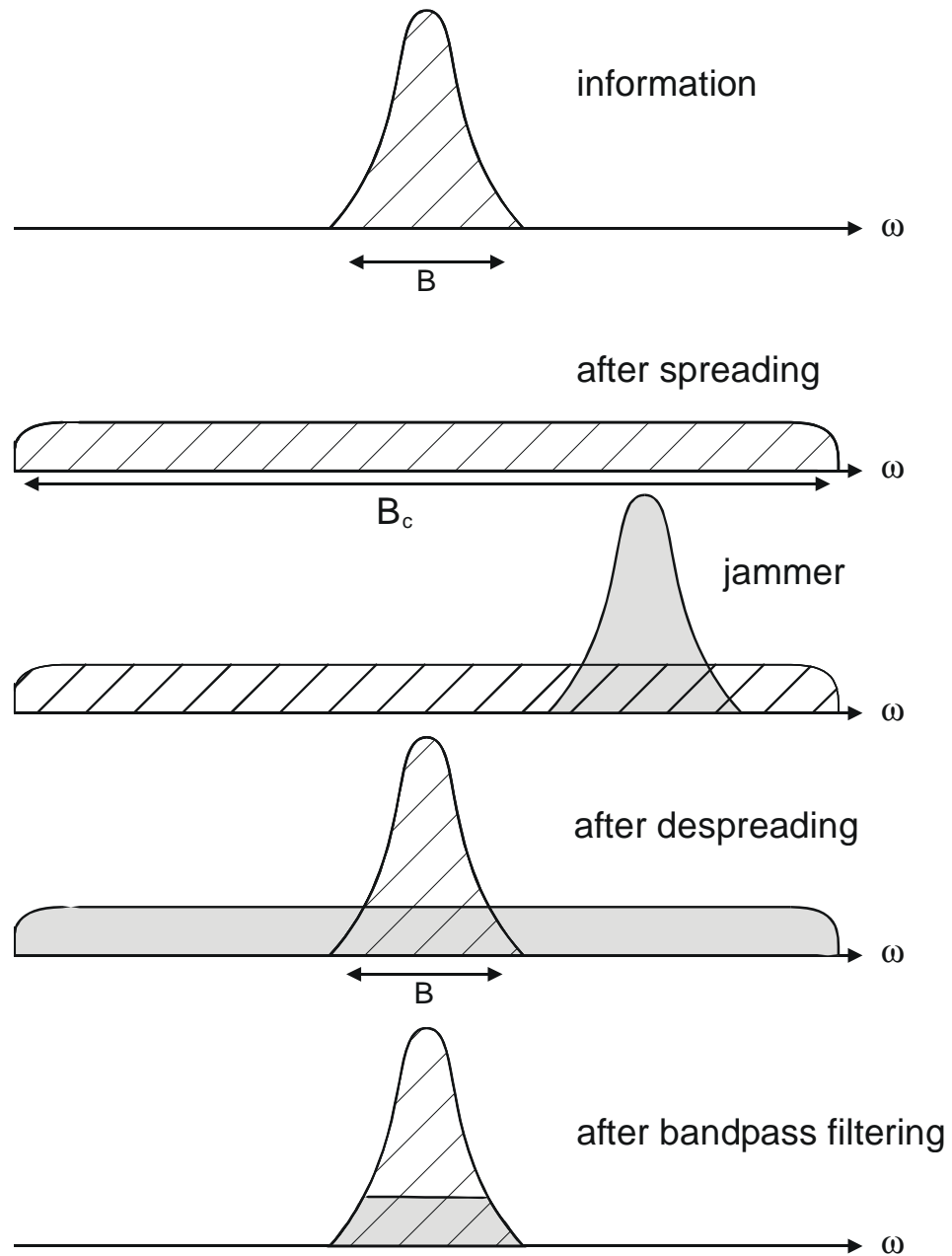
Chip rate  $R_c = 1/T_c$



**Fig. 3-21: DS - CDMA**

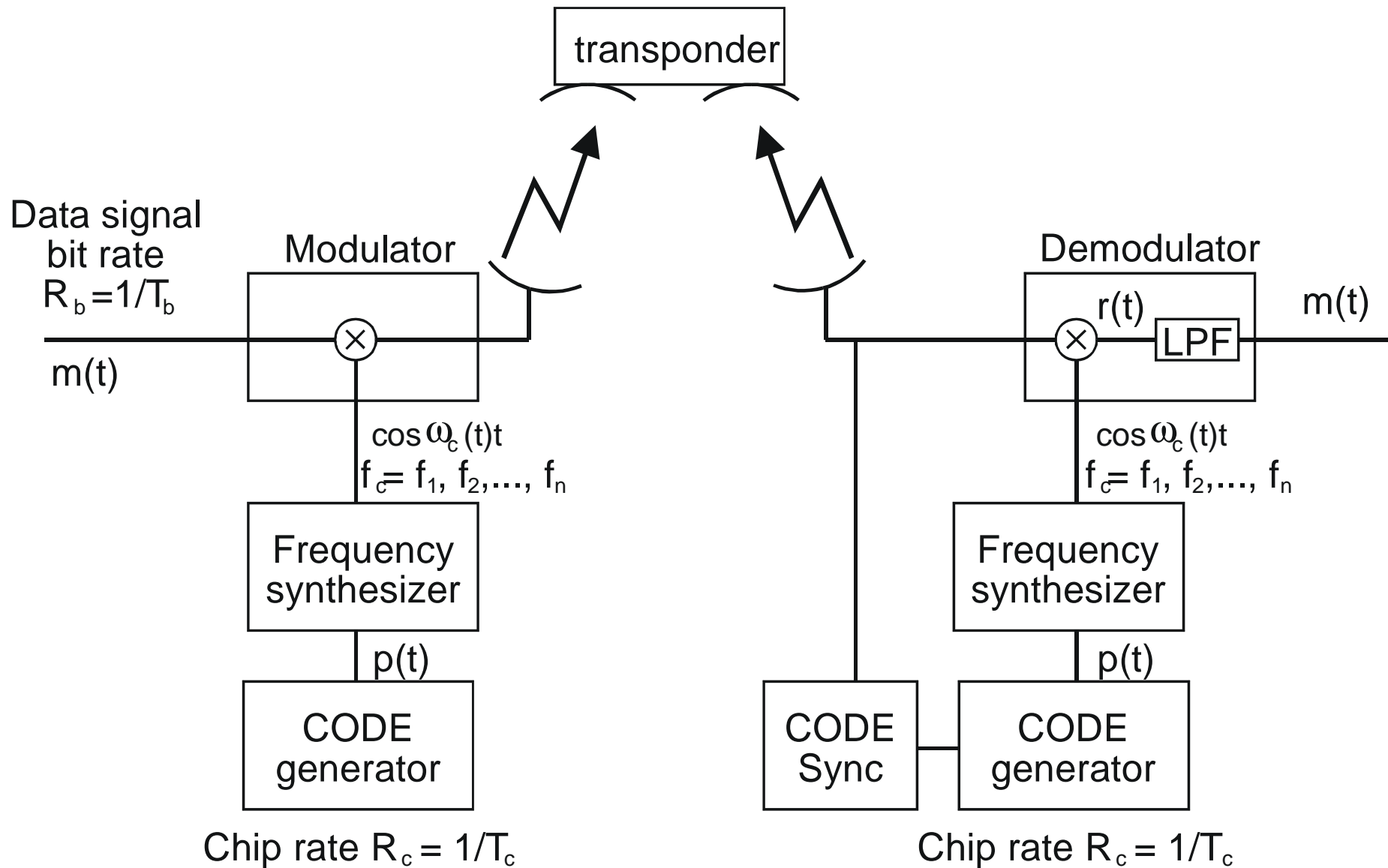


**Fig. 3-22:** The effect of spreading in the frequency

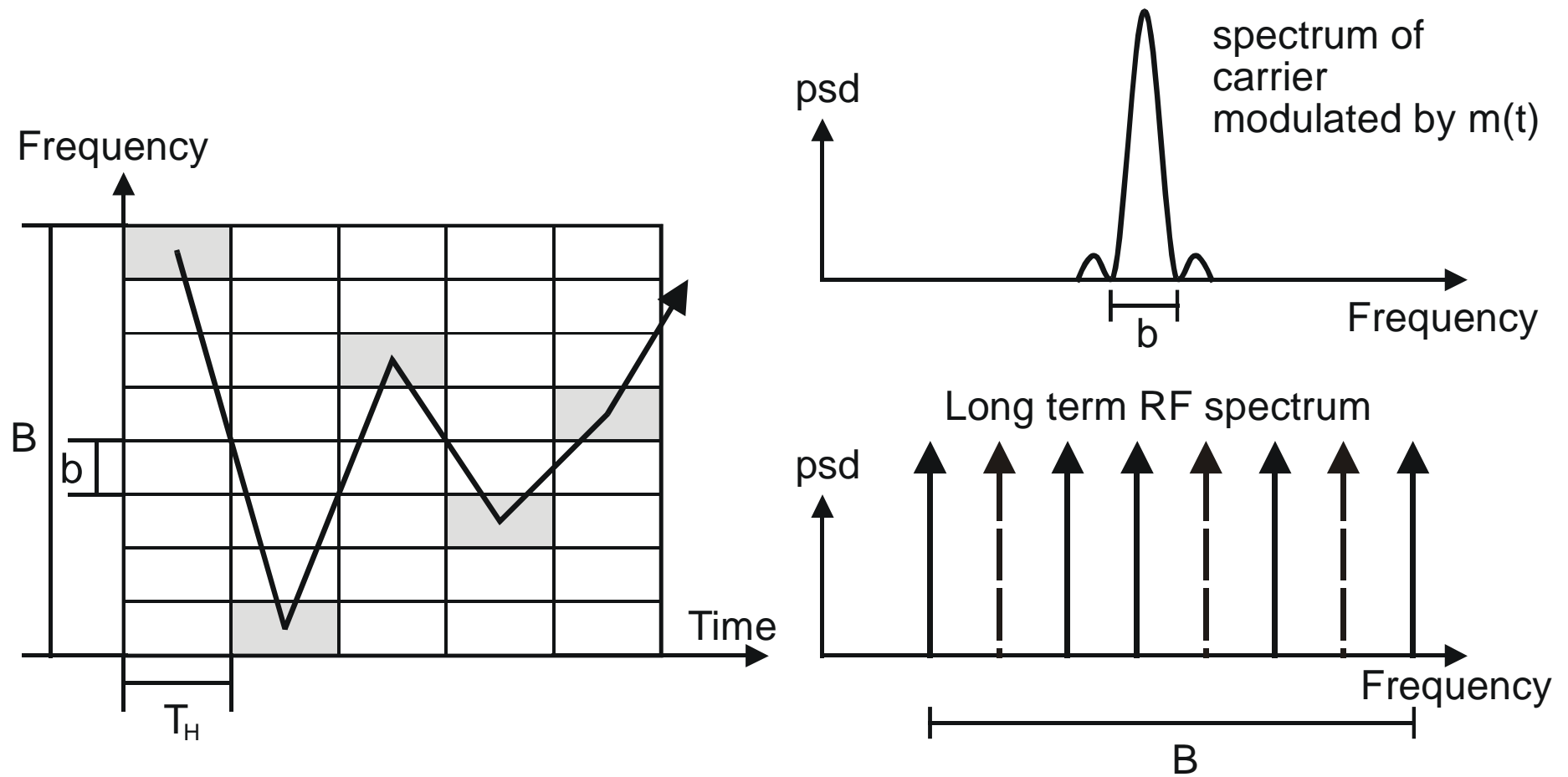


**Fig. 3-23:** Jammer reducing effect of DSSS



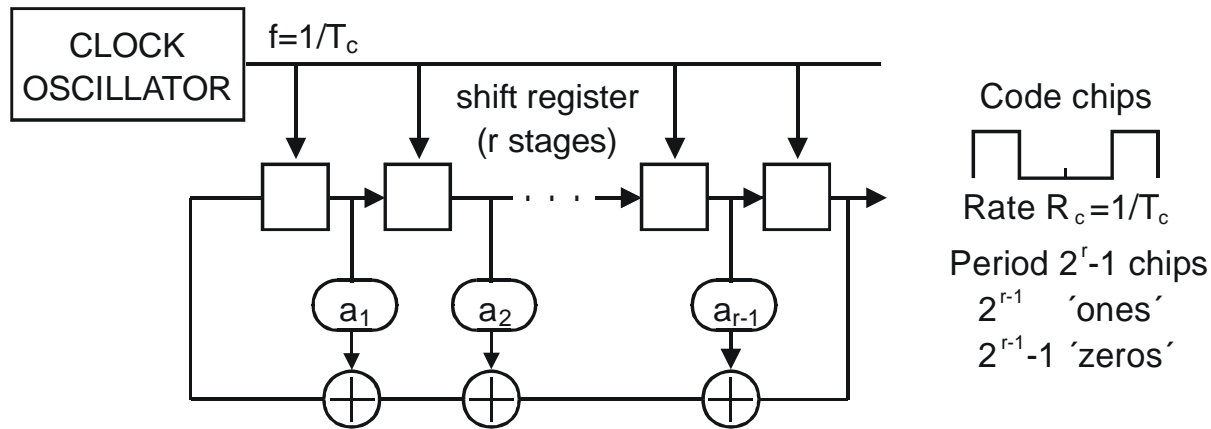


**Fig. 3-24:** Frequency Hopping: FH-CDMA



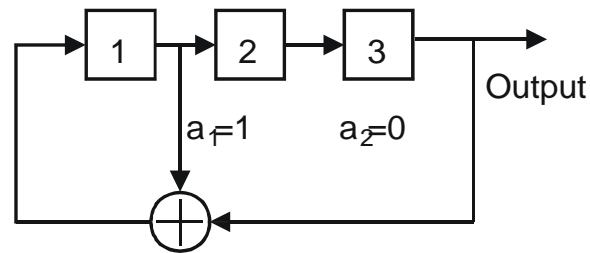
**Fig. 3-25: FH: Frequency domain**

(a)



$a_i = 0$  or  $1$

Example (r=3)



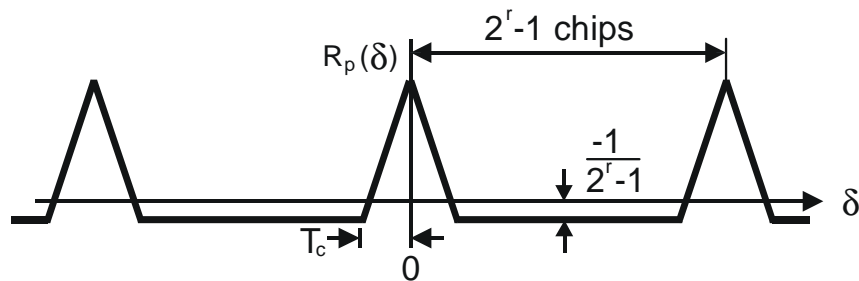
Shift register status

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

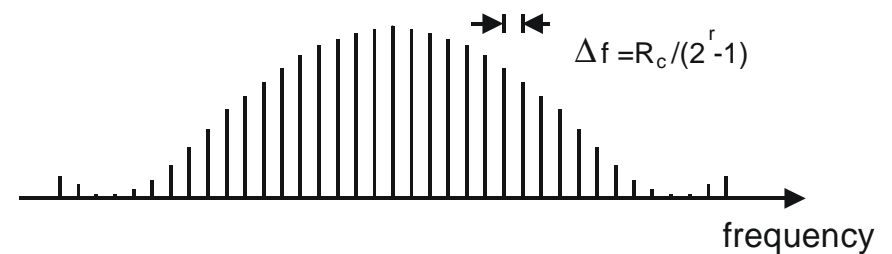
Output code sequence (1 period)

