EEE4121F
Mobile and Wireless Networks

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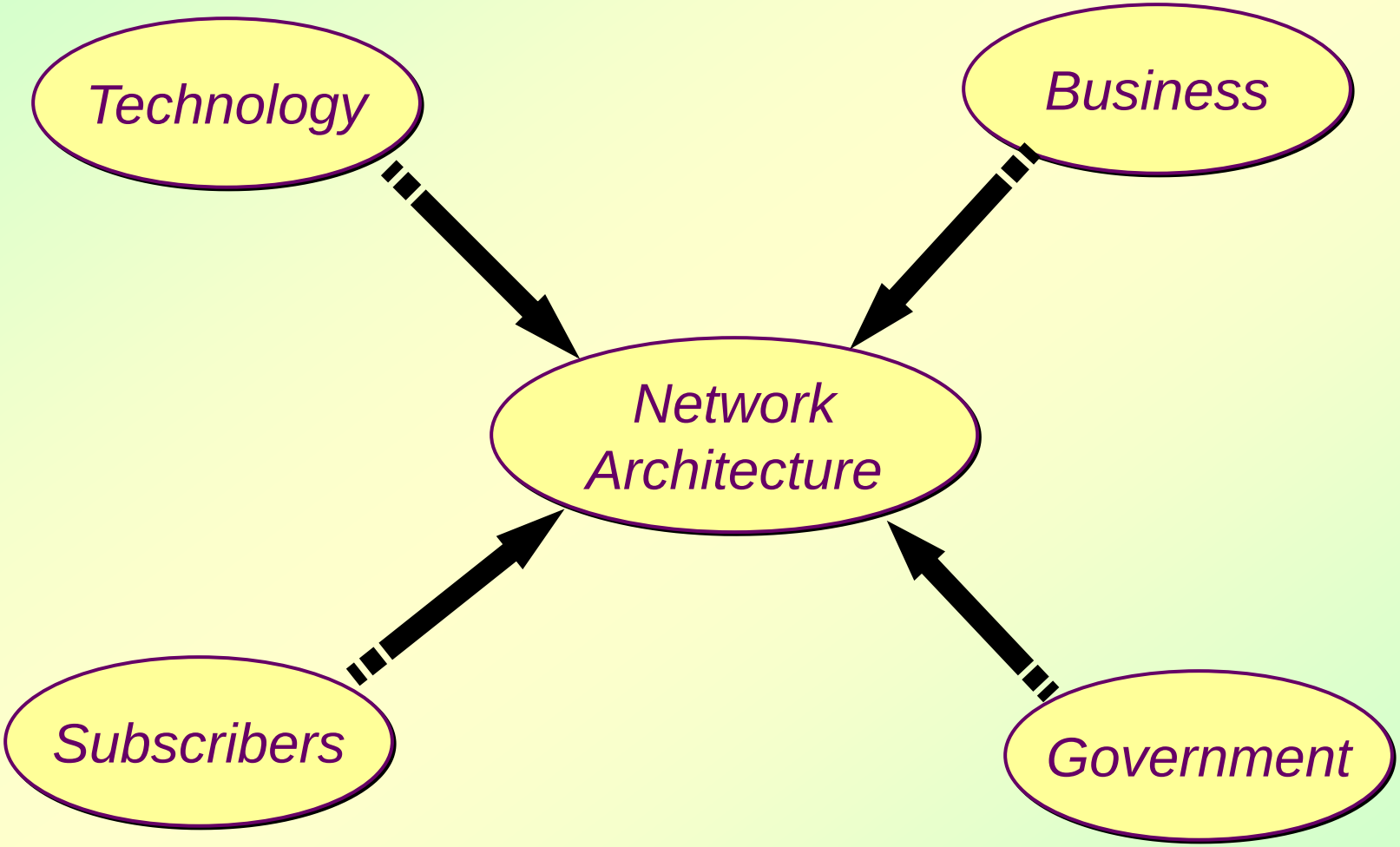
Architecture

General Meaning of Architecture:

