ບົດທີ 8 ການນຳໃຊ້ເຄືອຂ່າຍໂທລະສັບຜ່ານສາຍໃນການສົ່ງຂໍ້ມູນ (Using Telephone and Cable Networks for Data Transmission)

1. ເຄືອຂ່າຍໂທລະສັບ (TELEPHONE NETWORK)

ເຄືອຂ່າຍໂທລະສັບຕັ້ງໂຕ໊ະແມ່ນໃນລະບົບສະວິດແບບ circuit switching. ເຄືອຂ່າຍໂທລະສັບໄດ້ເລີ່ມກຳເນີດຂຶ້ນກ່ອນປີ ຄ.ສ1800. ເຄືອຂ່າຍທັງໝົດ ແມ່ນຖືກອ້າງອີງການໃຊ້ງານລະບົບ plain old telephone system (POTS), ເປັນລະບົບອະນາລັອກແບບດັ່ງເດີມທີ່ໃຊ້ສັນຍານອະນາລັອກເພື່ອສົ່ງສັນຍານສຽງ.

Figure 1 ລະບົບໂທລະສັບ (A telephone system)

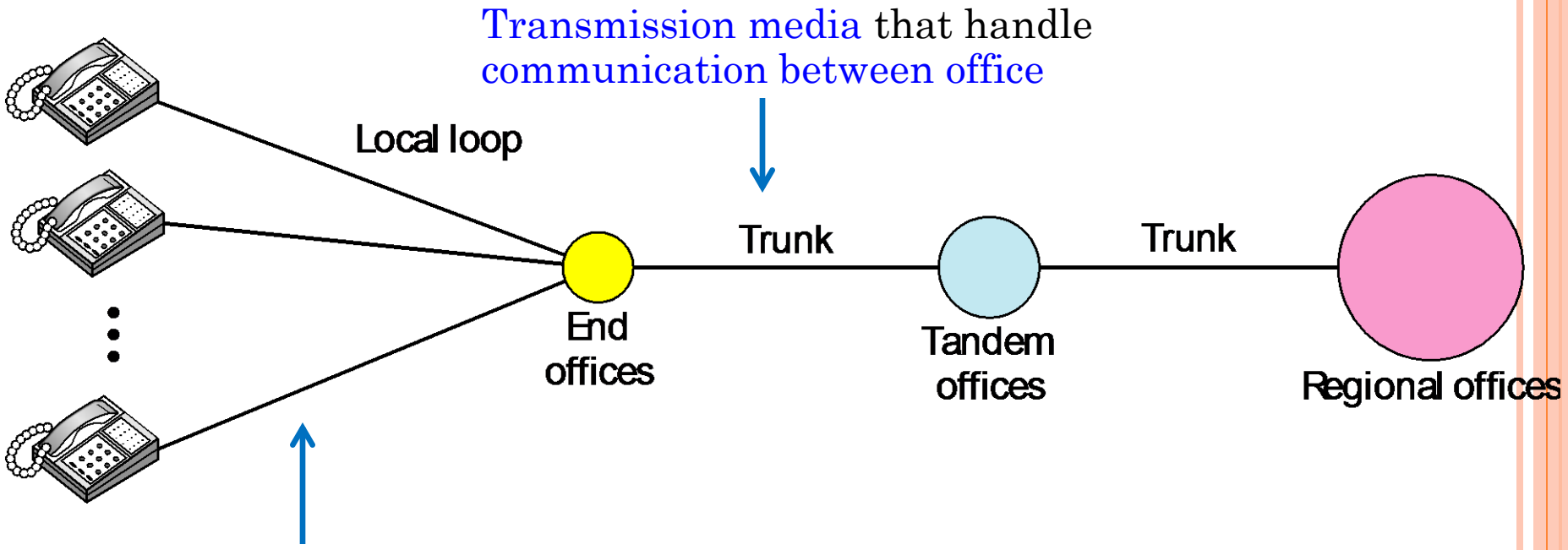
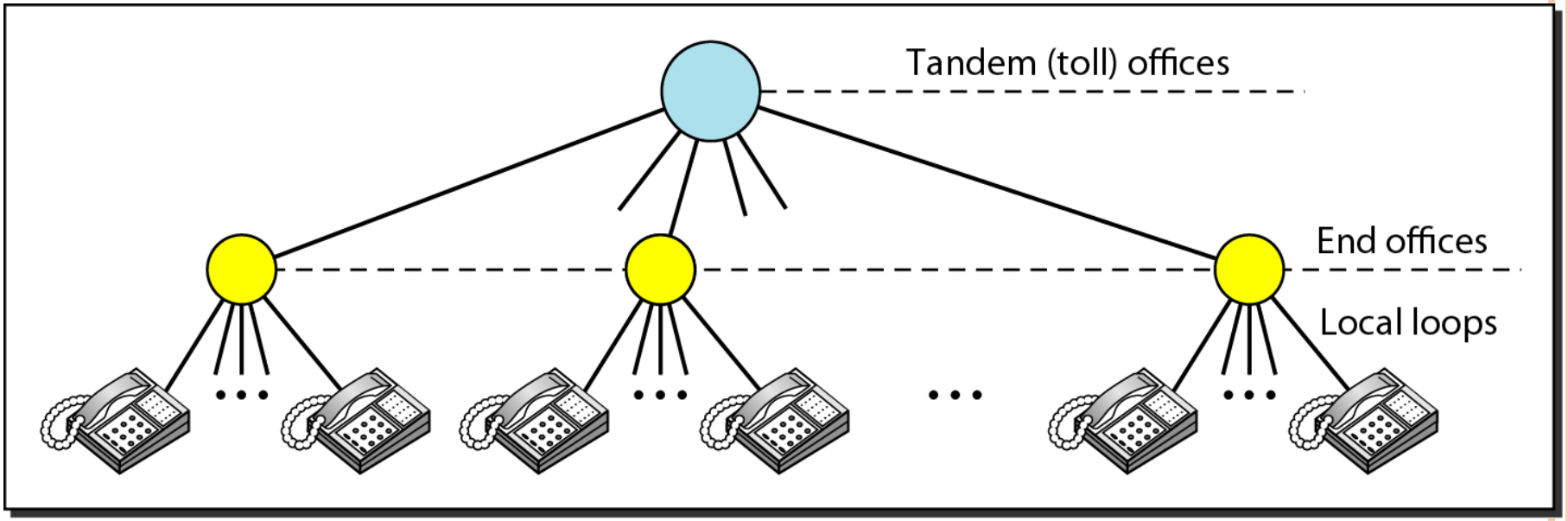
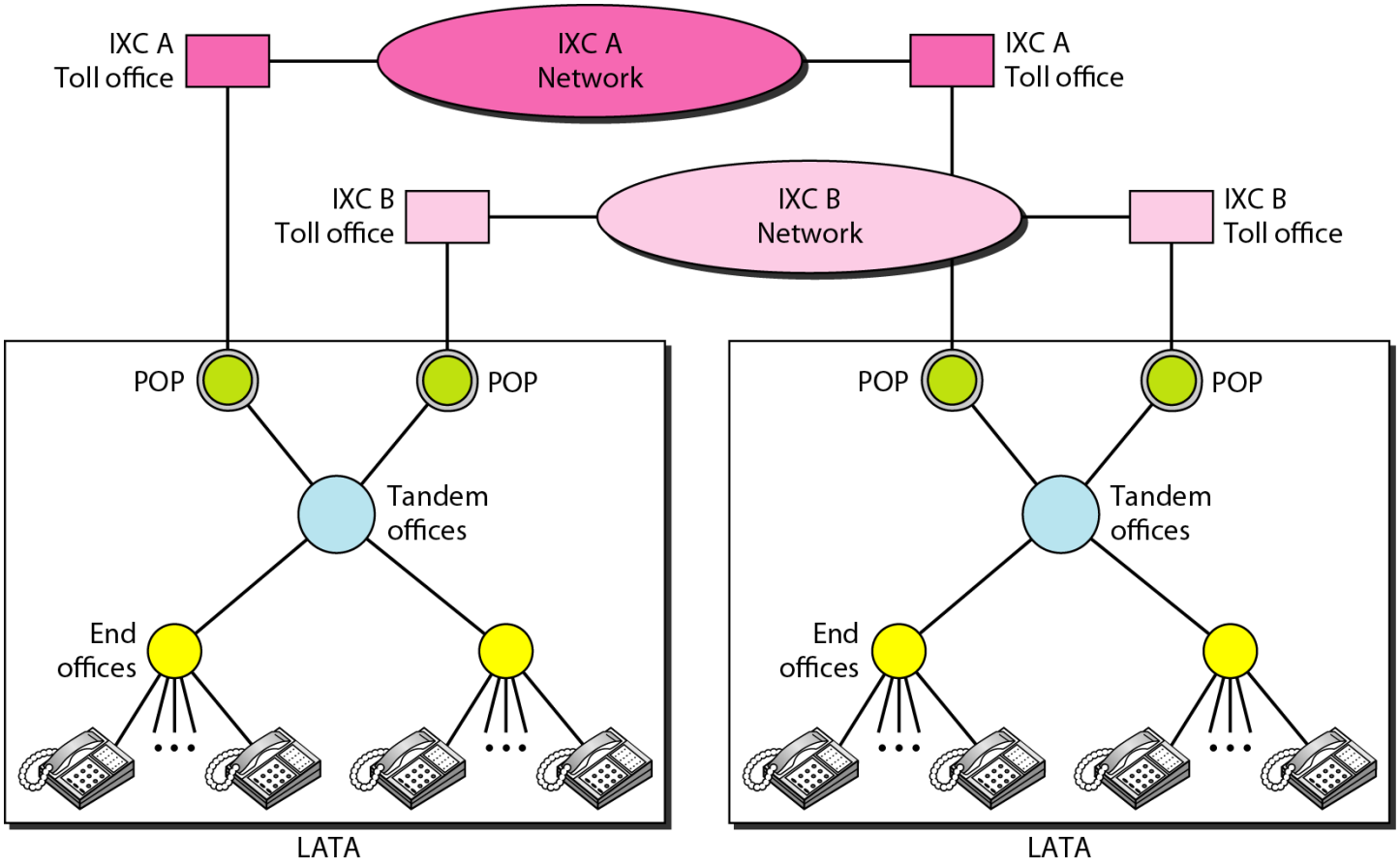