Repeat

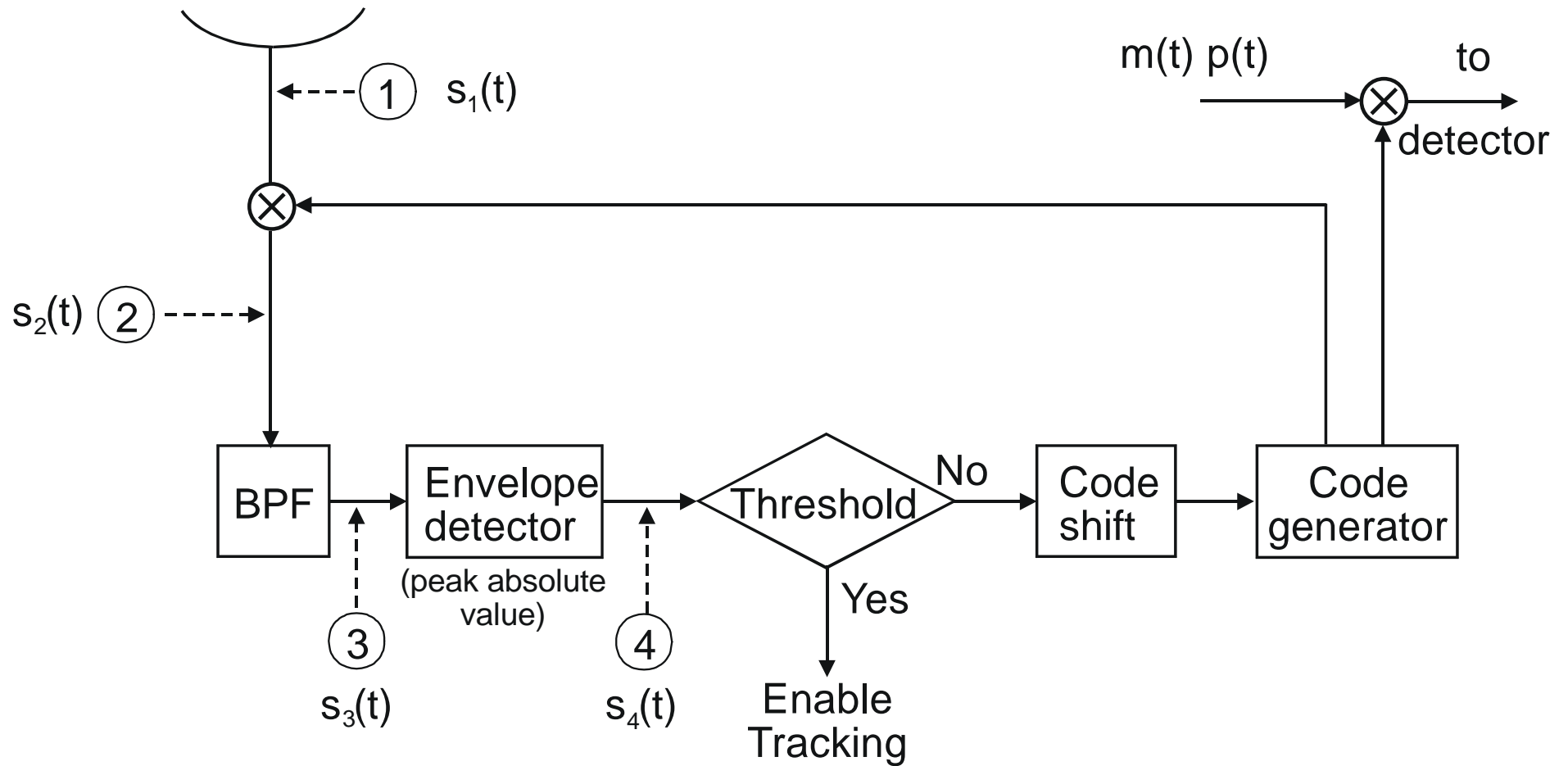
(b) CODE CORRELATION FUNCTION :



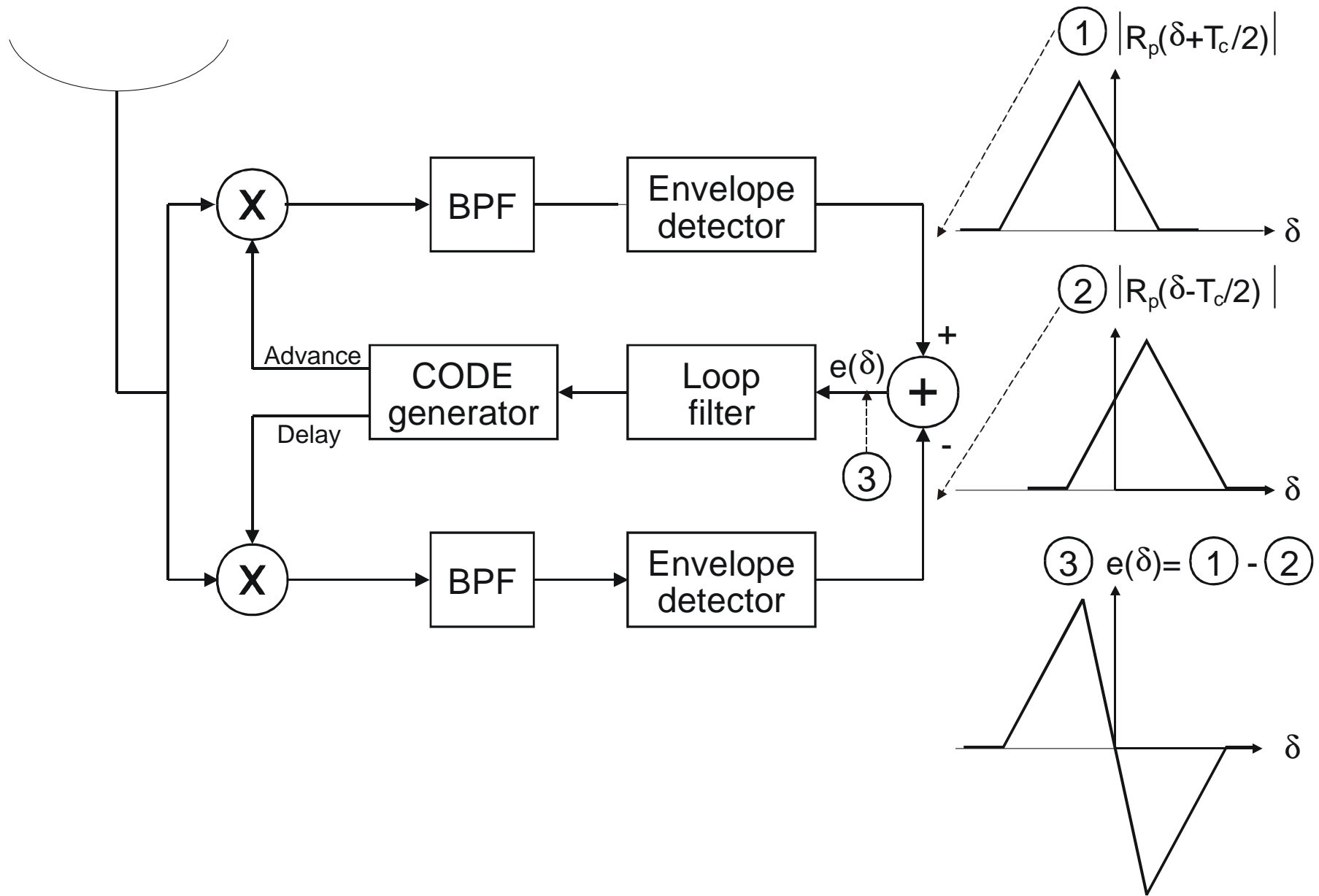
(c) CODE POWER SPECTRAL DENSITY



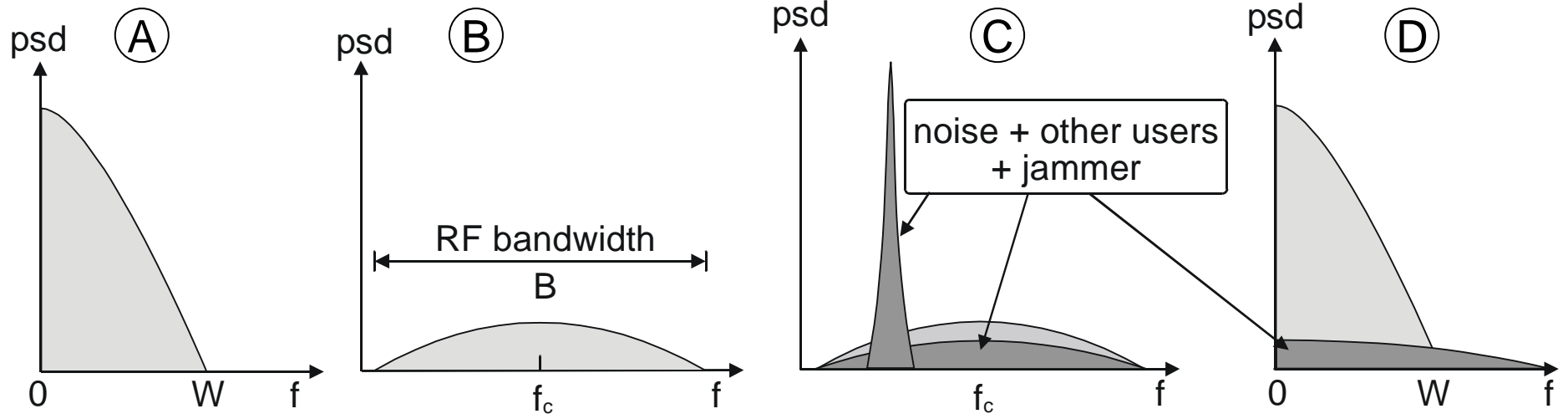
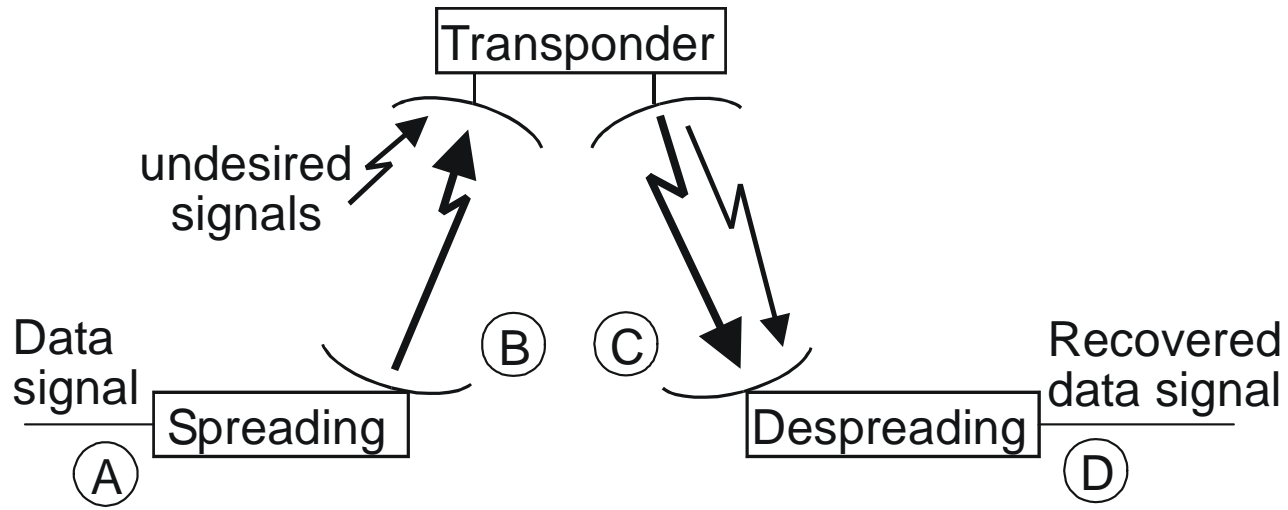
**Fig. 3-26:** Pseudo random sequences: (a) Generation (b) AFK (c) Power spectral density