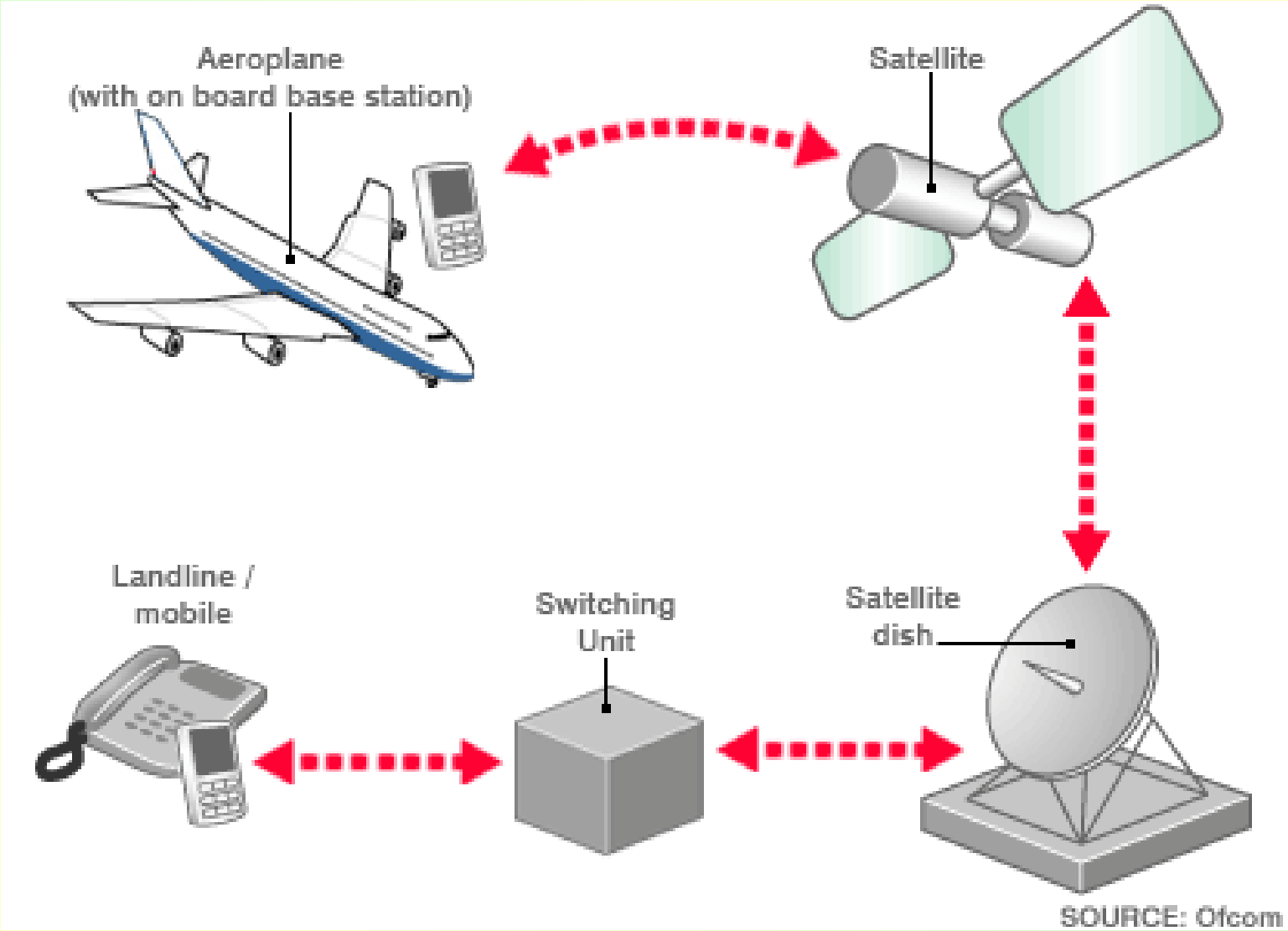
- The art and science of designing and erecting buildings and other physical structures

- A style and method of design and construction of buildings and other physical structures

Factors influencing Network Architecture



A Network Architecture for in-flight Voice Calls



GSM Architecture

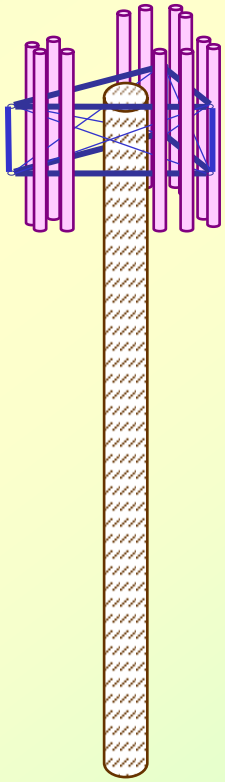
Outline

- The System Architecture
- Logical Channels and Framing
- System Acquisitions and Procedures
- Details of the Logical and Physical Channels
- The Radio Link Properties
- The GSM Receiver

Radio Access

Uplink

Downlink



Mobile Station (MS)