Figure 2 *Switching offices in a LATA (Local Access Transport Area)*



Intra-LATA service: services offered by common carriers (telephone companies) inside LATA

Figure 3 *Point Of Presences (POPs)*



Inter-LATA service: services between LATAs are handled by IntereXchange Carrier (sometime called long-distance companies)
- Inter-LATA services can be provided by several IXCs

3. DIGITAL SUBSCRIBER LINE

ຫຼັງໂມເດັມແບບດັ່ງເດີມໄດ້ປະສົບຄວາມສຳເລັດໃນການສົ່ງອັດຕາຂໍ້ມູນໄດ້ສູງສຸດທີ່ເພິ່ງພໍໃຈ, ບໍລິສັດທີ່ໃຫ້ບໍລິການກ່ຽວກັບໂທລະສັບໄດ້ມີການພັດທະນາເທັກໂນໂລຍີອື່ນຂຶ້ນມາ DSL, ສາມາດເຂົ້າເຖິງອິນເຕີເນັດດ້ວຍຄວາມໄວສູງ higher-speed access to the Internet. ເທັກໂນໂລຍີ Digital subscriber line (DSL) ເປັນໜຶ່ງຂອງການສື່ສານຜ່ານສາຍໂທລະສັບທີ່ສາມາດຮອງຮັບການສື່ສານດິຈິຕອນຄວາມໄວສູງ.