**Fig. 3-27:** Code acquisition in a DS-CDMA system

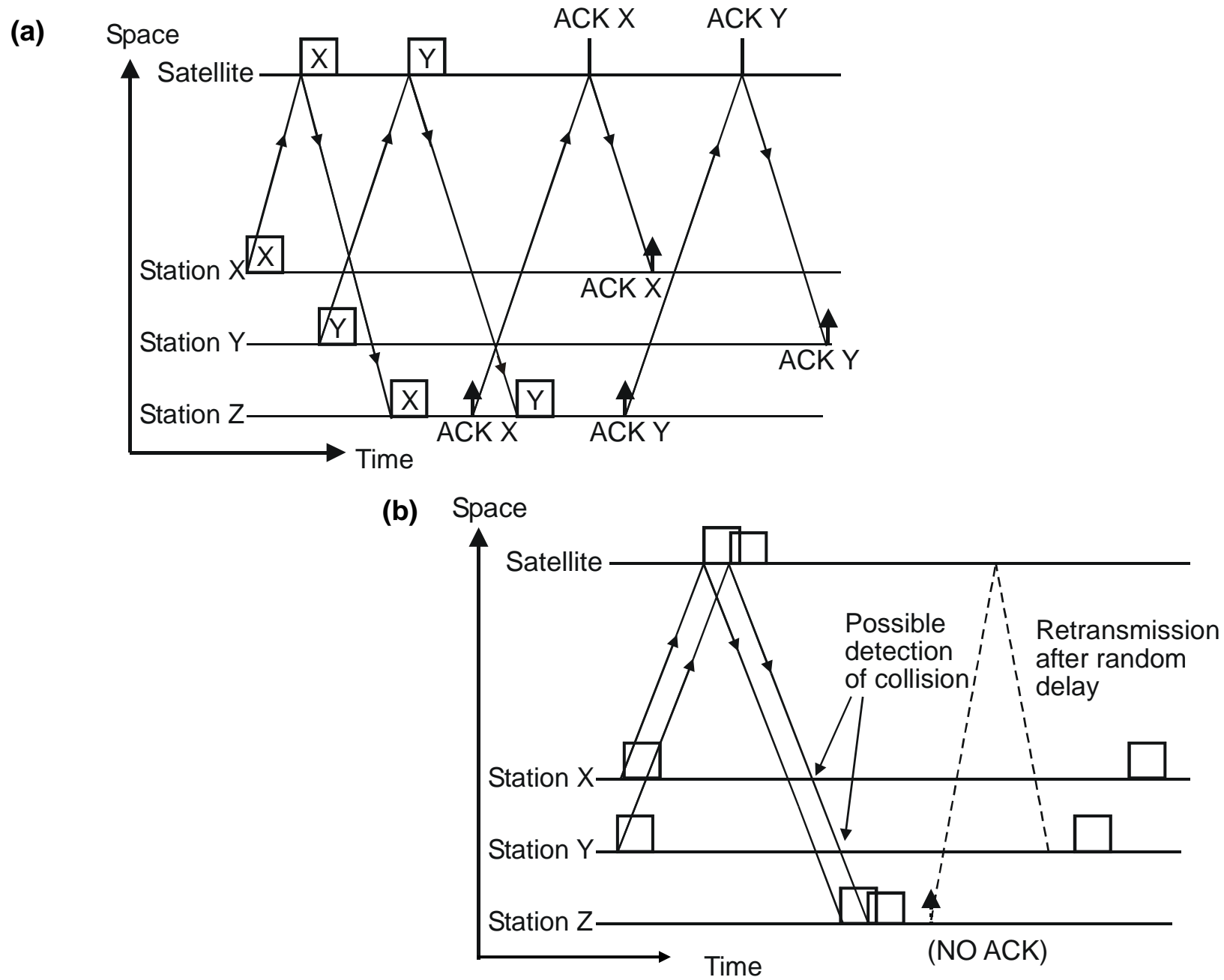


**Fig. 3-28:** Code tracking in a DS-CDMA system

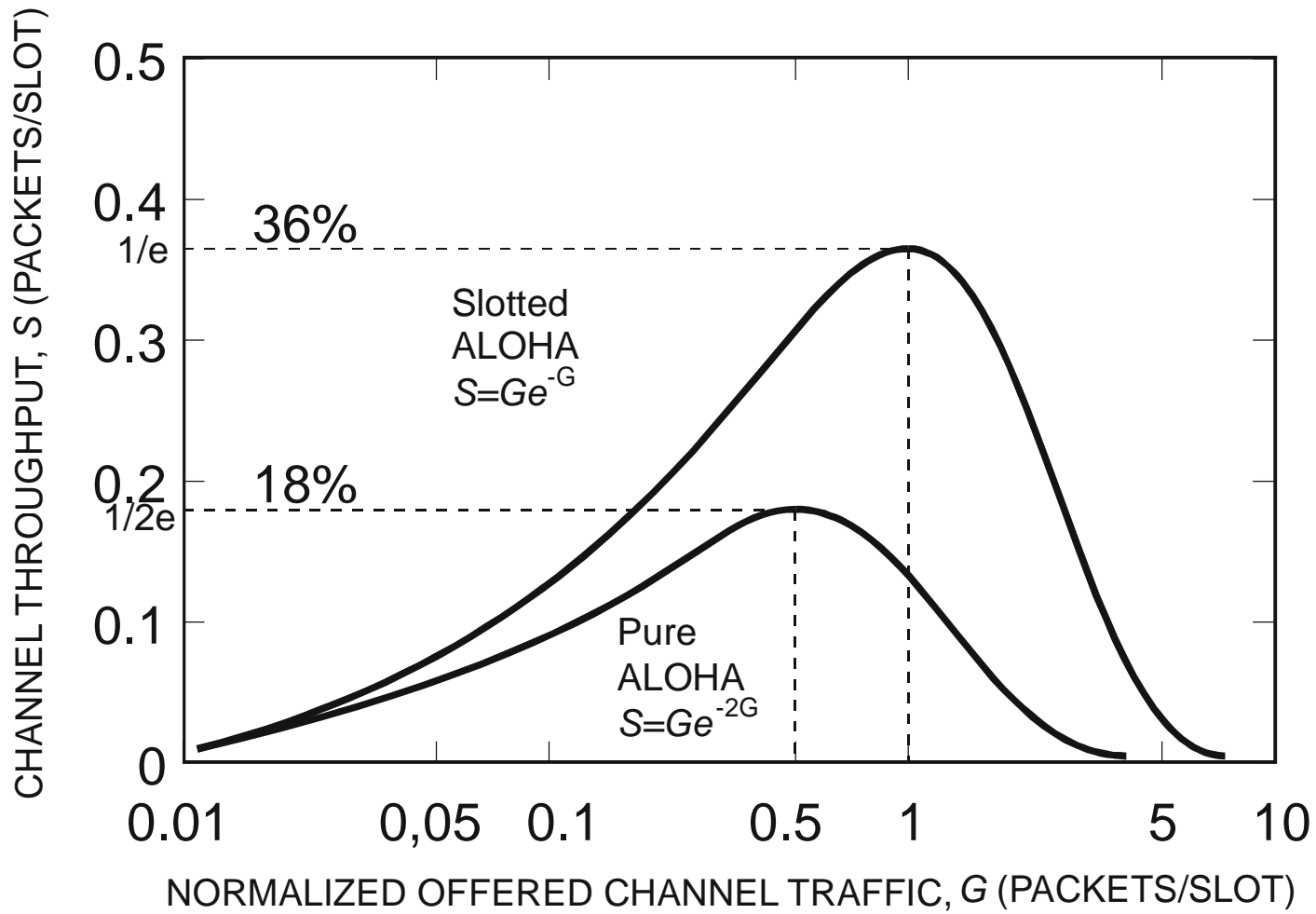


psd = Power spectral density  
 f = Frequency

**Fig. 3-29:** Spread spectrum transmission in a DS-CDMA system

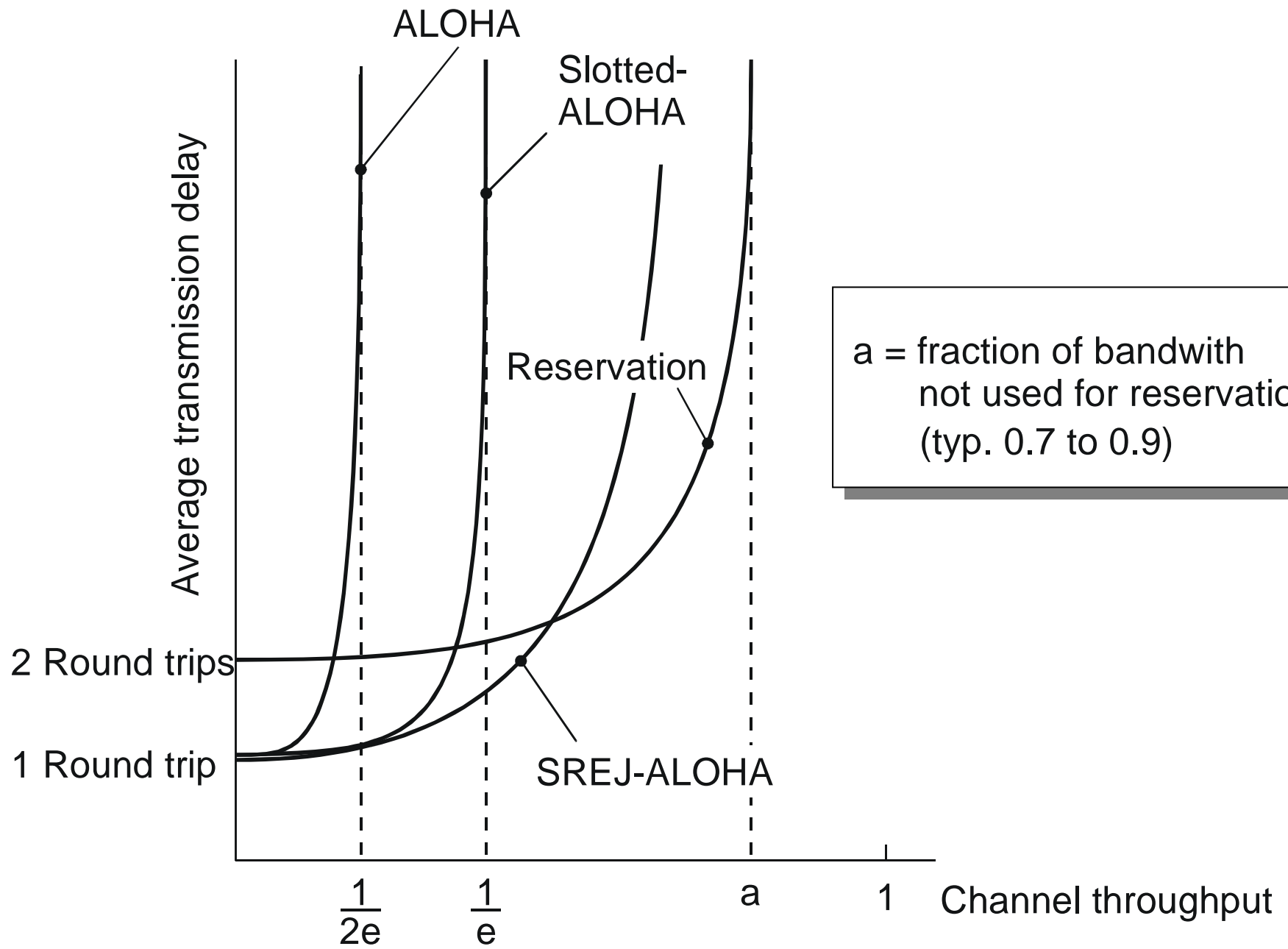


**Fig. 4-1: ALOAH-Protocoll: (a) without collision, (b) with collision**

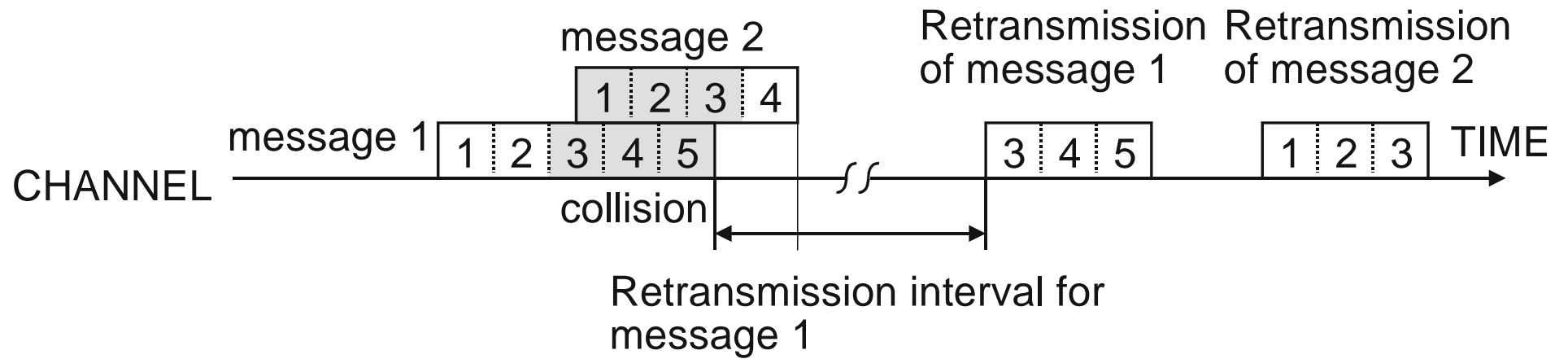


**Fig:4-2:** Pure ALOHA, Slotted ALOHA: Efficiency

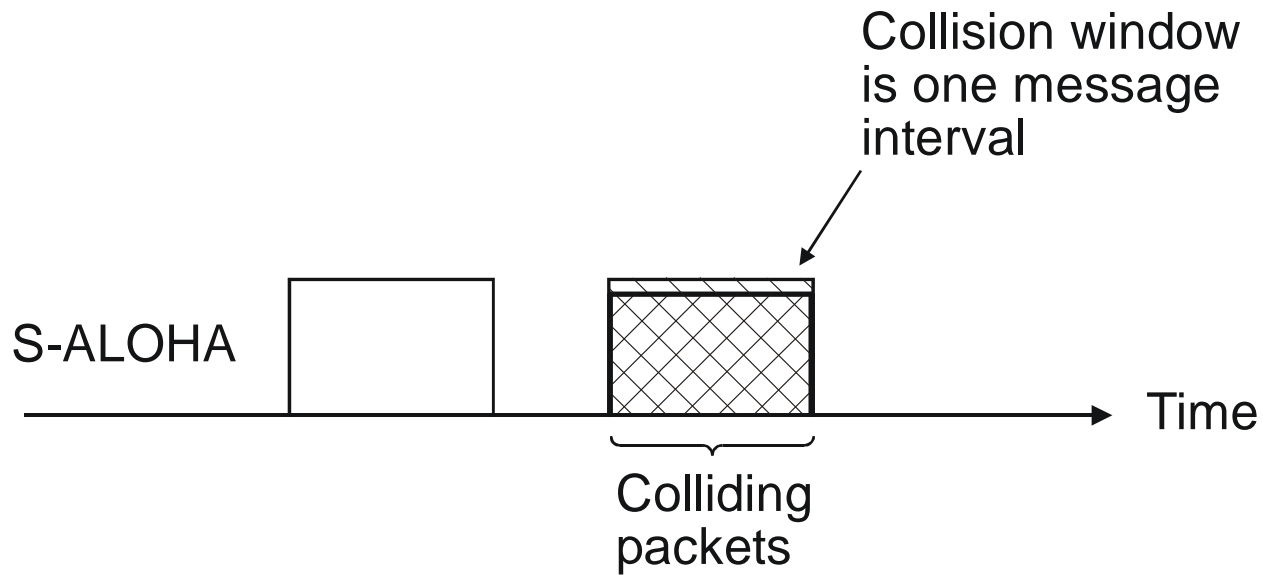
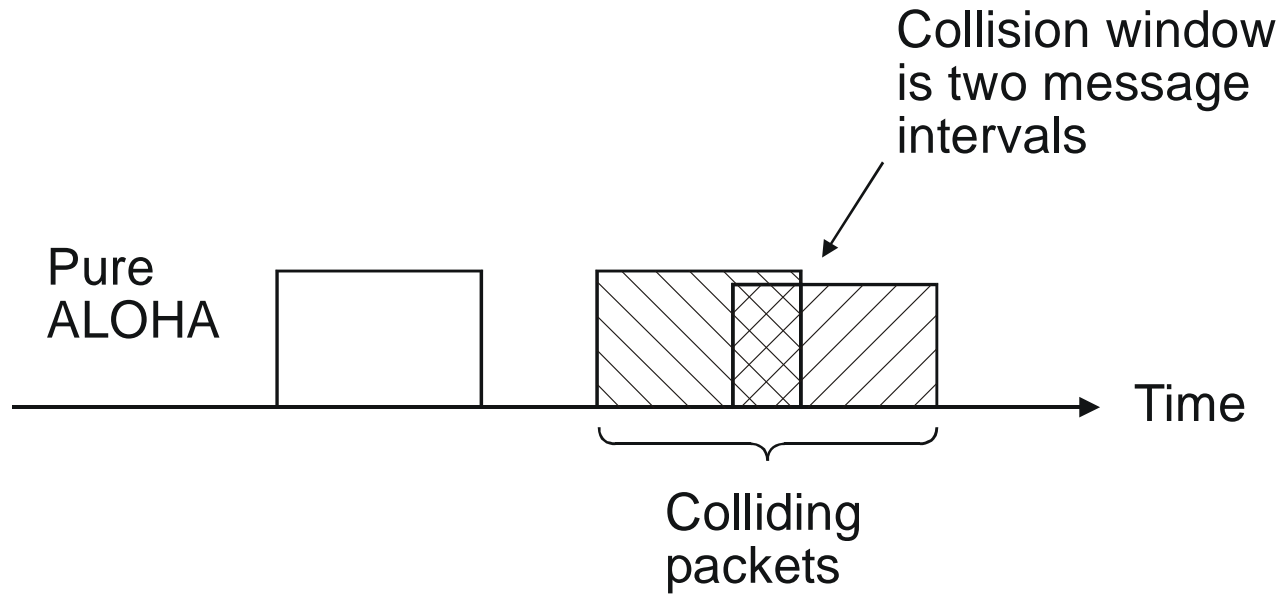




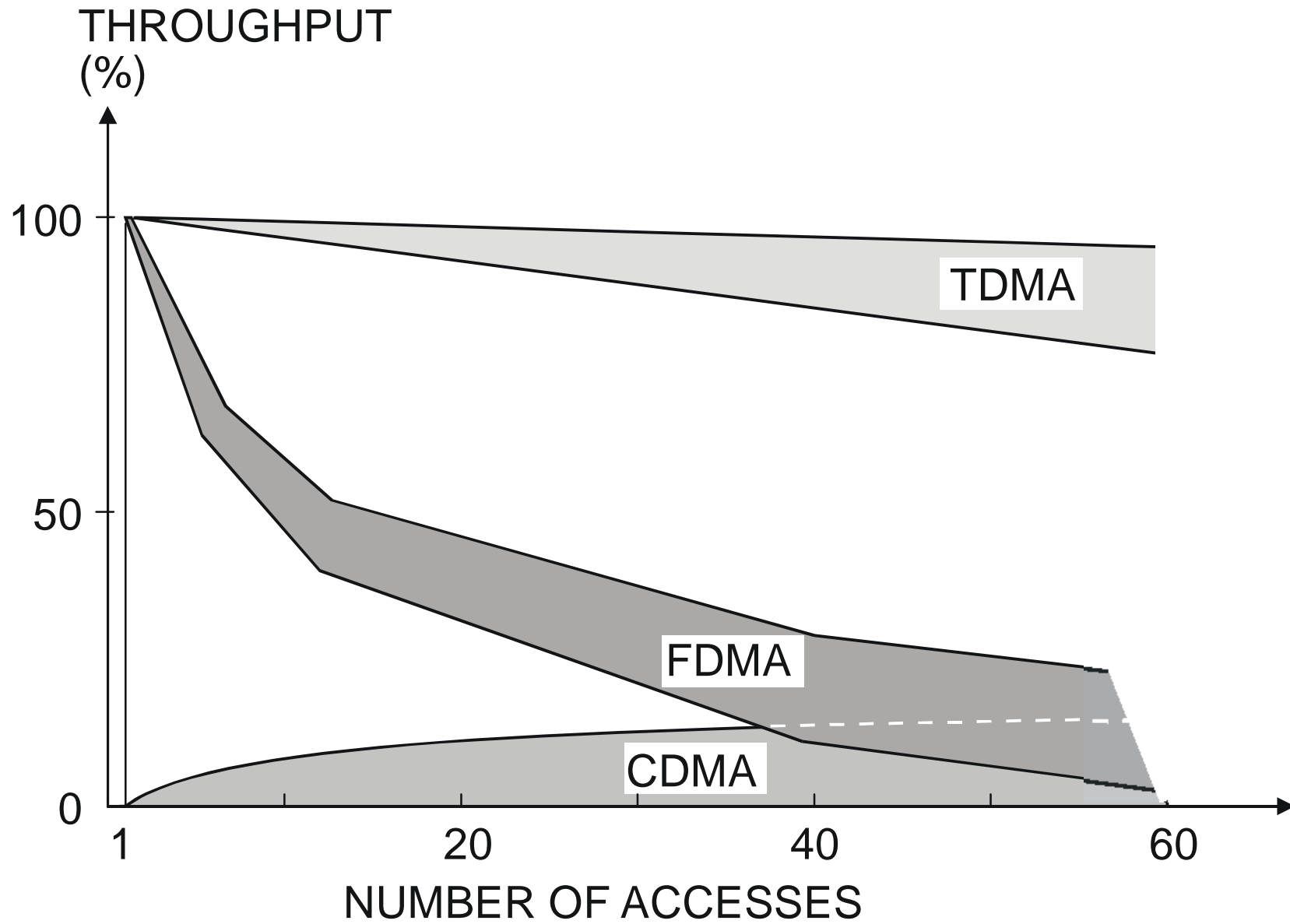
**Fig. 4-3:** Average transmission delays