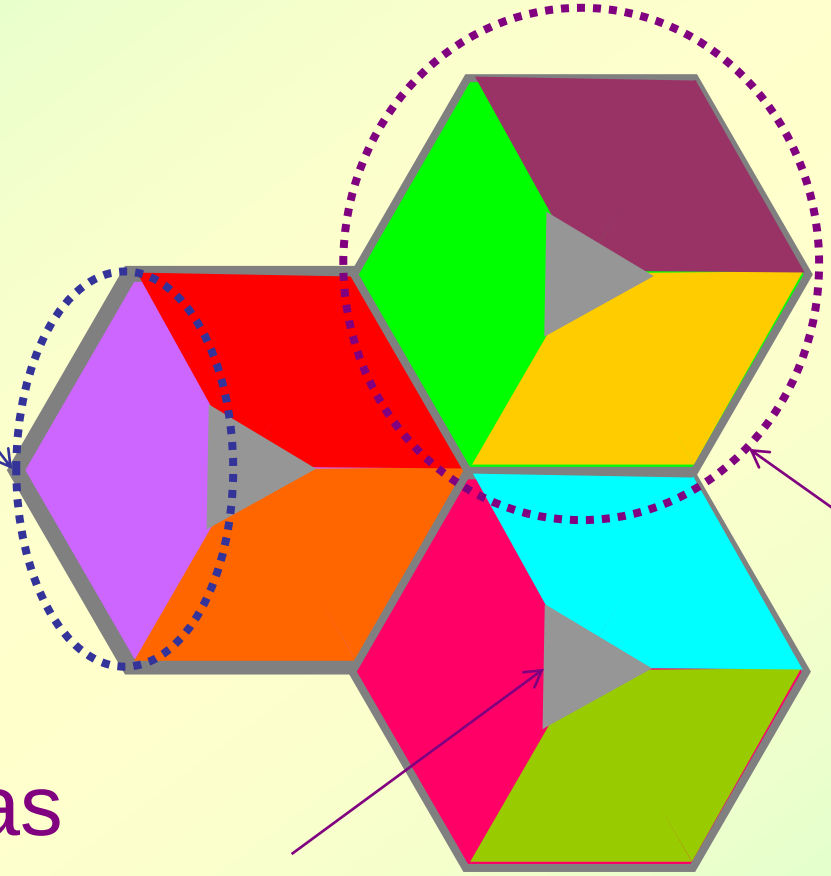
Base Transceiver Station (BTS)

Mobile Station

Mobile Station (MS)

- Mobile station is a combination of terminal equipment and subscriber data
- Terminal equipment is called mobile equipment (ME)
- Subscriber's data is stored in a separate module called SIM (subscriber identity module)
- MS = (ME + SIM)
- SIM contains the identification number of the user, and a list of available networks
- SIM also contains tools needed for authentication and ciphering