Asymmetric DSL: ADSL, ADSL Lite, RADSL, VDSL

Symmetric DSL: HDSL, SDSL

Note

ADSL ແມ່ນເທັກໂນໂລຢີການສື່ສານແບບ asymmetric ອອກແບບມາ ສຳລັບໃຊ້ງານພາຍໃນເຮືອນທີ່ພັກອາໃສ, ບໍ່ເໝາະສົມກັບການເຮັດທຸລະກິດ.

Upload speed < Download speed

ການສື່ສານຜ່ານຄູ່ສາຍທອງແດງສາມາດຮັກ bandwidths ໄດ້ເຖິງ 1.1 MHz.

ADSL ເປັນເທັກໂນໂລຢີທີ່ສາມາດປັບຕົວໄດ້. ລະບົບແມ່ນໃຊ້ອັດຕາຂໍ້ມູນ ເທິງເງື່ອນໄຂຂອງການສື່ສານຜ່ານຄູ່ສາຍທອງແດງ.

SYMMETRIC DIGITAL SUBSCRIBER LINE (SDSL)

- SDSL ຄ້າຍຄືກັນກັບ HDSL (ໃຊ້ໜຶ່ງສາຍ twisted-pair ຂອງ HDSL)
  - ຮອງຮັບການສື່ສານແບບ full-duplex ໃນການສື່ສານແບບ symmetric ຮອງຮັບອັດຕາຄວາມໄວເຖິງ 768 kbps ໃນການເຊື່ອມຕໍ່ກັນໂດຍກົງ.
- ຄວາມແຕກຕ່າງ (The difference)
  - ການສົ່ງ (Transmission): twisted-pair (1 pairs)
  - ການນຳໃຊ້ “Echo cancellation” ເພື່ອສ້າງ full-duplex ຜ່ານໜຶ່ງສາຍສົ່ງ ສັນຍານ.

Table *Summary of DSL technologies*

Technology	*Downstream Rate*	*Upstream Rate*	*Distance (ft)*	*Twisted Pairs*	*Line Code*
ADSL	1.5–6.1 Mbps	16–640 kbps	12,000	1	DMT
ADSL Lite	1.5 Mbps	500 kbps	18,000	1	DMT
HDSL	1.5–2.0 Mbps	1.5–2.0 Mbps	12,000	2	2B1Q
SDSL	768 kbps	768 kbps	12,000	1	2B1Q
VDSL	25–55 Mbps	3.2 Mbps	3000–10,000	1	DMT

4. CABLE TV NETWORKS

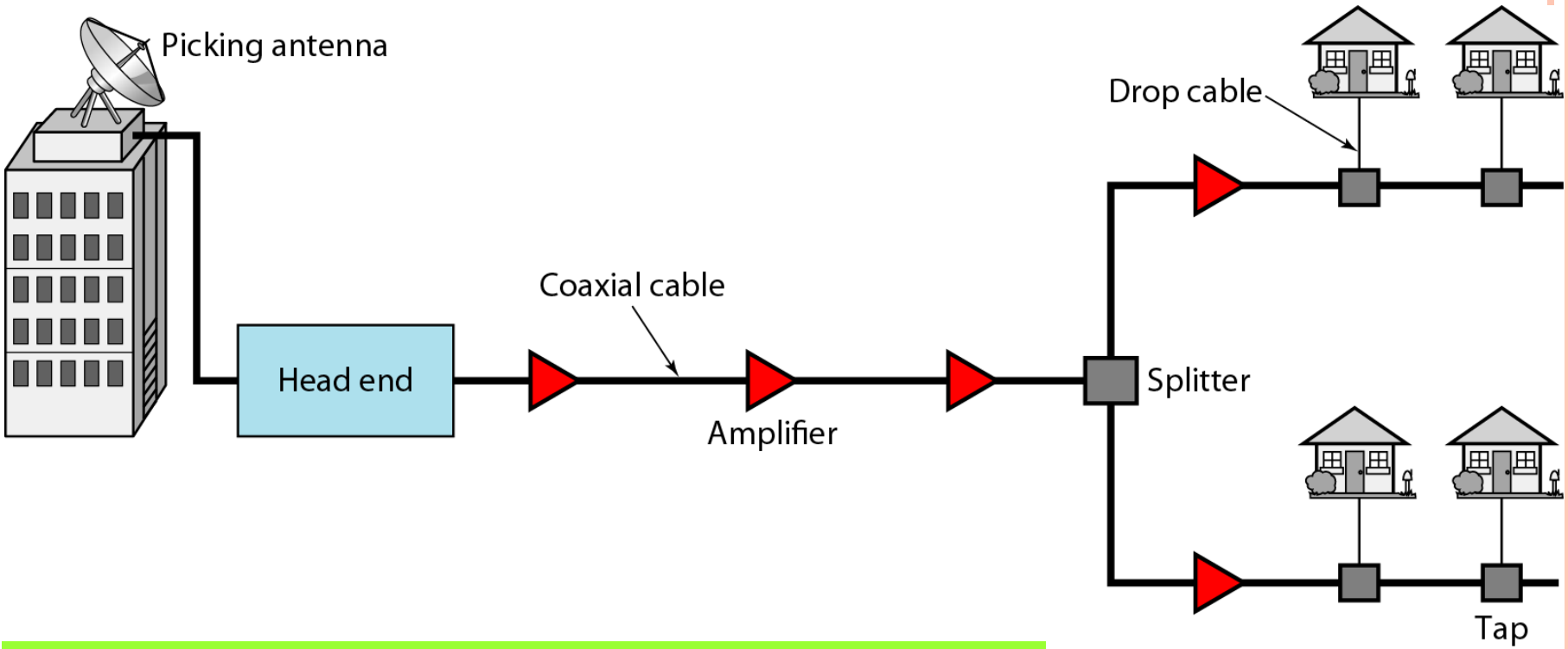
ຜູ້ໃຫ້ບໍລິການໃນເຄືອຂ່າຍໂທລະພາບ TV network ໄດ້ເລີ່ມໃຫ້ບໍລິການຮູບແບບວີດີໂອ, ແຕ່ມັນໄດ້ກ້າວເຂົ້າໄປເປັນທຸລະກິດຂອງອິນເຕີເນັດ. ເຄືອຂ່າຍນີ້ສາມາດໃຫ້ບໍລິການການຫຼິ້ນອິນເຕີເນັດທີ່ມີຄວາມໄວສູງ.