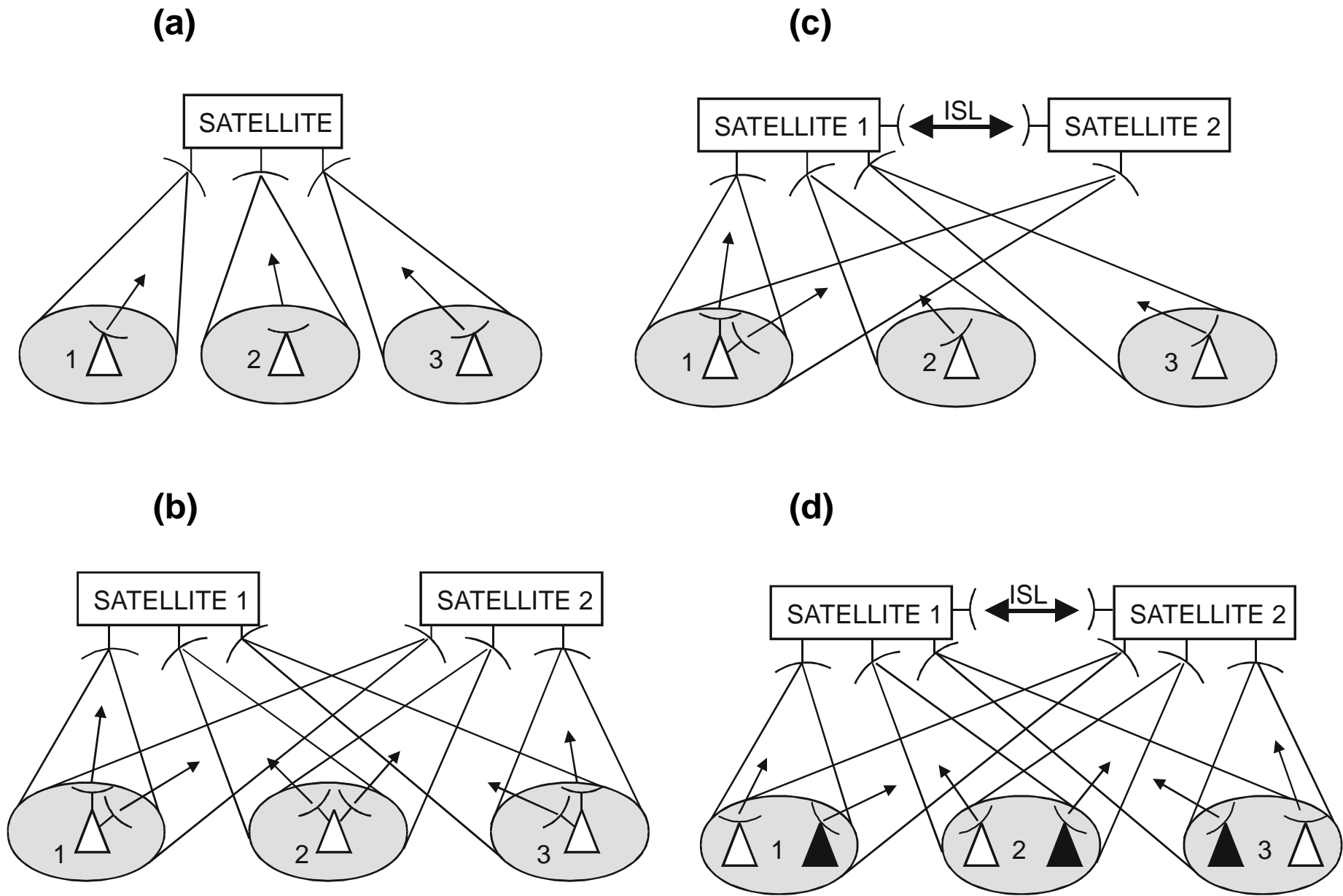
**Fig. 4-4:** Selective Rejection ALOAH



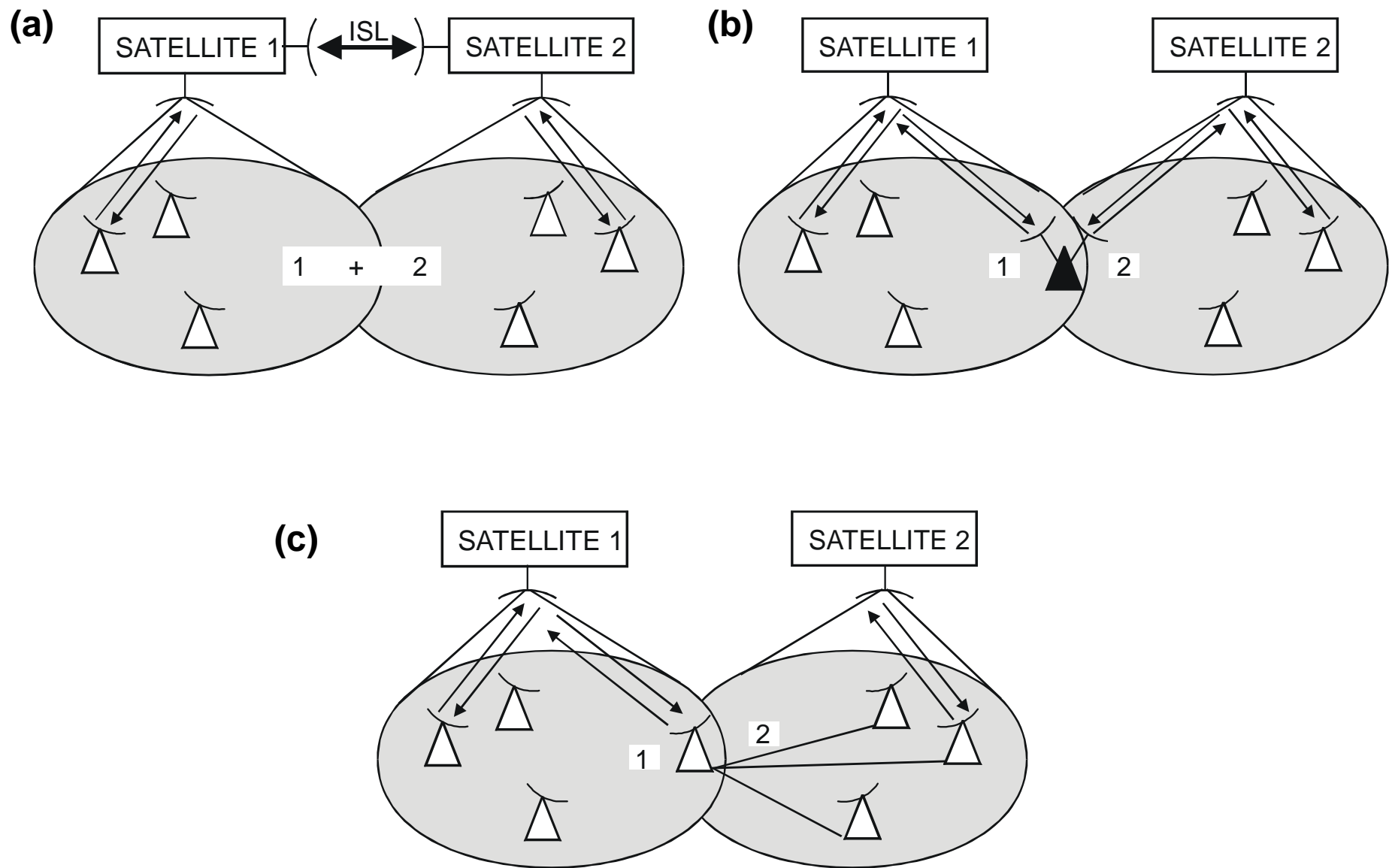
**Fig. 4-5:** Pure ALOAH, Slotted ALOAH: Collision Diagrams



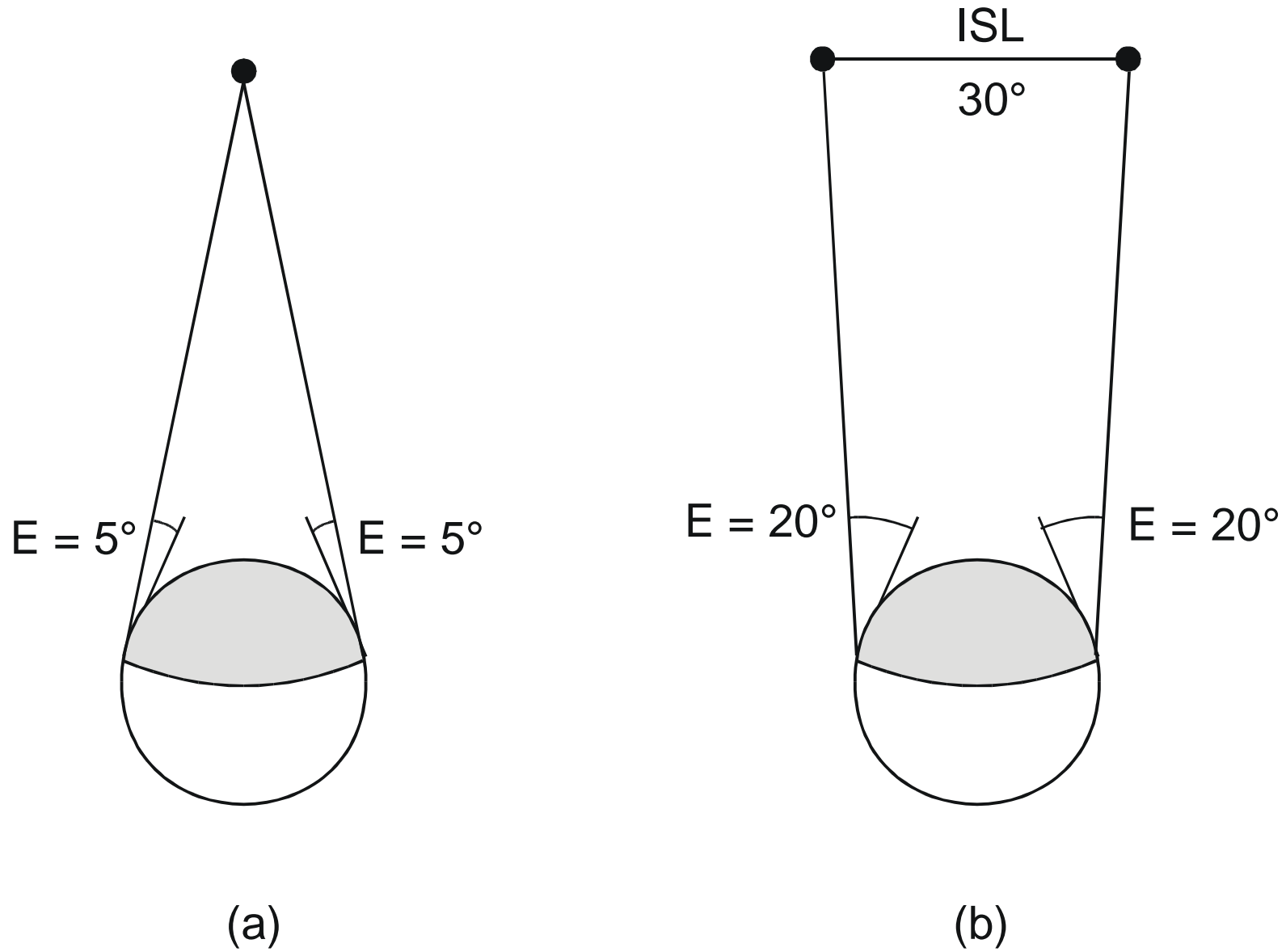
**Fig. 4-6:** TDMA, FDMA CDMA: Comparison of throughput



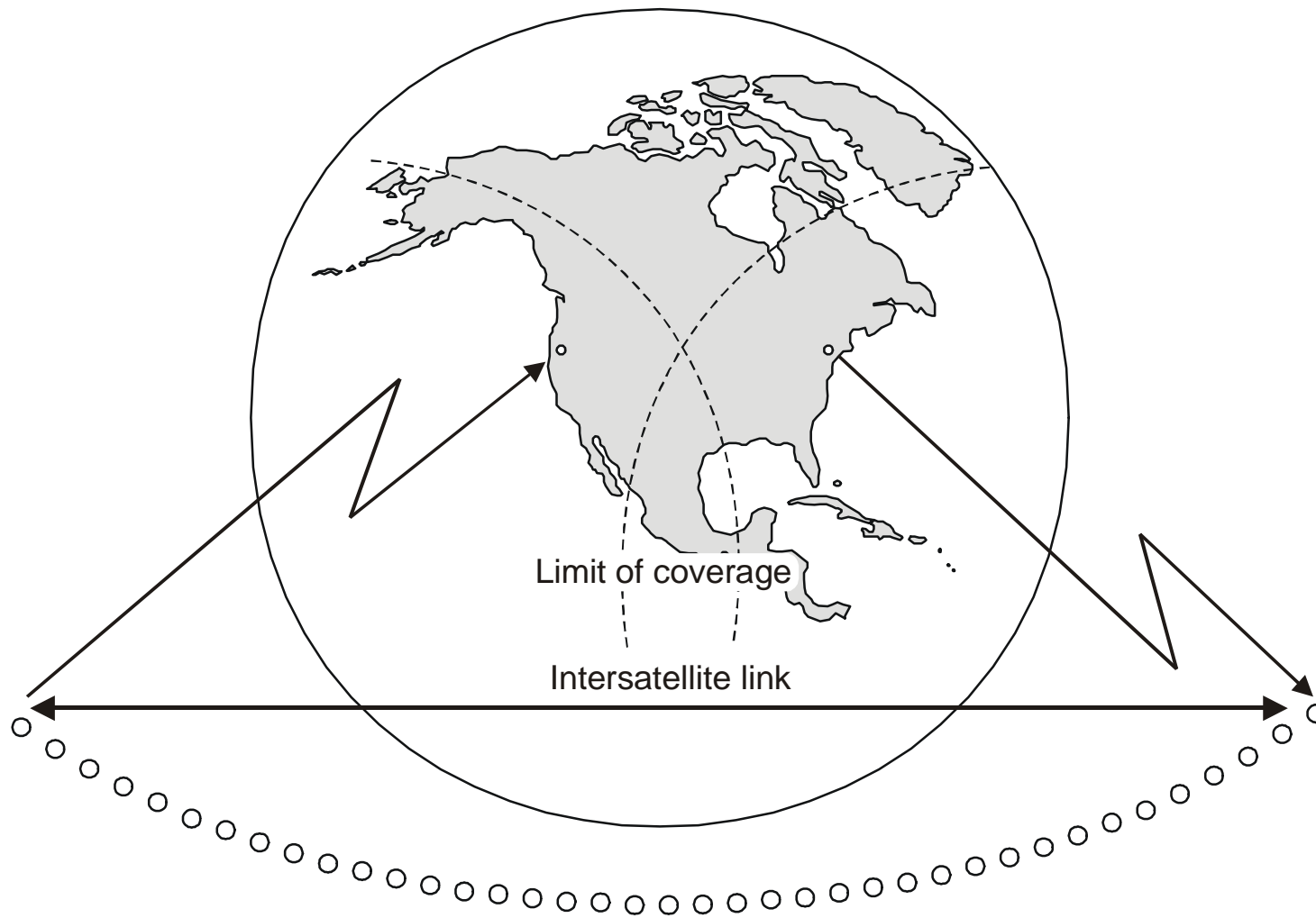
**Fig. 5-1:** Use of an ISL to increase the systems capacity



**Fig. 5-2:** Extension of system coverage (a) by using an ISL (b) by using a station comon to both networks (c) by using a terrestrial network