Cells and Sectors

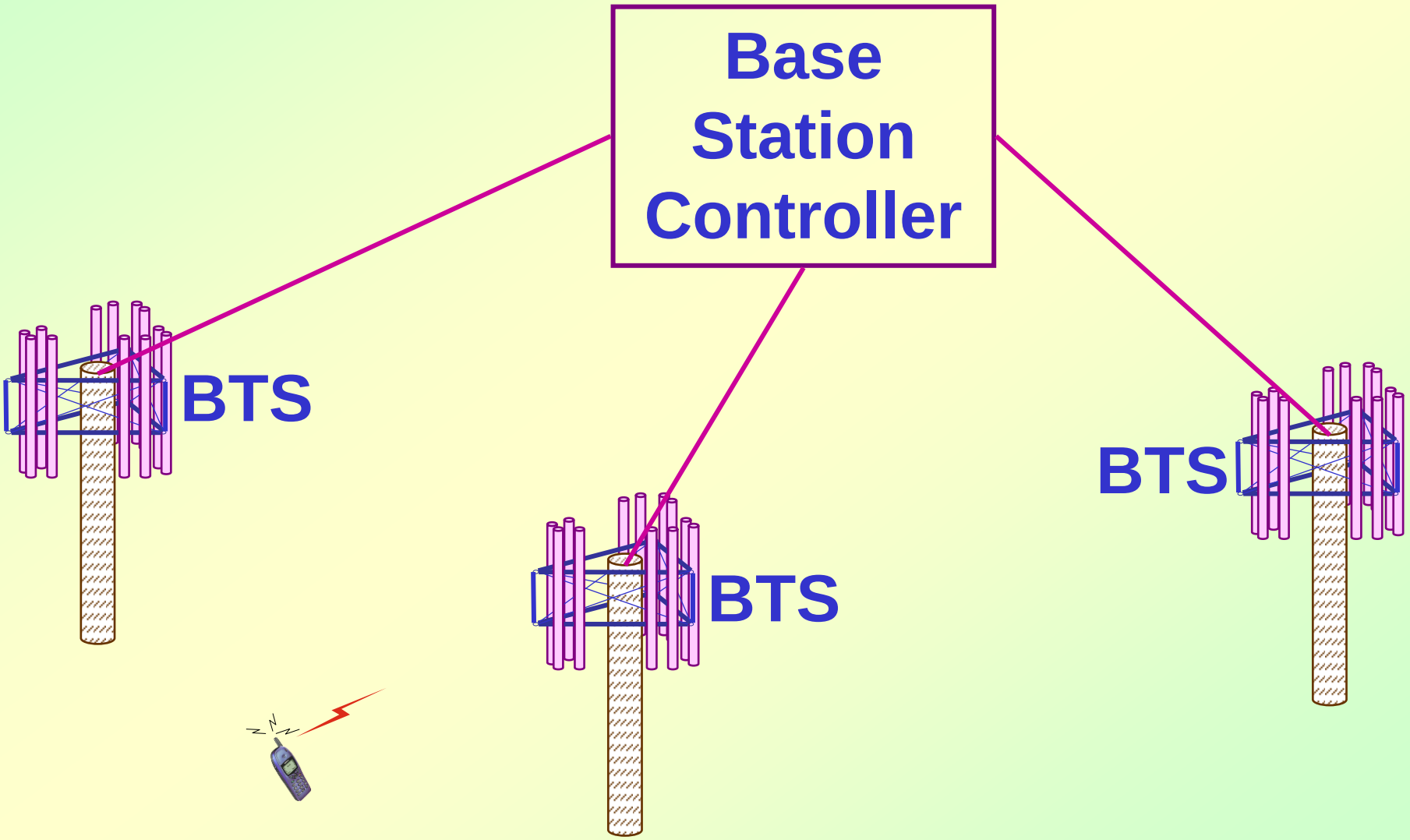


Sector

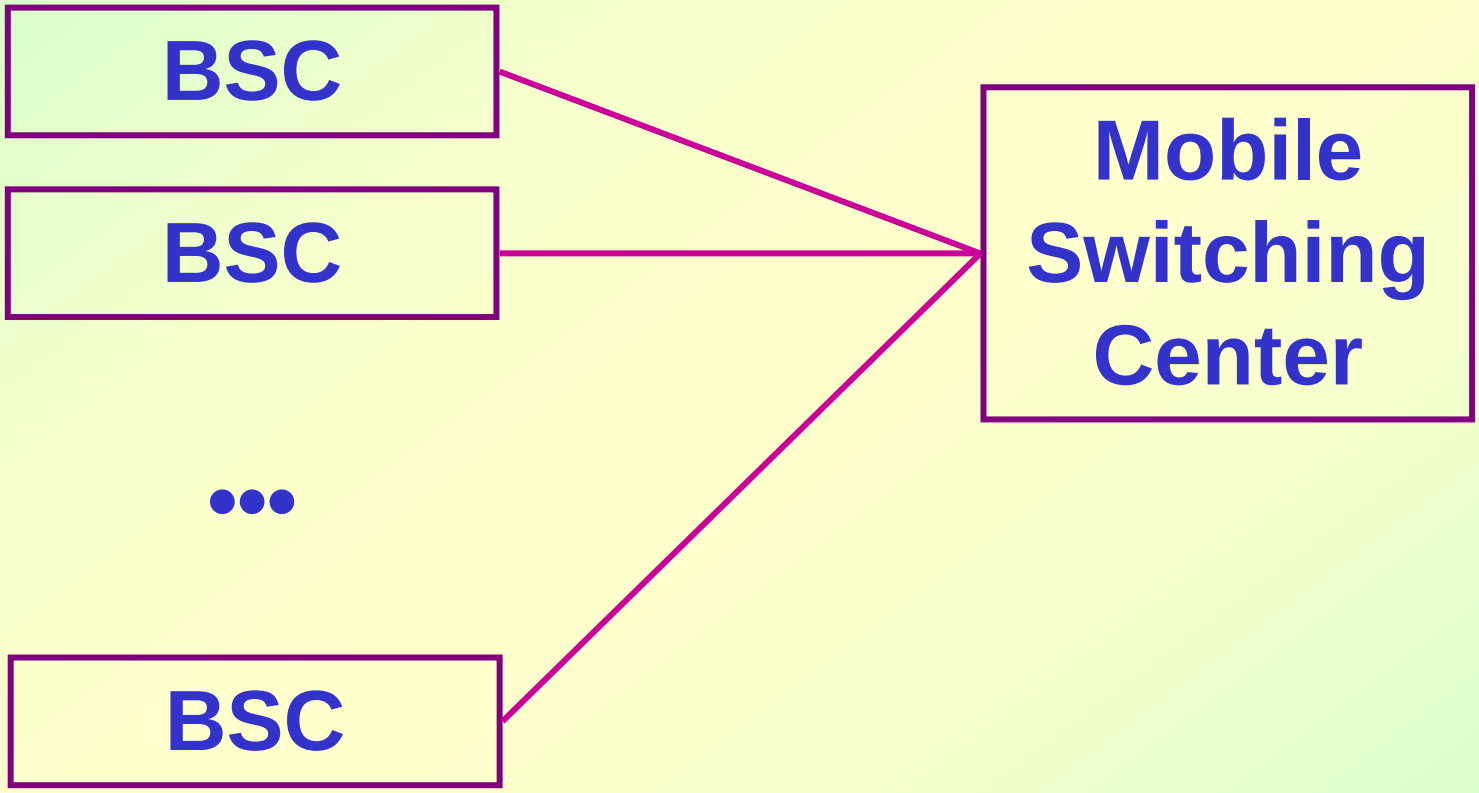
Cell

120° antennas
facing the 3 sectors