Topics discussed in this section:

Traditional Cable Networks

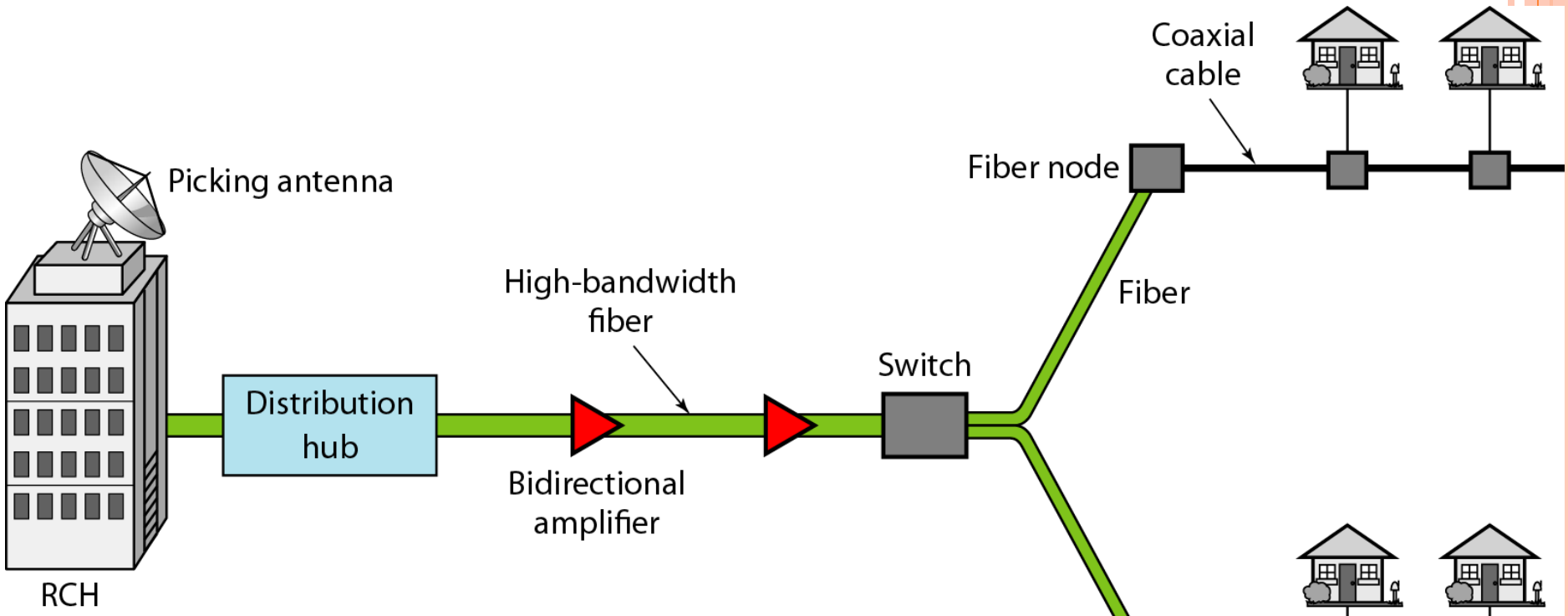
Hybrid Fiber-Coaxial (HFC) Network

Figure 4 ເຄືອຂ່າຍເຄໂບລທີວີແບບດັ່ງເດີມ (*Traditional cable TV network*)



Communication in the traditional cable TV network is unidirectional.