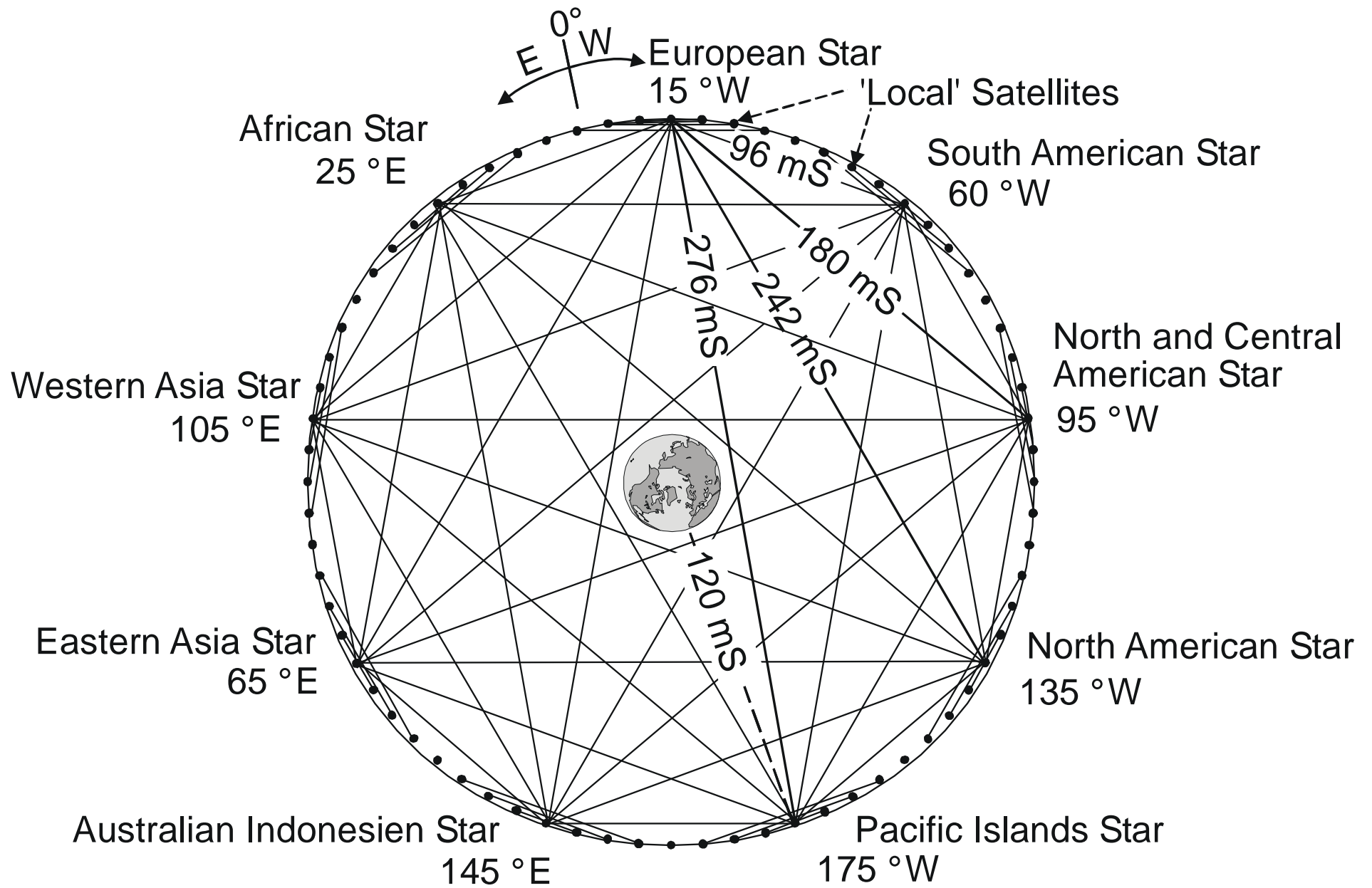


**Fig. 5-3:** Increase of the minimum elevation angle of earth station

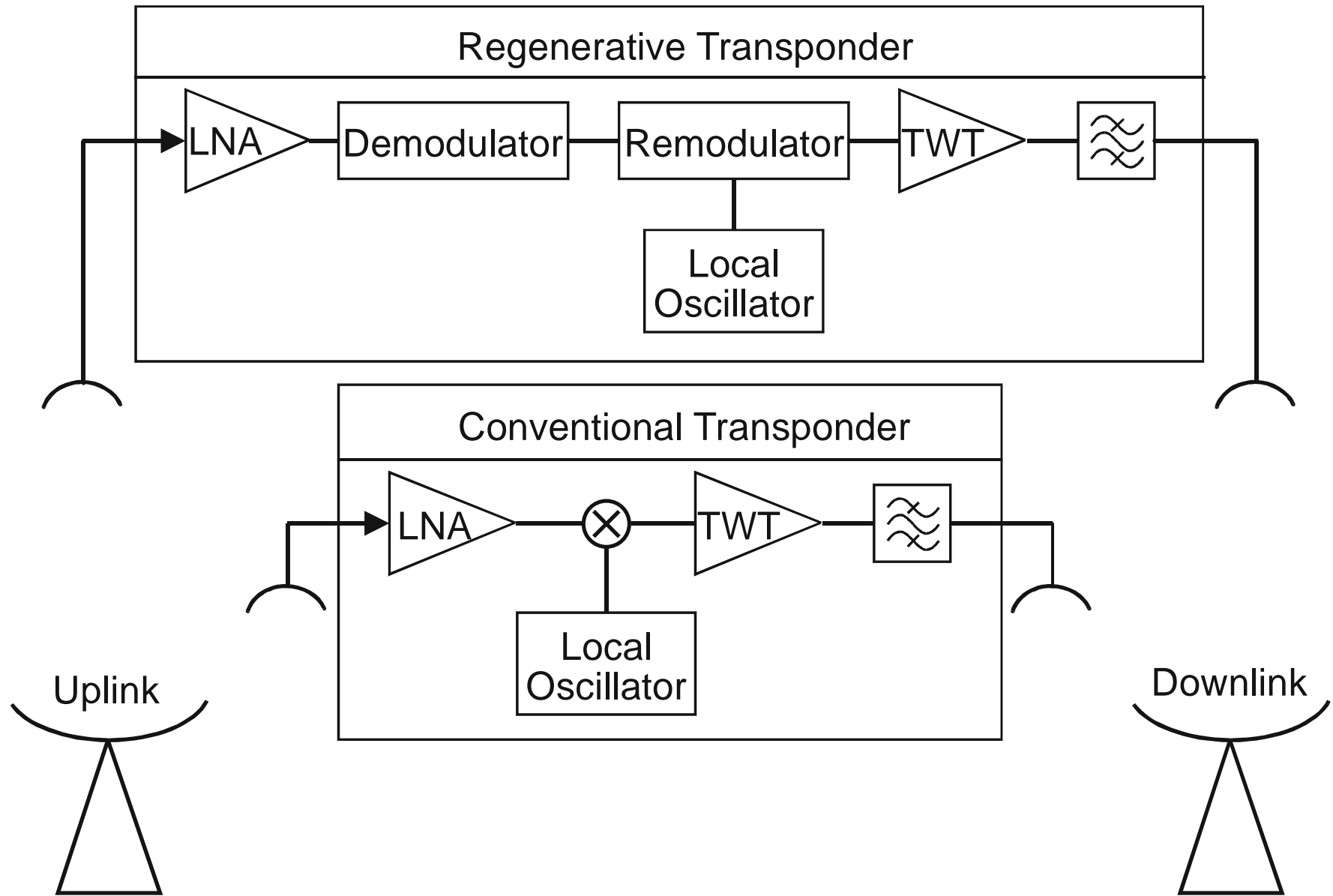


**Fig. 5-4:** Complete coverage of the United States in spite of saturation of the orbital arc

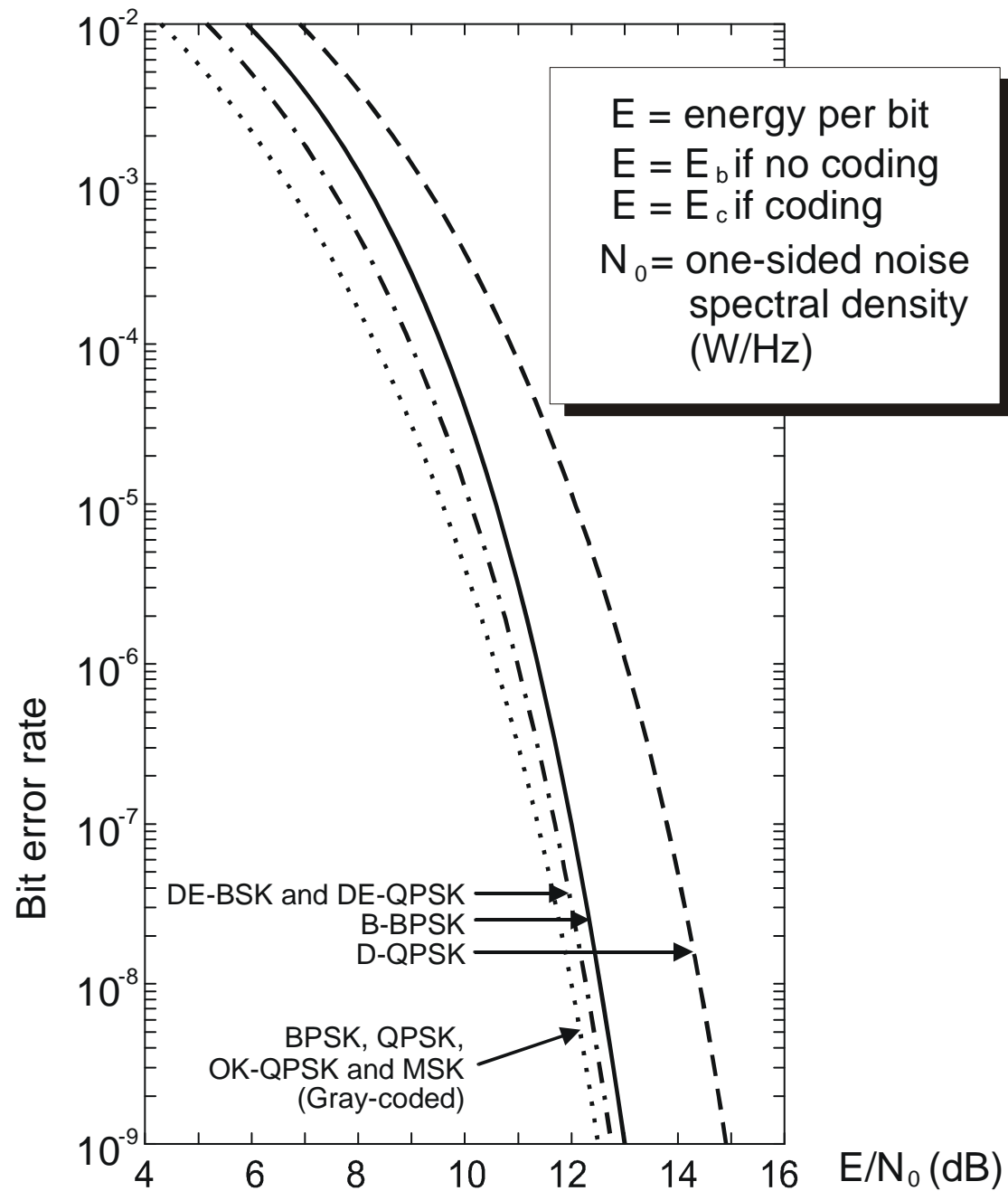




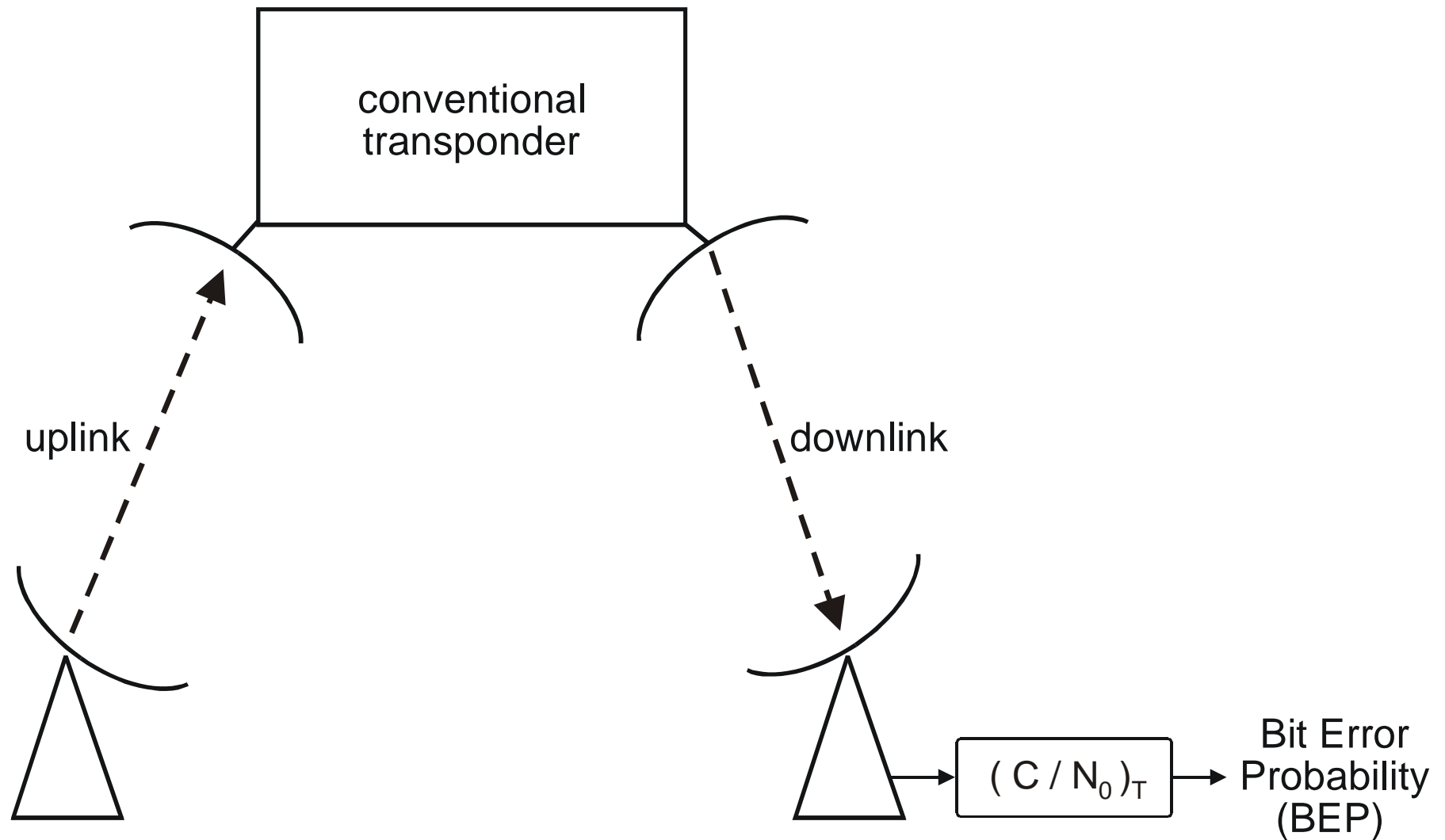
**Fig. 5-5:** Example of global network



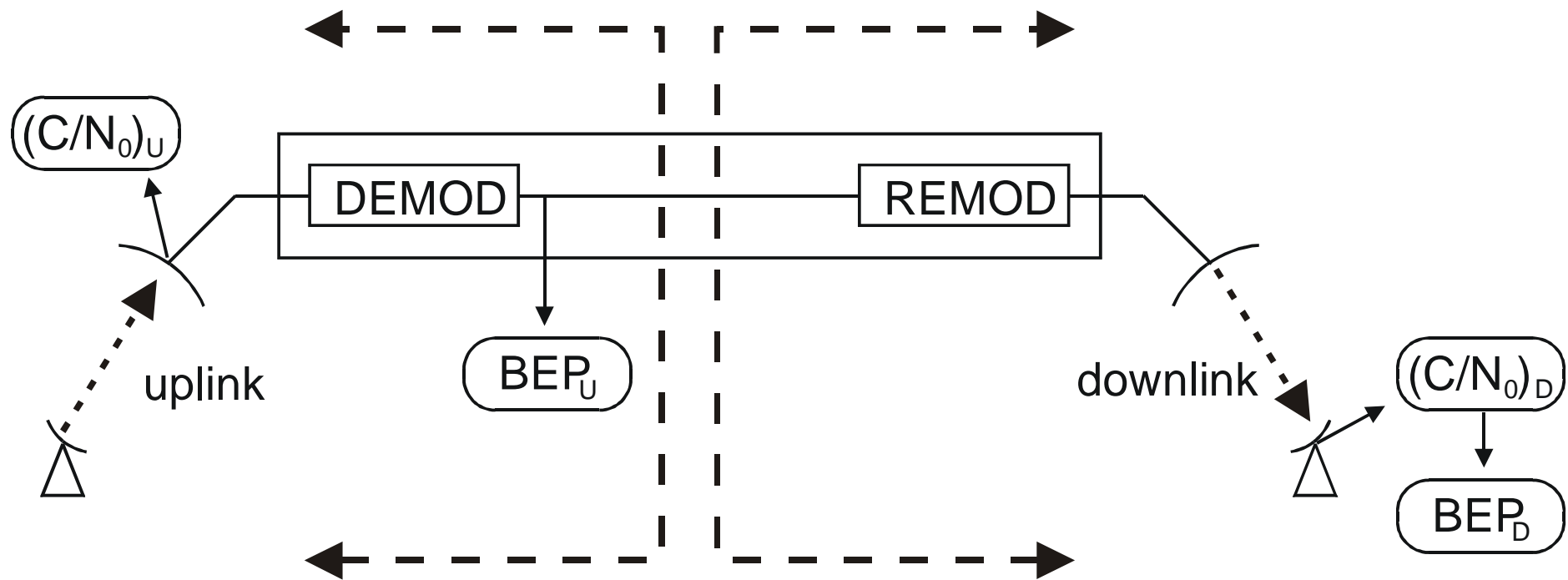
**Fig. 6-1:** Regenerative versus transparent transponder