Base Station



Mobile Switching Center
MSC



GSM Network

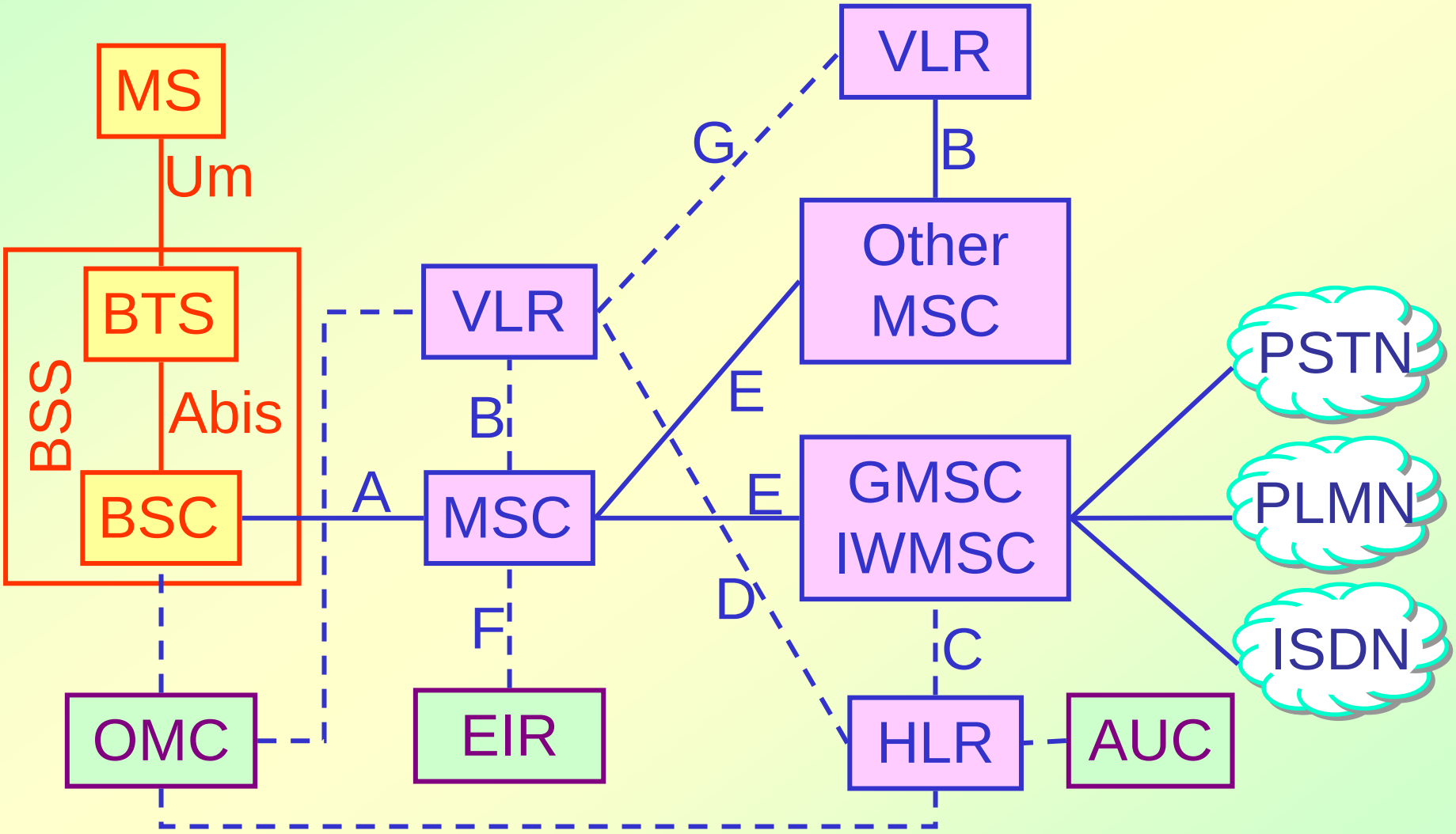
GSM network is divided into three subsystems