Figure 5 *Hybrid fiber-coaxial (HFC) network*

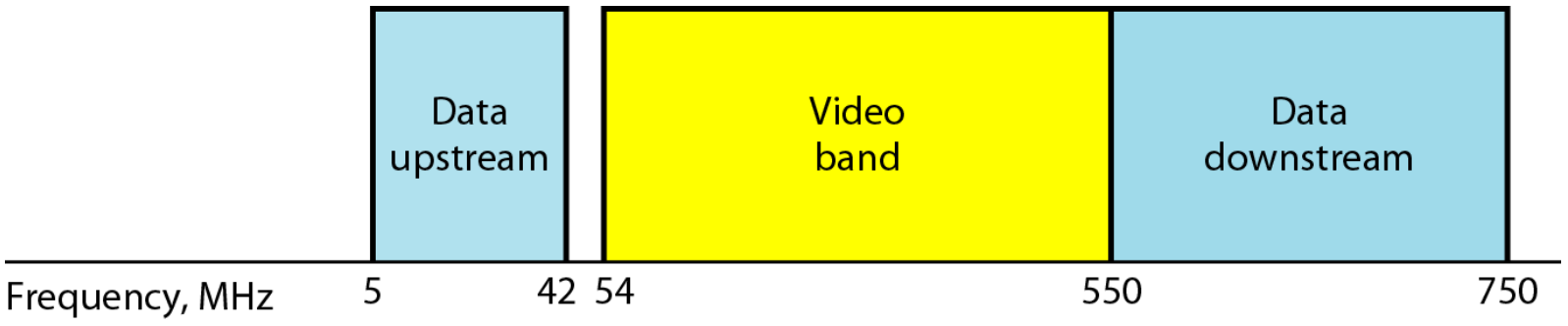


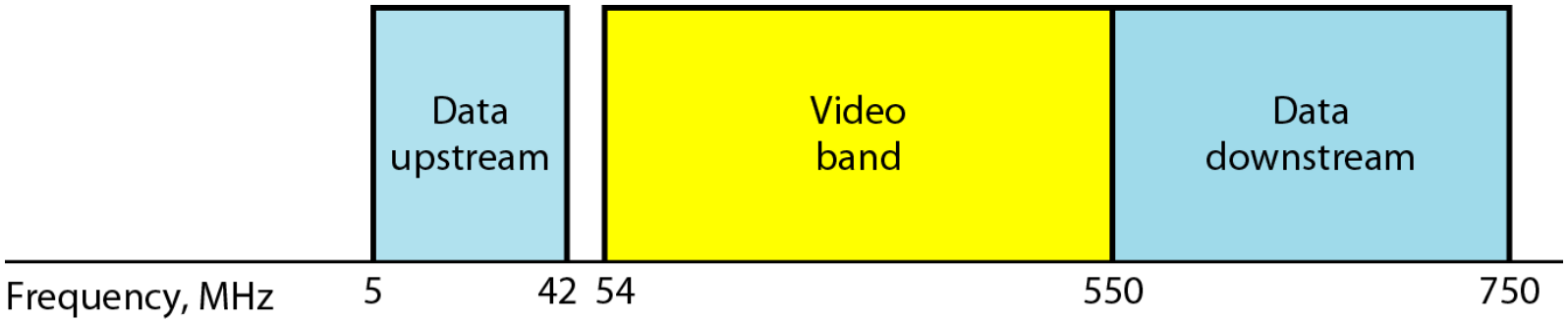
Communication in an HFC cable TV network can be bidirectional.

5. CABLE TV FOR DATA TRANSFER

ปัจจุบันนี้บริษัท (Cable companies) แม่นได้มีการแข่งขันกับบริษัทโทละสับ (telephone companies) สำลับลูกค้าผู้ที่ต้องการความไวสูงในการถ่ายโอนข้อมูนในที่พักอาใส.