**Fig. 6-2:** Bit error rates



**Fig. 6-3:** SATCOM-link with a transparent transponder



**Fig. 6-4:** SATCOM-link with a regenerative transponder

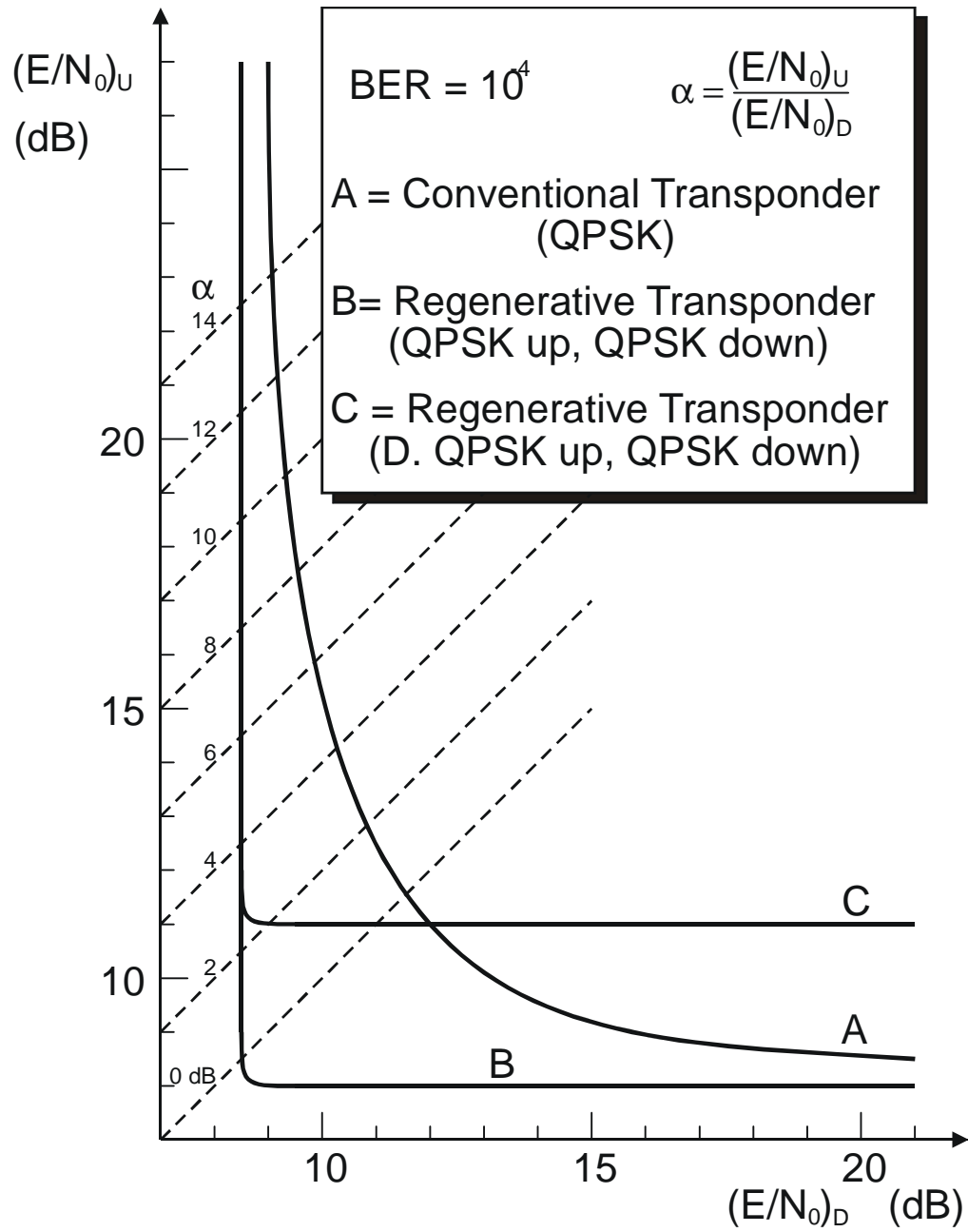
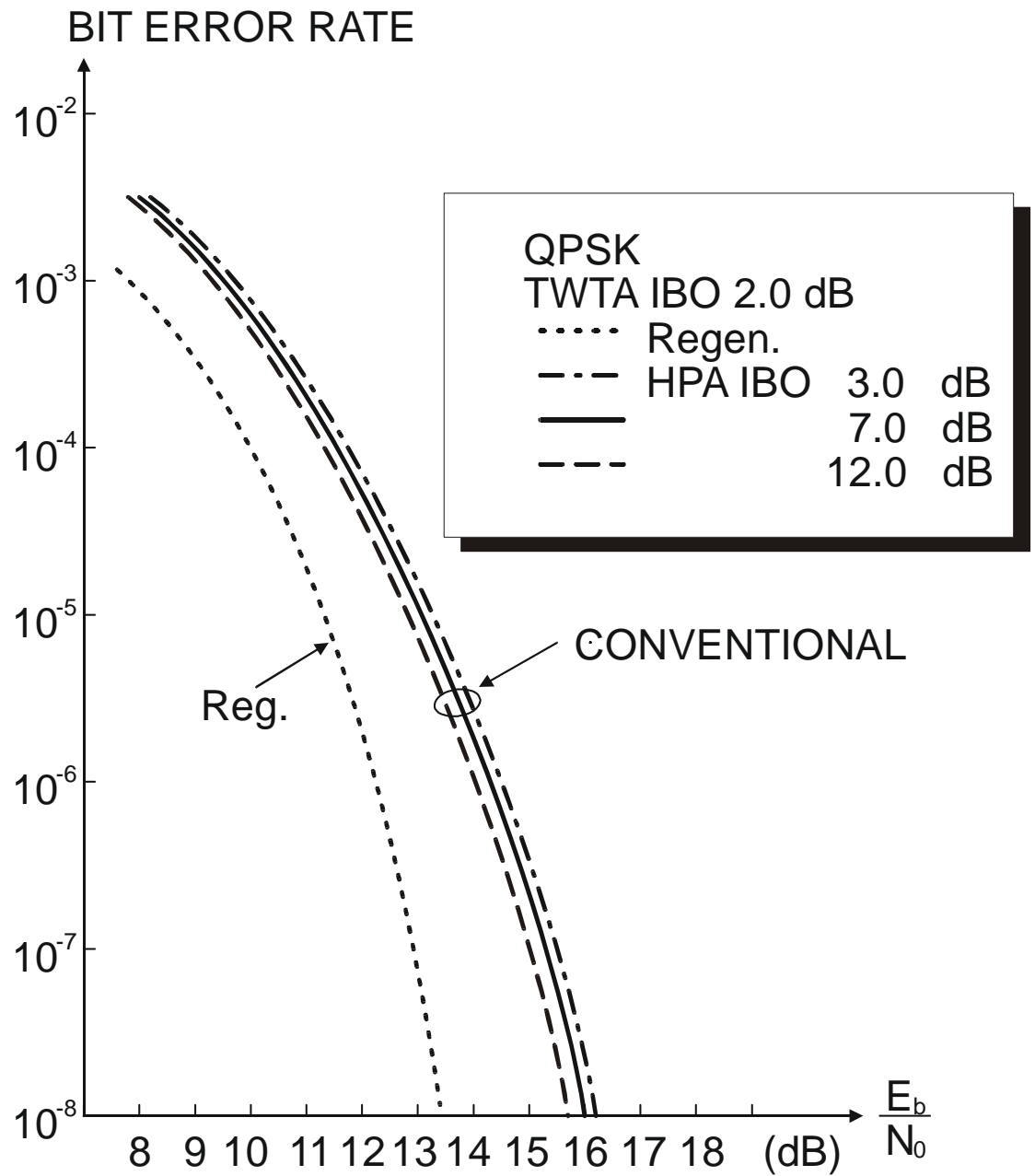
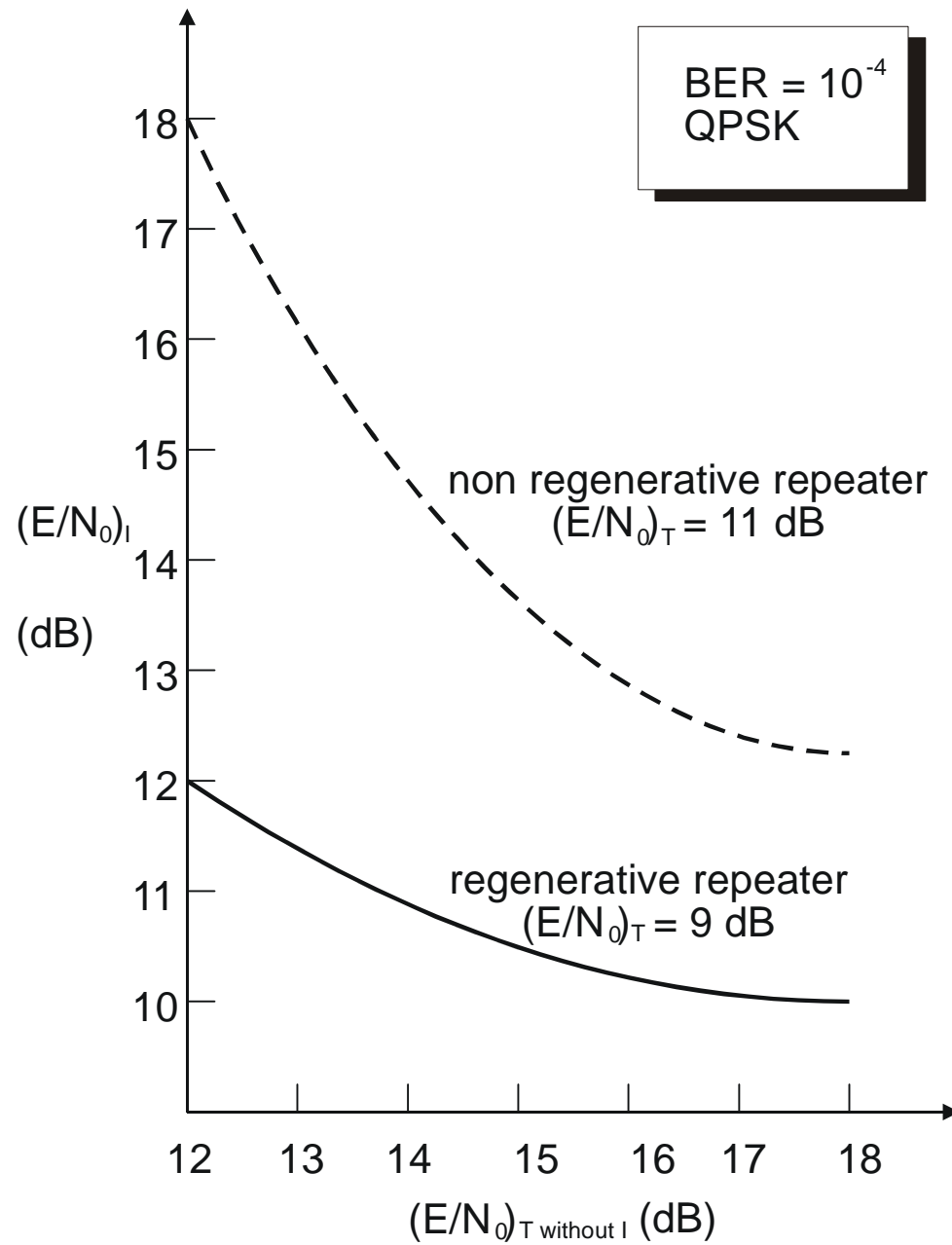