BSS
Basestation
Subsystem

SSS
Switching
Subsystem

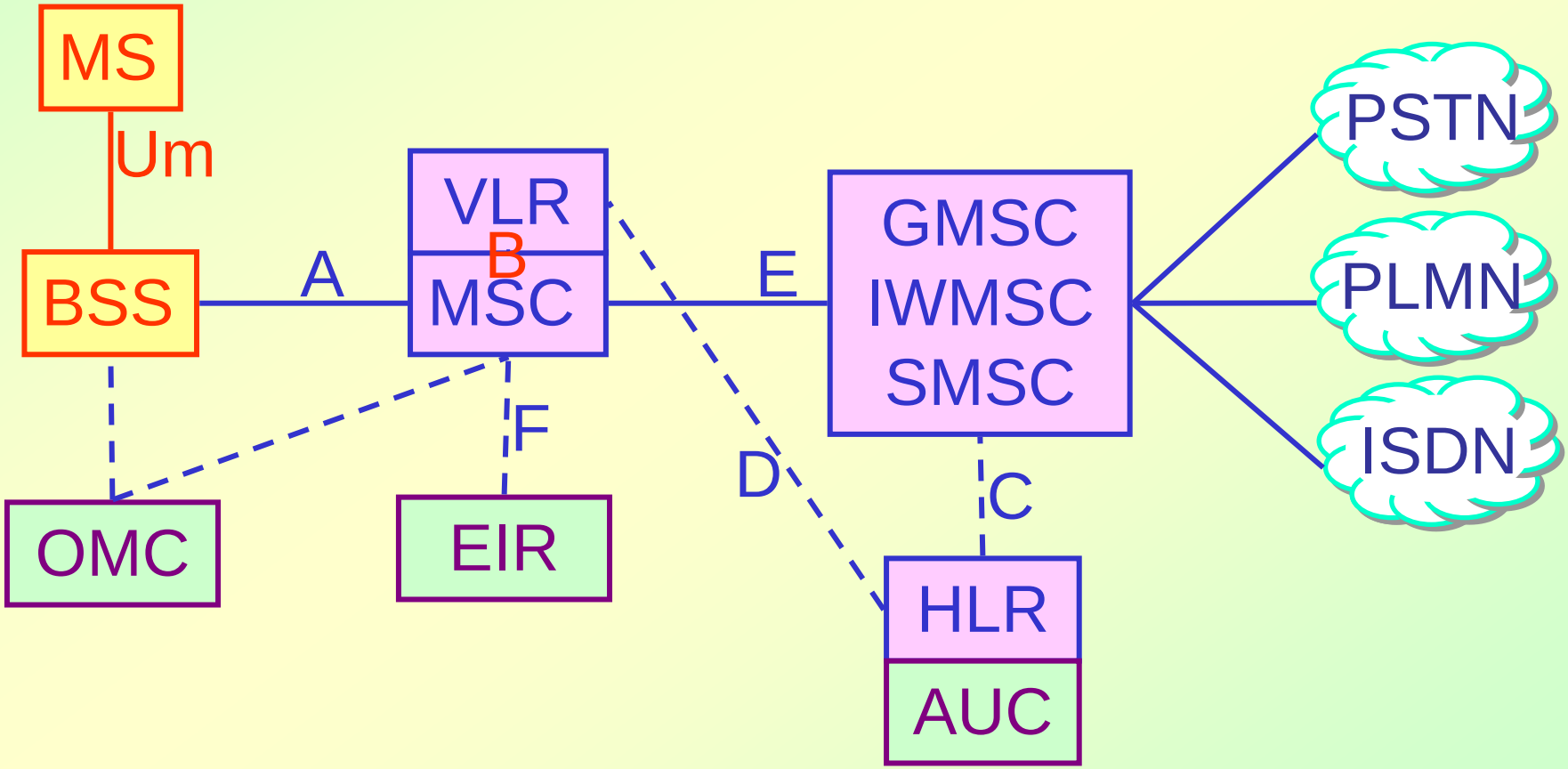
OMS
Operation &
Maintenance
Subsystem

GSM Network


MS
Um
BTS
BSS
Abis
BSC
A
VLR
B
MSC
F
EIR
G
VLR
B
Other
MSC
E
E
GMSC
IWMSC
D
C
HLR
AUC
OMC
PSTN
PLMN
ISDN

GSM Network

- Combining MSC and VLR; HLR and AUC; and integrating SMSC into GMSC:



Gateway MSC (GMSC)

- Interface to other networks:
- ISDN
- PSTN
- other PLMNs

Gateway MSC (GMSC) Functions

- Mobility management
- Connection management
- Call control
- Activation/deactivation of supplementary services
- Forwarding of short messages
- Collection of relevant information for charging purposes

Database

- Database for call control and network management:

- Home location register (HLR)
- Visited location register (VLR)
- Authentication center (AUC)
- Equipment identity register (EIR)

Mobile Switching Center
MSC/ VLR

MSC performs the following functions:

Call Control

- MSC identifies the type of call, the destination, and the origin of a call
- It also set up, supervises, and clear connections

Initiation of Paging

- Paging is the process of locating a particular mobile station in case of a mobile terminated call (a call to mobile station)