Figure 6 *Division of coaxial cable band by CATV*





- Subband division (6 MHz / channel)
  - Video: 54 – 550 MHz
  - Upstream: 5 - 42 MHz
  - Downstream: 550 – 750 MHz

- Modulation
  - Upstream: QPSK -> 12 Mbps
  - Downstream: 64 QAM -> 30 Mbps

Figure 7 *Cable Modem (CM)*

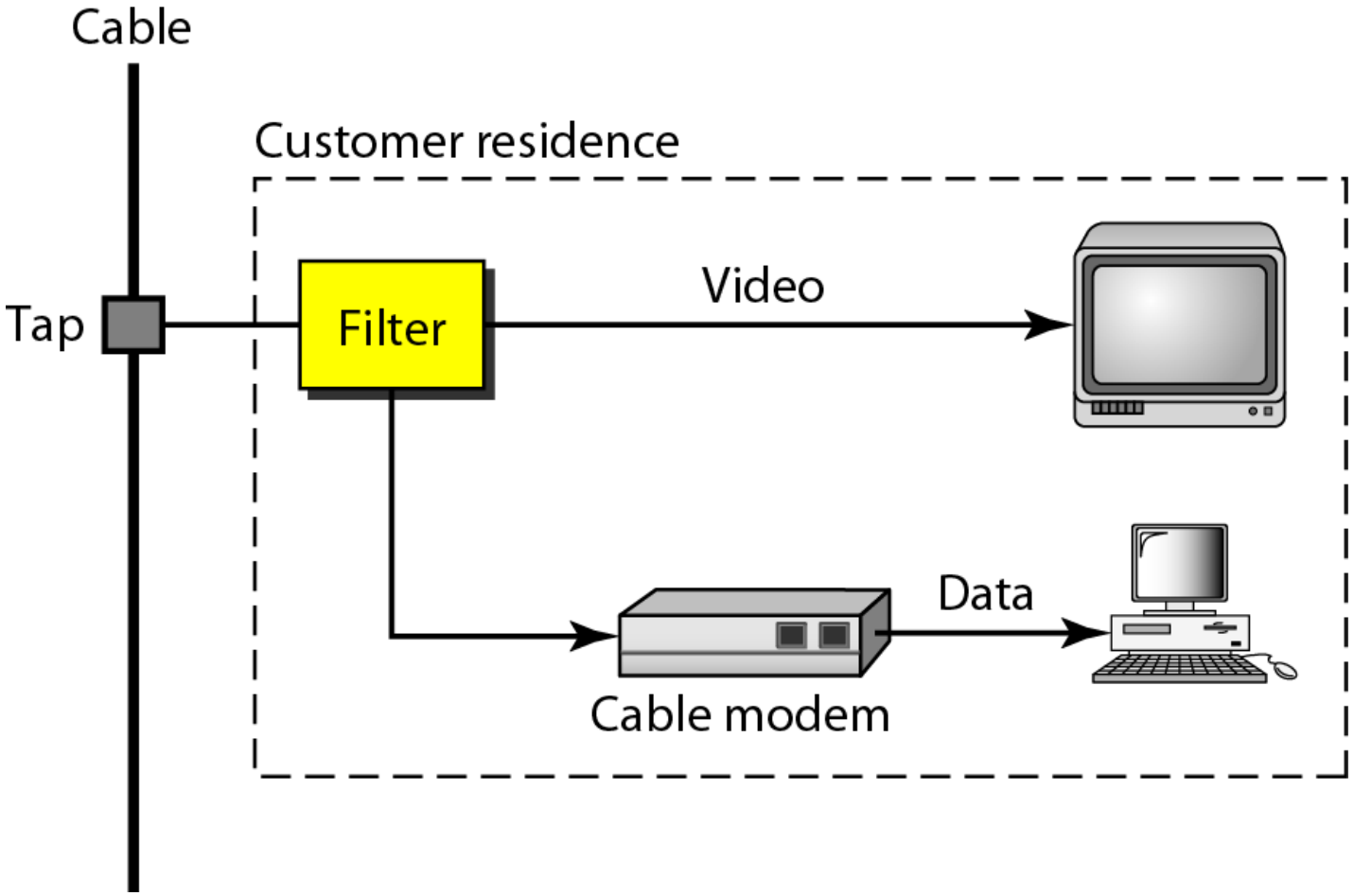
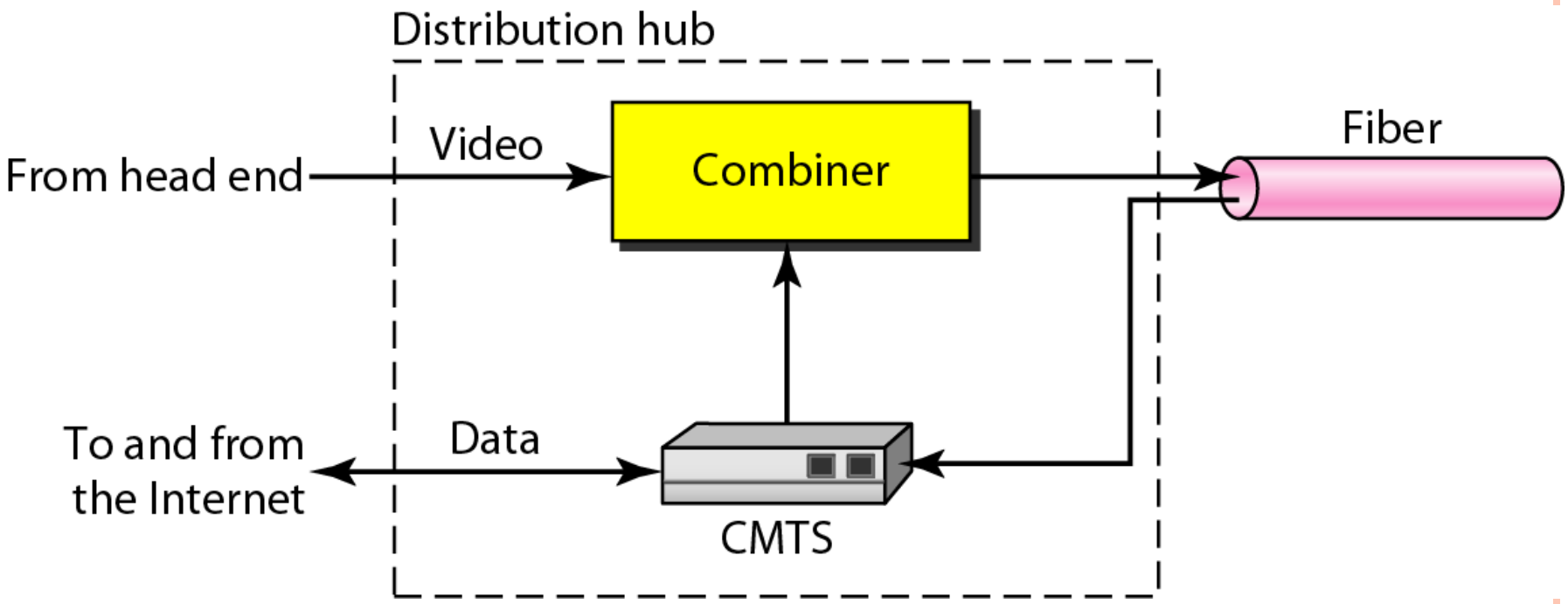