Fig. 6-5: Comparison of station – to - station

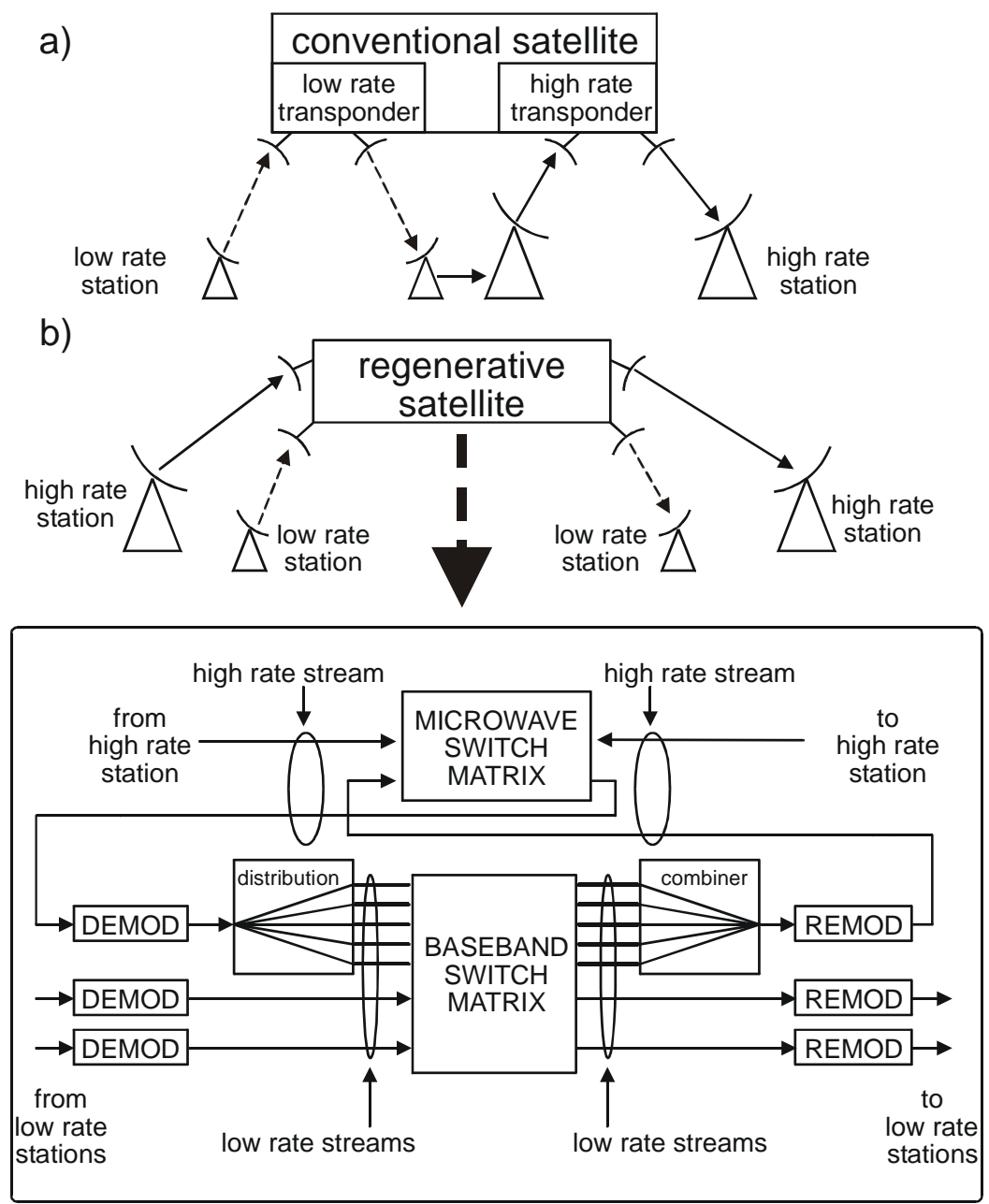


**Fig. 6-6:** Bit error rates

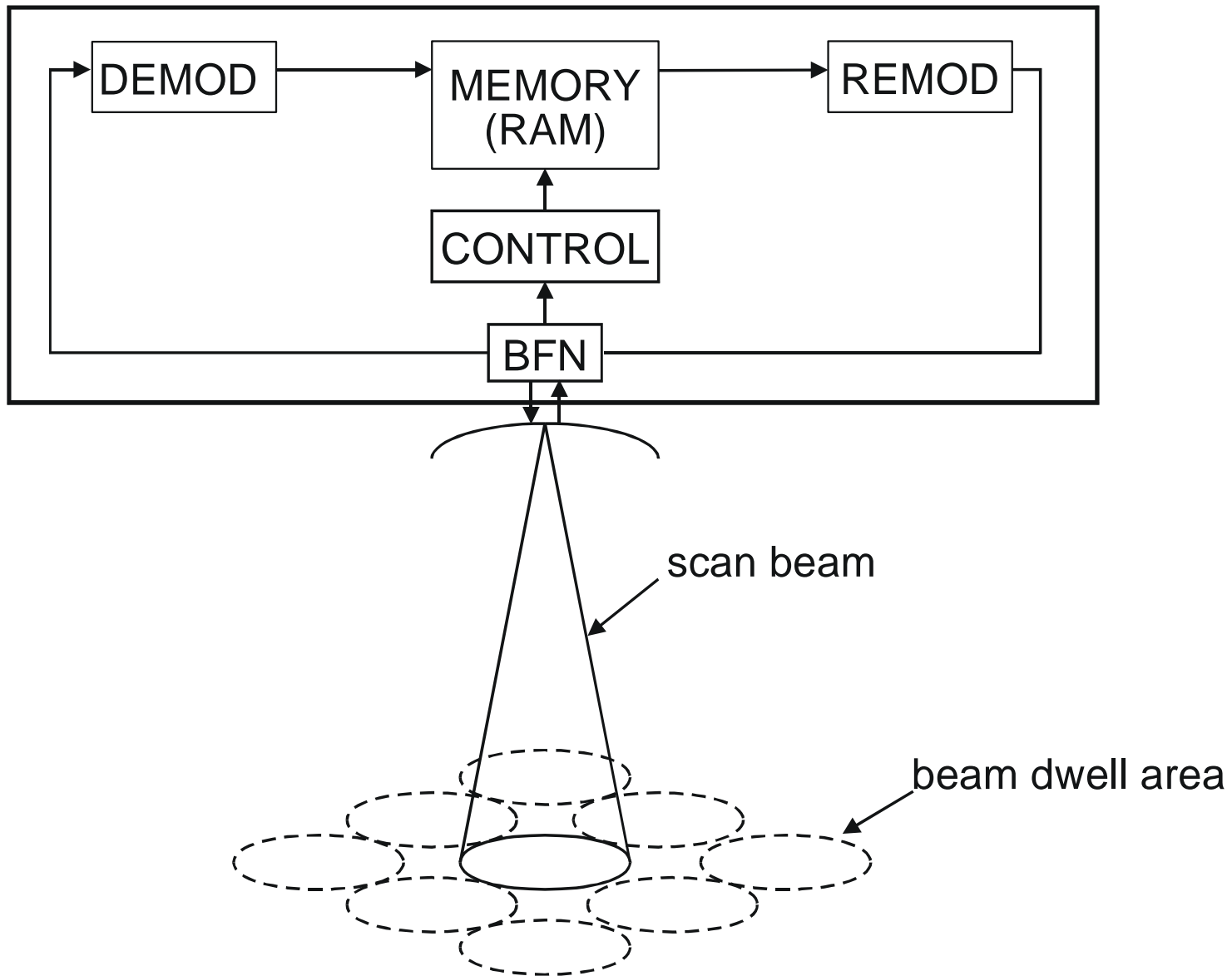


**Fig. 6-7:** Permissible interference level

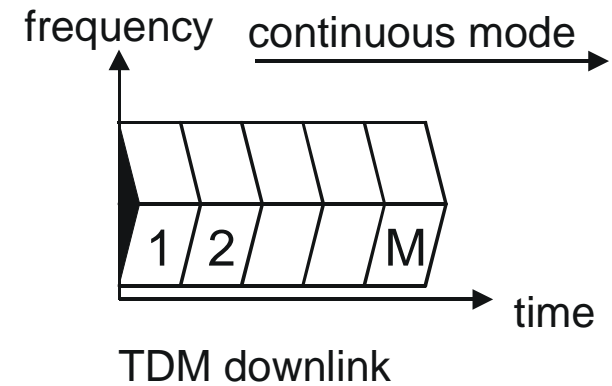
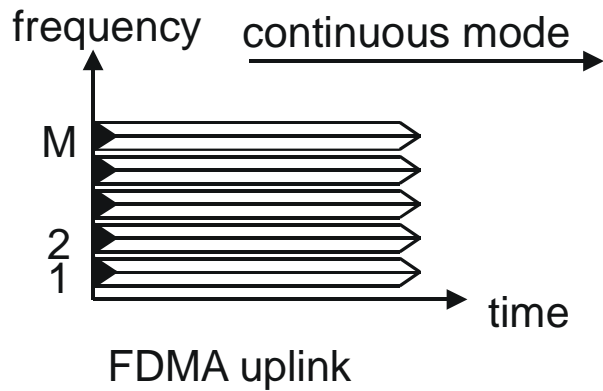
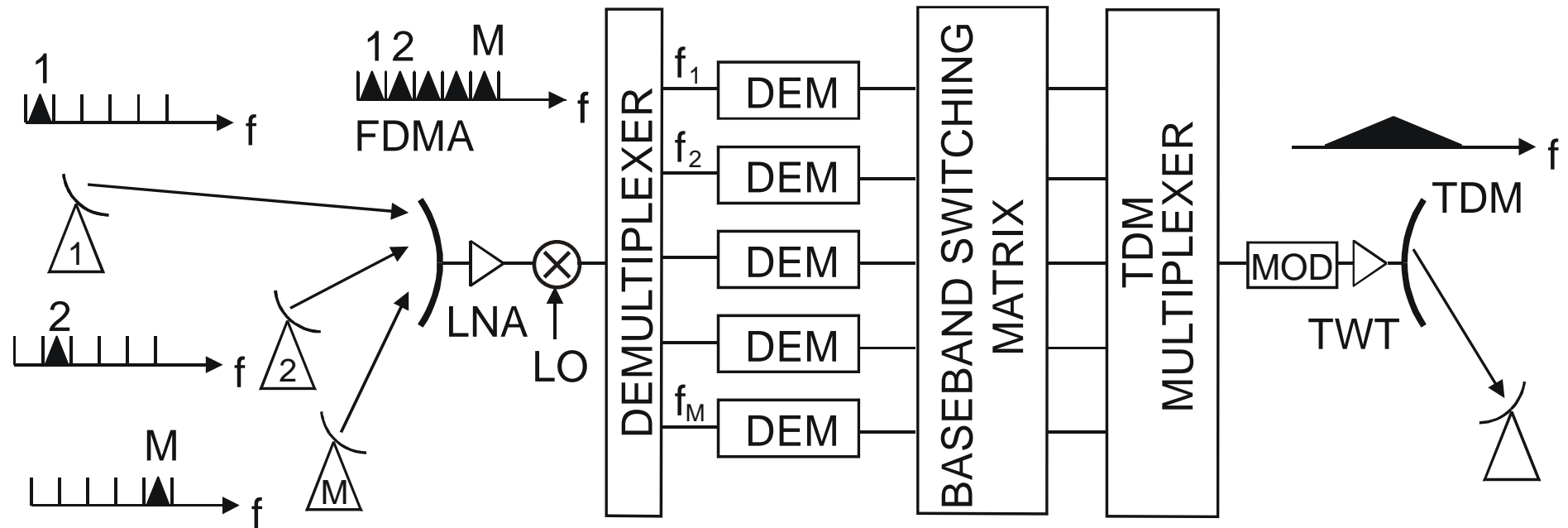




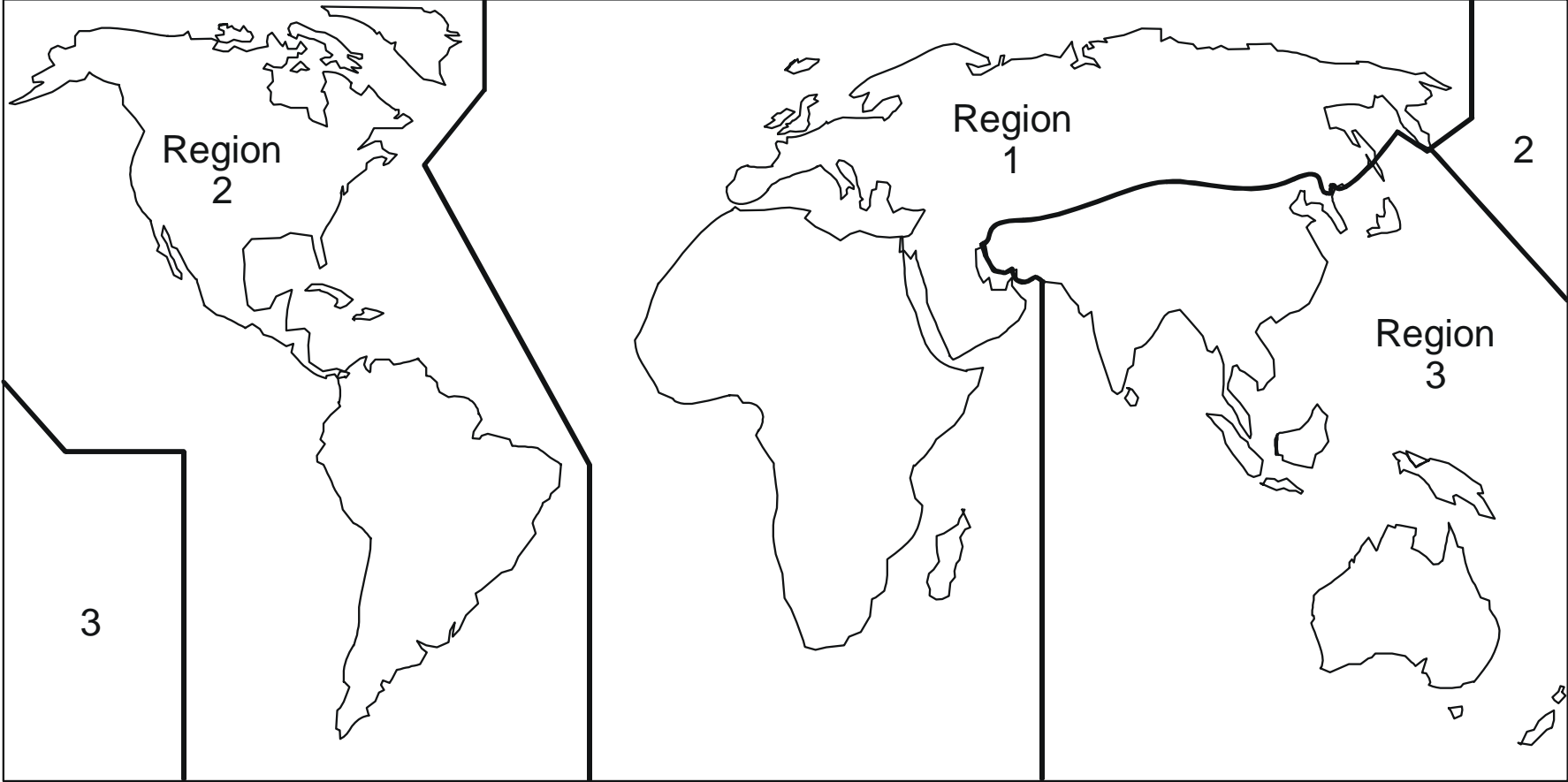
**Fig. 6-8:** Interconnection of two networks with carriers of different capacity



**Fig. 6-9:** Single beam regenerative scanning satellite network



**Fig. 6-10:** Regenerative transponder using FDMA on the uplink and TDM or the downlink



**Fig.7-1: ITU regions**

Style of Type  
used to designate  
allocation:

RESOURCE

PRIMARY ALLOCATIONS

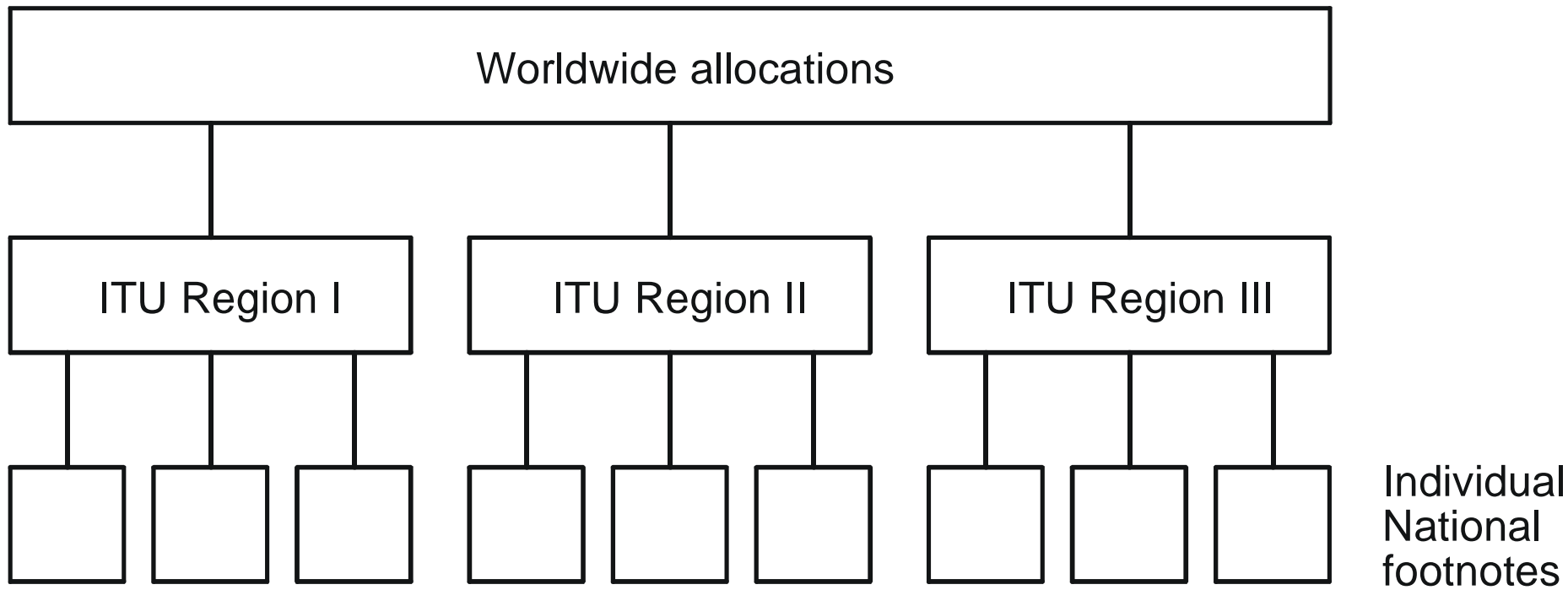
*Permitted Allocations*

Secondary  
Allocation

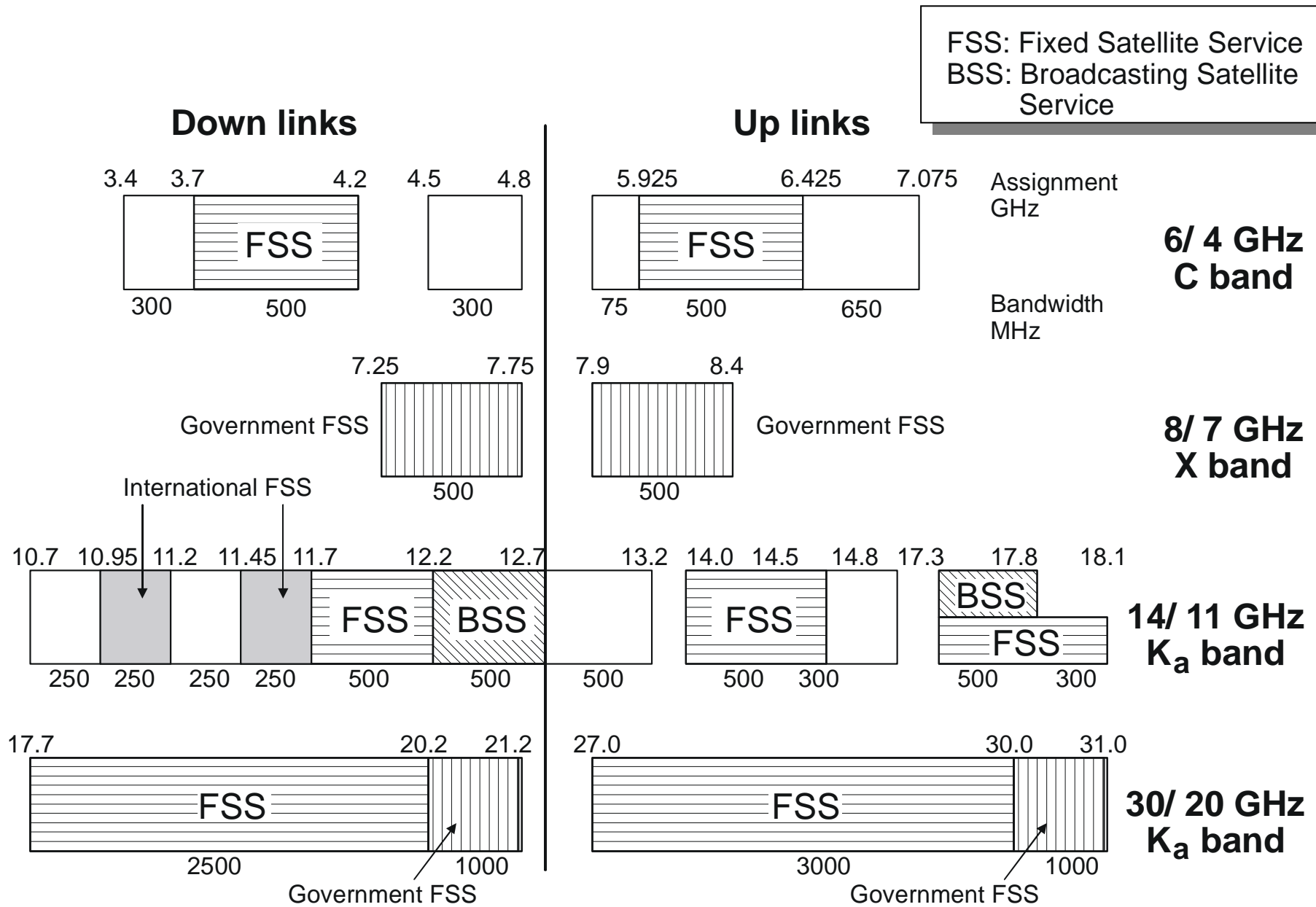
Equal rights with PRIMARY but  
PRIMARY has prior choice of  
frequencies

These services shall not cause  
harmful interference to or claim  
protection from stations of a  
PRIMARY or permitted service

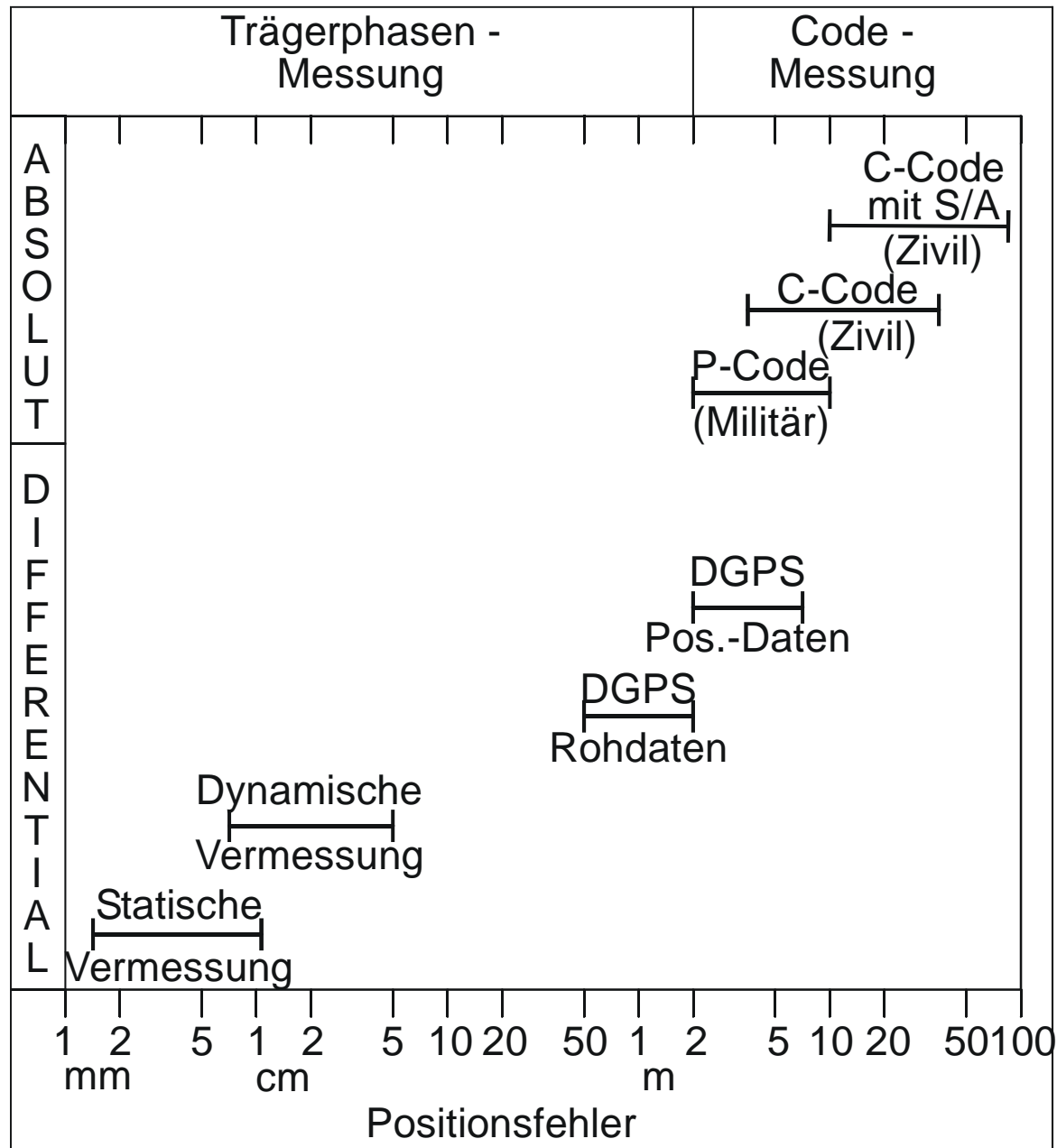
**Fig. 7-2:** ITU allocations by priority classification



**Fig. 7-3:** ITU allocations by geographical region

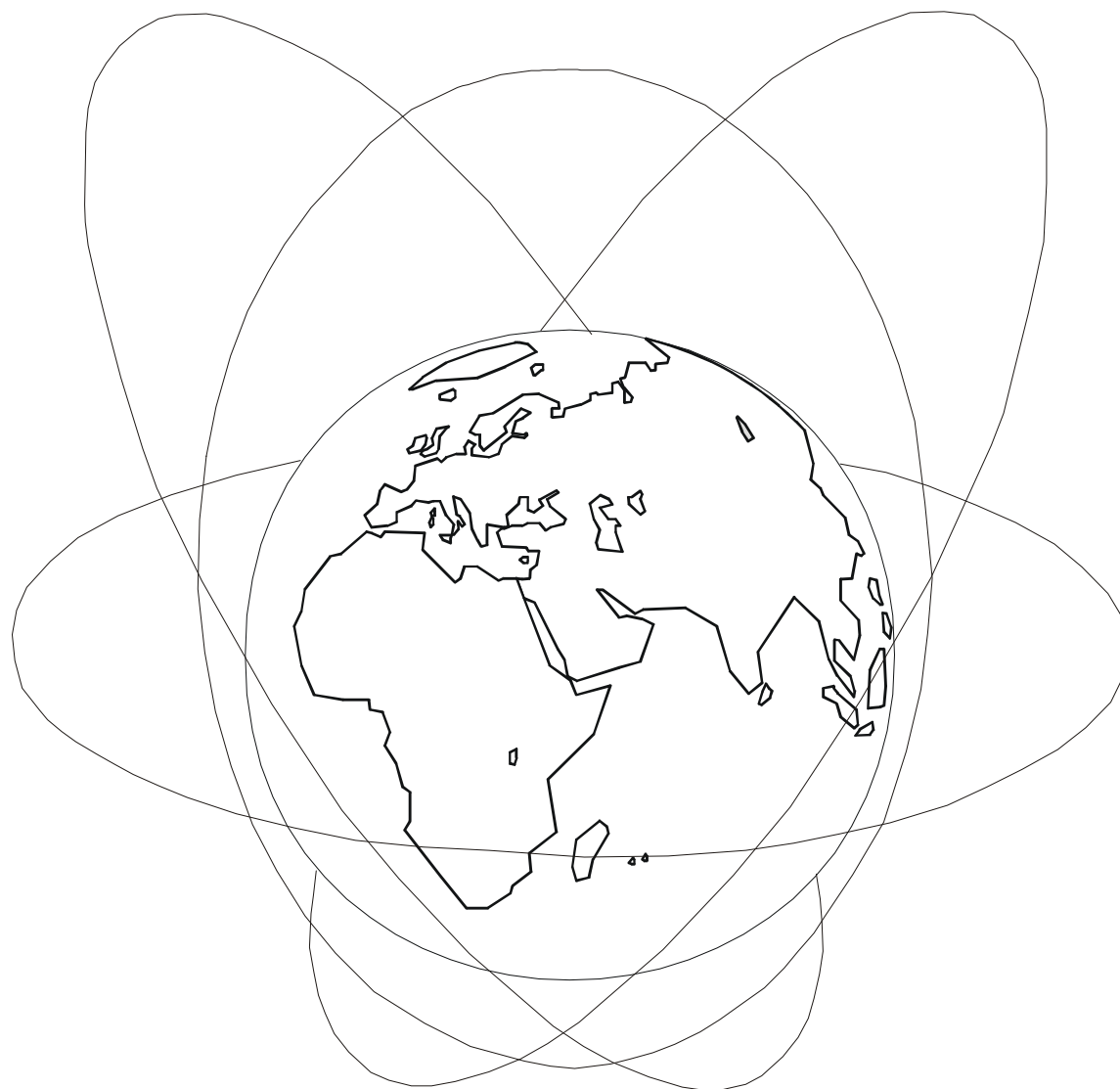


**Fig. 7-4:** Western hemisphere frequency assignments

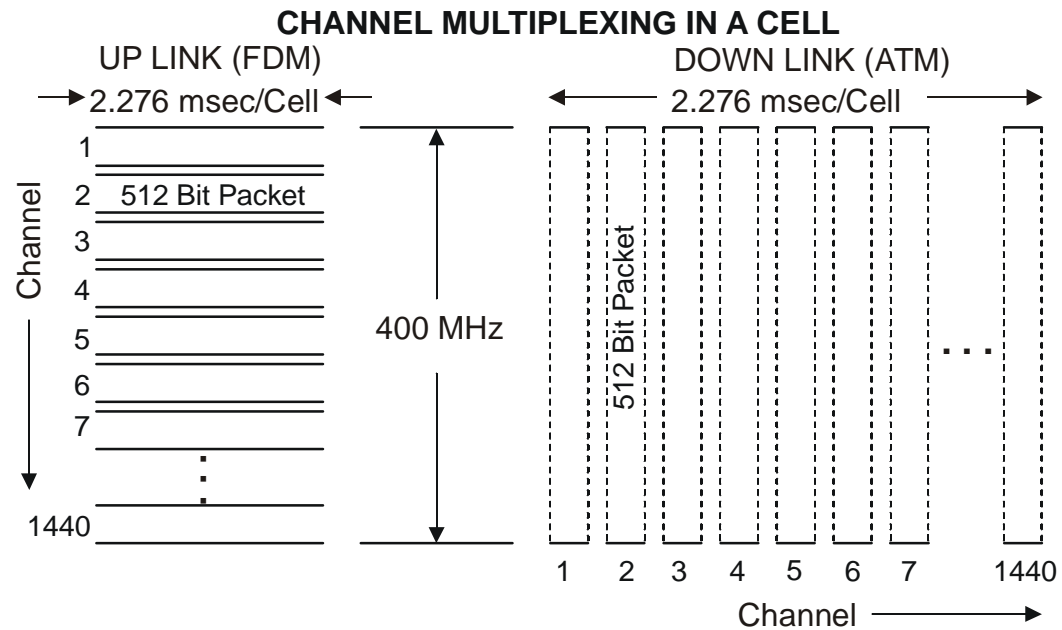
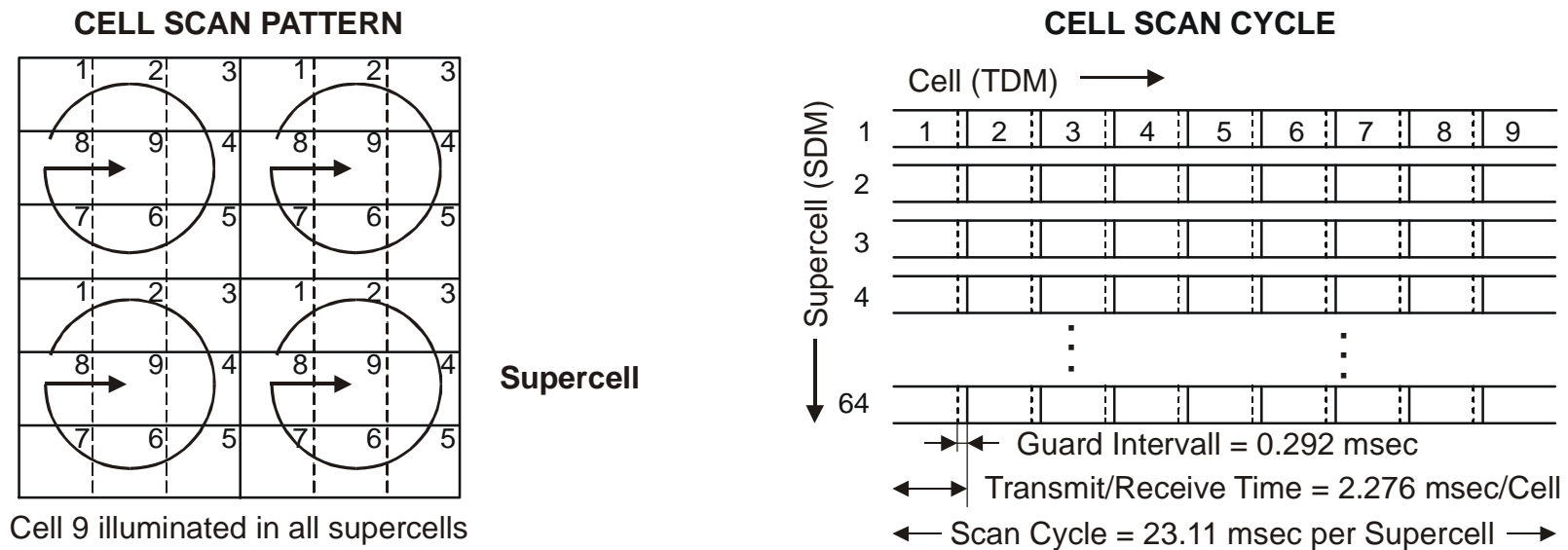


**Fig. 7-5: GPS Genauigkeitsstufen**





**Fig. 7-6: ELLIPSO: Three inclined elliptical and circular equitorial orbit**



**Fig. 7-7: Teledisc's Standard Terminal Multi Access Method**