Charging Data Collection

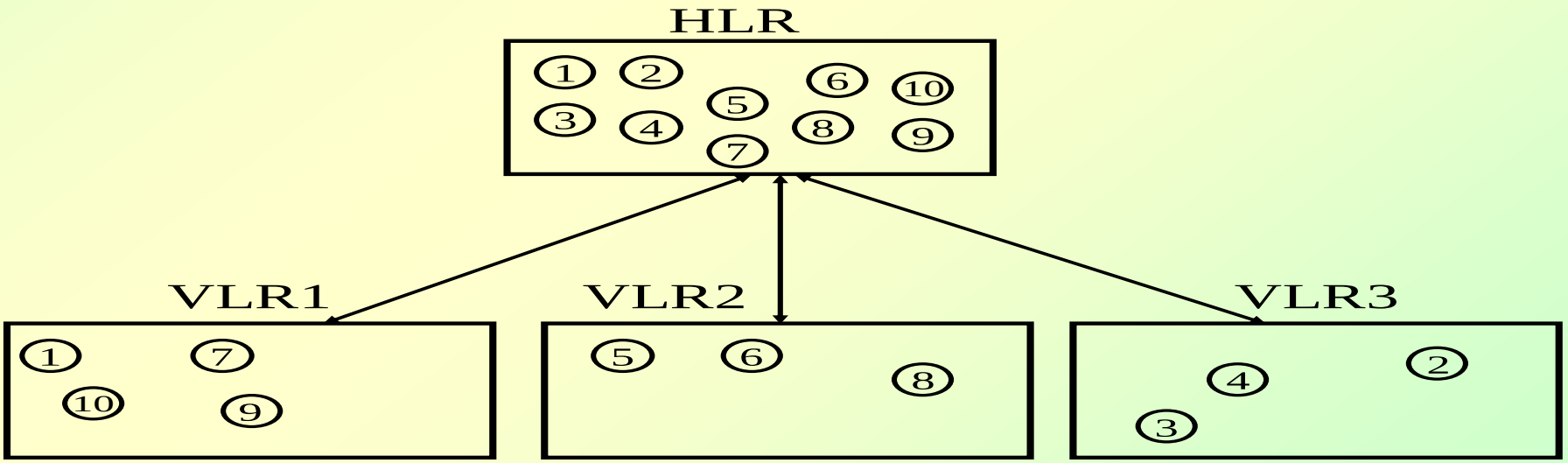
Visitor Location Register MSC/VLR

- VLR is often integrated with the MSC
- It is a database which contains information about subscribers that are currently in the service area of the MSC/VLR
- It contains information such as:
  - identification number of subscribers
  - security information for authentication of the SIM card and for ciphering
  - services that the subscriber can use

Why is VLR regarded as a distributed HLR?

- The HLR contains information (Service profile, routing information) about mobile stations.

- The information contained in the HLR are distributed among a number of VLRs in the network. Therefore the VLR can be regarded as a distributed HLR. The figure bellows shows the information of ten subscribers that are distributed among three VLR.



Home Location Register/Authentication Center HLR/AUC

- Home Location Register stores users' information and provide to MSC
  - Service profile
  - Routing information
- Authentication Center
- Verifies SIMcard
- Prepares ciphering information for transport via air interface

Equipment Identity Register
EIR

- Network may check the international mobile equipment identity (IMEI) number of the MS in EIR and may accept or reject the MS
- IMEI/ EIR can be used to discourage the theft of cell phones
- Checking your IMEI number: *#06#

Short Message Service (SMS) Center

- Short Message Service Center (SMSC) is optional to service provider and is not part of SSS

- Functions
  - Stores received short messages
  - Forwards to MS if attached
  - Else, stores until participant is reachable

Base Station Subsystem (BSS)

- One Transcoder or Transcoding Rate Adaptation Unit (TRAU)
- Several Base Transceiver Station (BTS)
- One Base Station Controller (BSC)

Base Station Subsystem (BSS): TRAU

- Describes voice information
- Reduces transmission rate of voice information
- Creates information frames

TRAU

- Converts the 64 kbps PCM-speech into 16 kbps compressed speech (13 kbps speech + 3 kbps overhead)
- Same vocoding technique is used in MS to convert analog signal into digital speech at 13 kbps (full rate)

TRAU

- Could also operate at 6.5 kbps (half rate)
- Is turned off when carrying data (not speech)