Figure 8 *Cable Modem Transmission System (CMTS)*



9.3 SONET (Synchronous Optical NETworks)

SONET Devices

SONET Frame

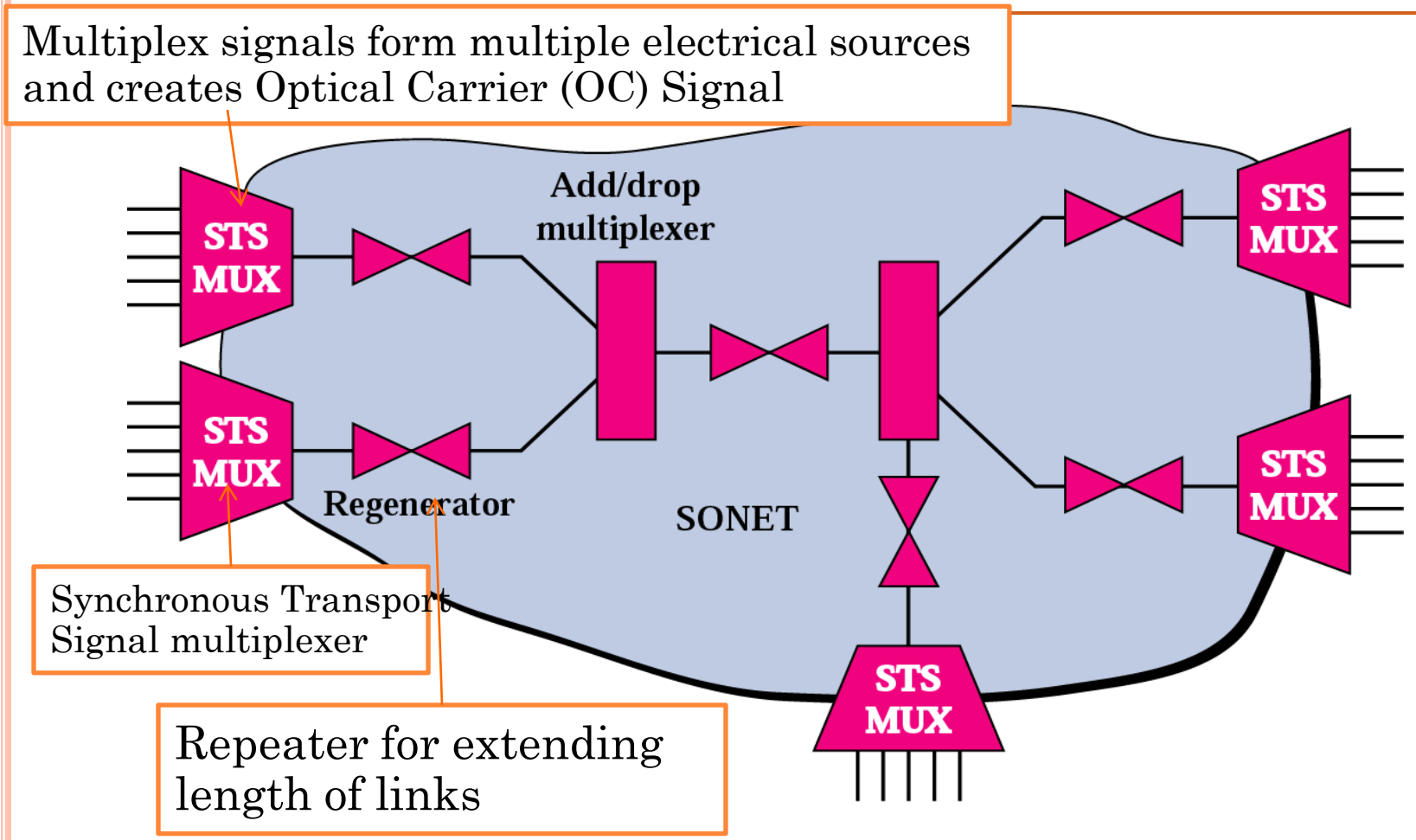
Frame Transmission

Synchronous Transport Signals
STS-1

Virtual Tributaries

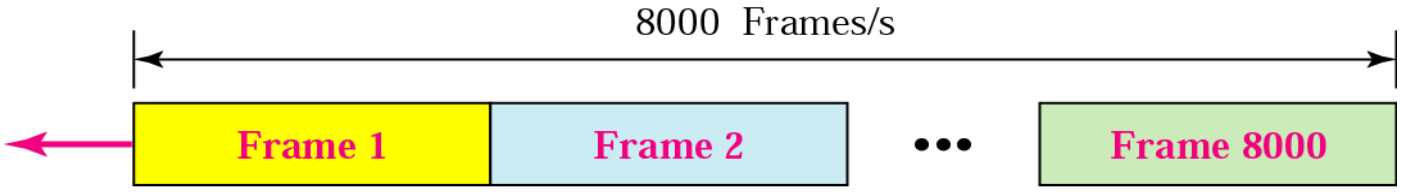
Higher-Rate Service

Figure 9 *A SONET (Synchronous Optical Networks)*



synchronous TDM system

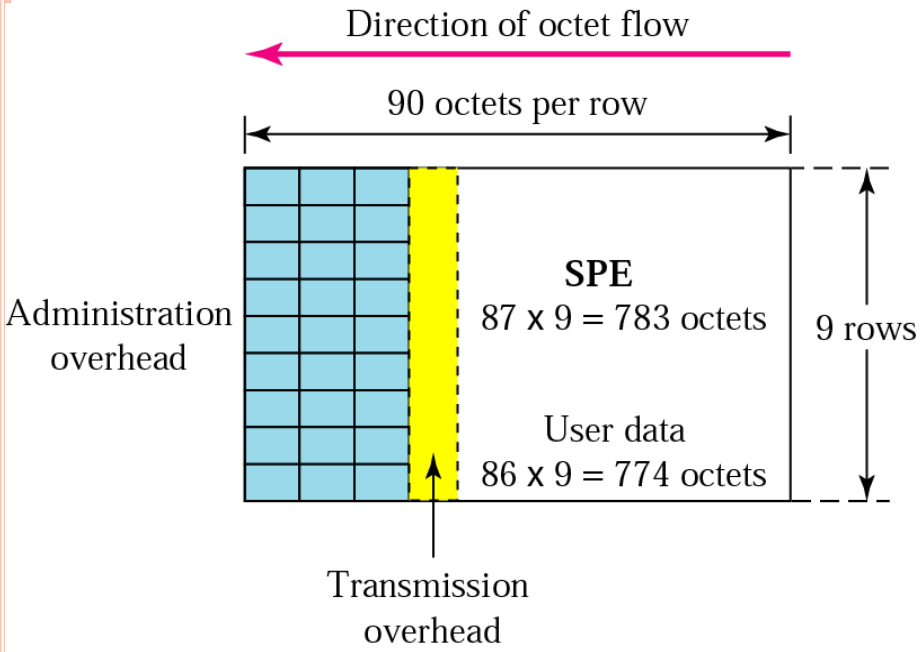
Figure 10 *Frame format*

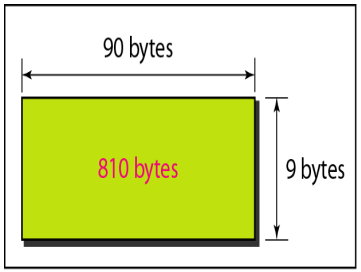


Raw rate = 8000 frames/s x 9 x 90 x 8 = 51,840,000 bps

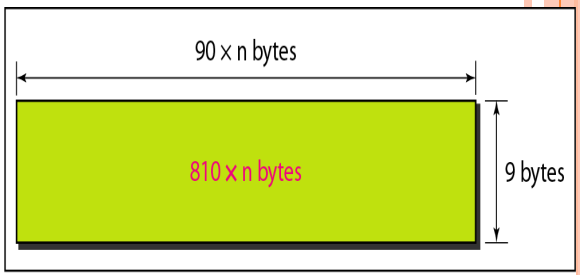
SPE rate = 8000 frames/s x 9 x 87 x 8 = 50,112,000 bps

User rate = 8000 frames/s x 9 x 86 x 8 = 49,536,000 bps

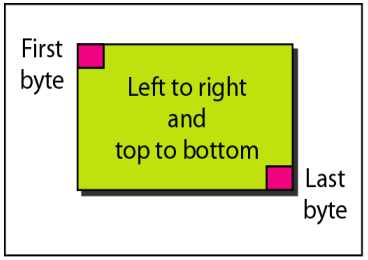




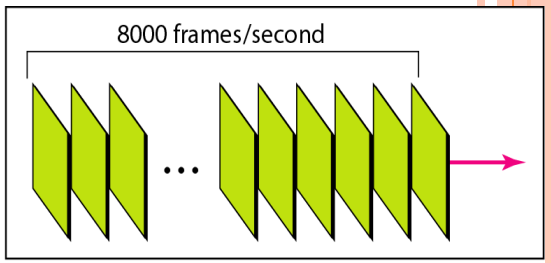
a. STS-1 frame



b. STS-n frame



a. Byte transmission

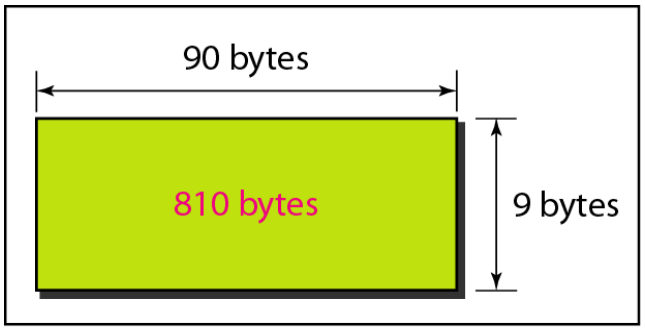


b. Frame transmission

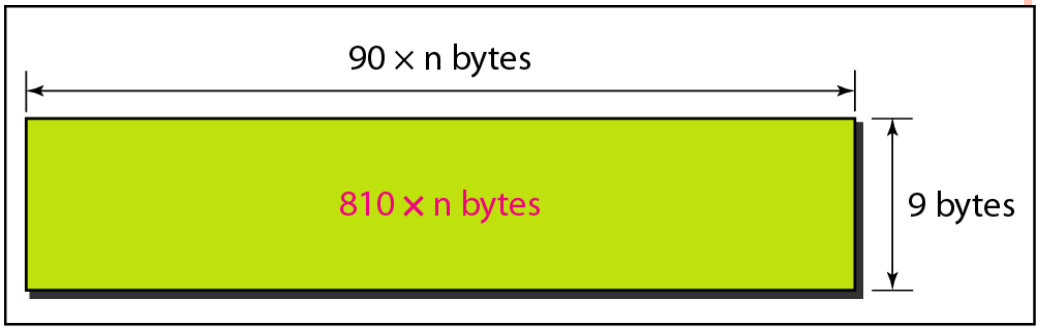
SPE : Synchronous Payload Envelopment

STS-1 frames

STS-n frames

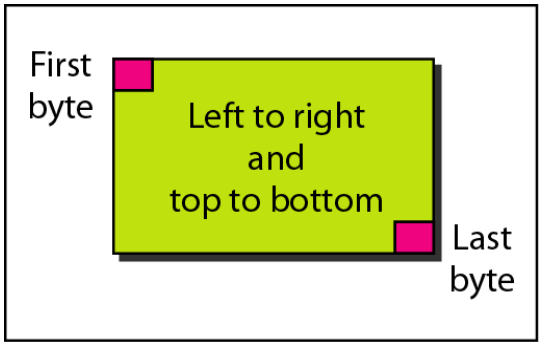


a. STS-1 frame

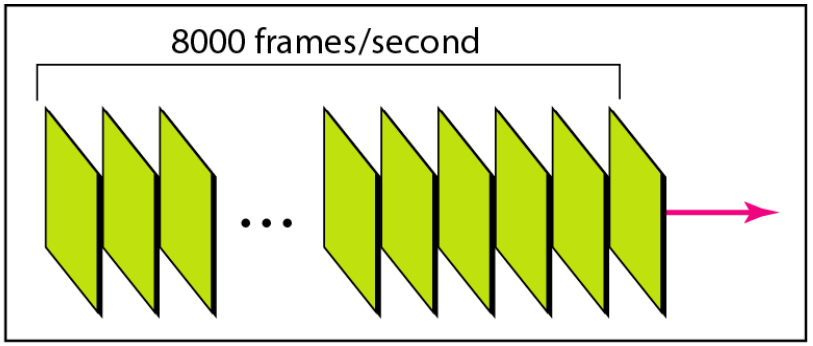


b. STS-n frame

STS-1 frames in transition

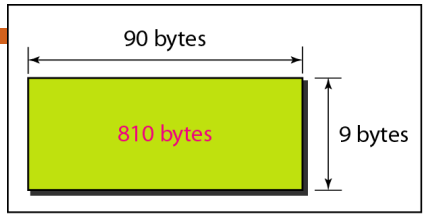


a. Byte transmission

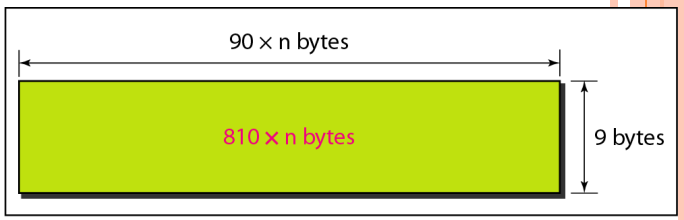


b. Frame transmission

Table 11 SONET rates



a. STS-1 frame



b. STS-n frame

STS	OC	Rate (Mbps)	SPE (Mbps)	User (Mbps)
STS-1	OC-1	51.84	50.12	49.536
STS-3	OC-3	155.52	150.336	148.608
STS-9	OC-9	466.56	451.008	445.824
STS-12	OC-12	622.08	601.344	594.432
STS-18	OC-18	933.12	902.016	891.648
STS-24	OC-24	1244.16	1202.688	1188.864
STS-36	OC-36	1866.23	1804.032	1783.296
STS-48	OC-48	2488.32	2405.376	2377.728
STS-192	OC-192	9953.28	9621.604	9510.912

OC-Optical Carrier
STS- Synchronous Transfer Signal