BSC

TRAU

Full rate

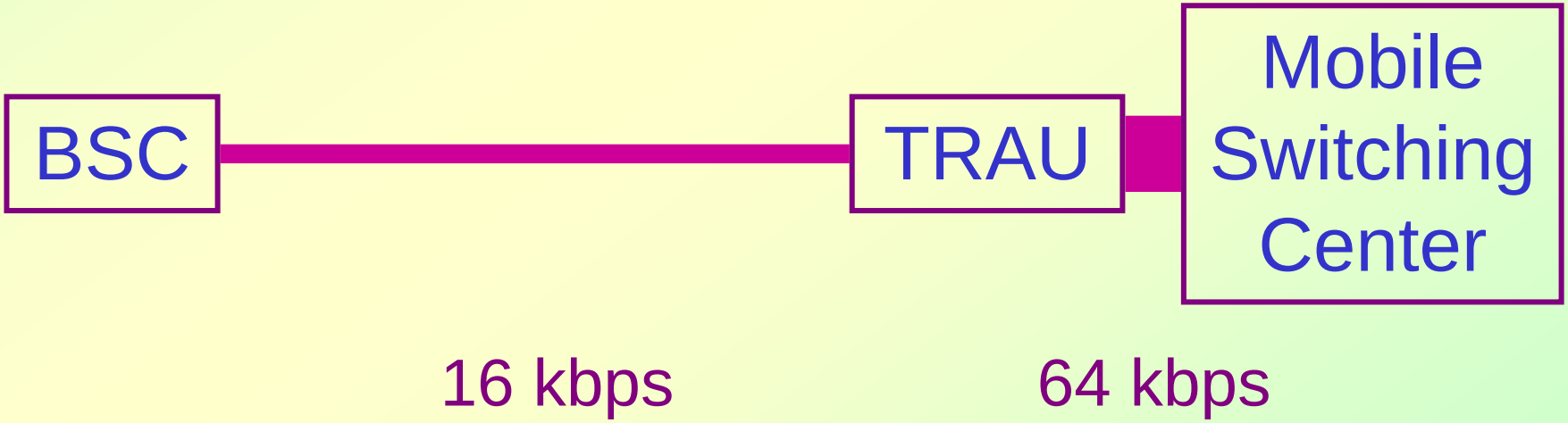
13 kbps — 16 kbps

Half rate

6.5 kbps — 8 kbps

TRAU

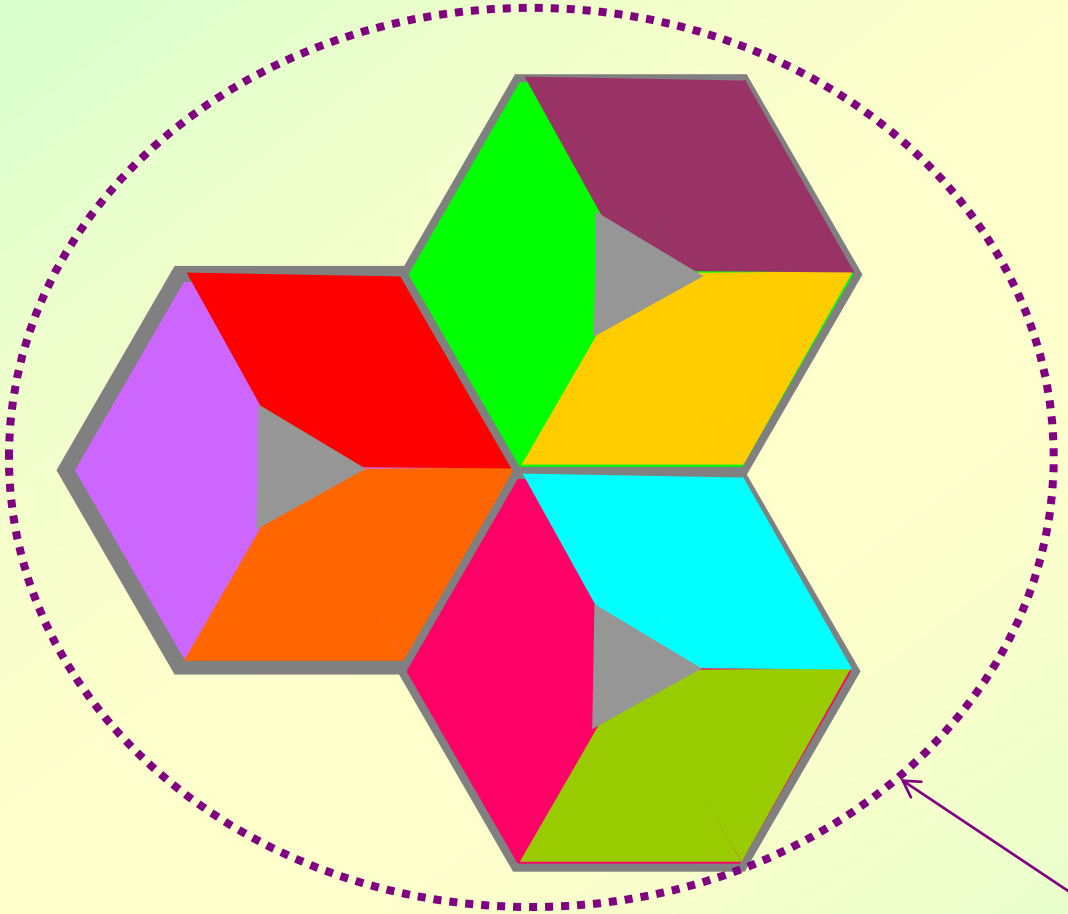
- May be functionally assigned to the BSC
- May be physically located with the MSC to save transmitting 64 kbps/speech connection
- May be moved further up for “Tandem free” operation in 3G Network



Base Station Subsystem (BSS): Base Transceiver Station (BTS)

- Base Transceiver Stations are in clusters of three (120° sectors) in cells of diameter 300 m – 35 km.
- Some BTS's could serve as "Umbrella Cells" that may cover several cells to serve fast mobile units.

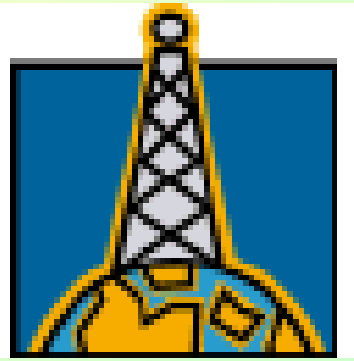
Umbrella Cell



Umbrella Cell

Base Station Subsystem (BSS): Base Transceiver Station (BTS)

- Each BTS has a different Cell Identity (CI)
- Each BTS has several (≤16) Transmit/Receive (Tx/Rx) units.
- The BTS also has control circuits for operation, management and clock distribution



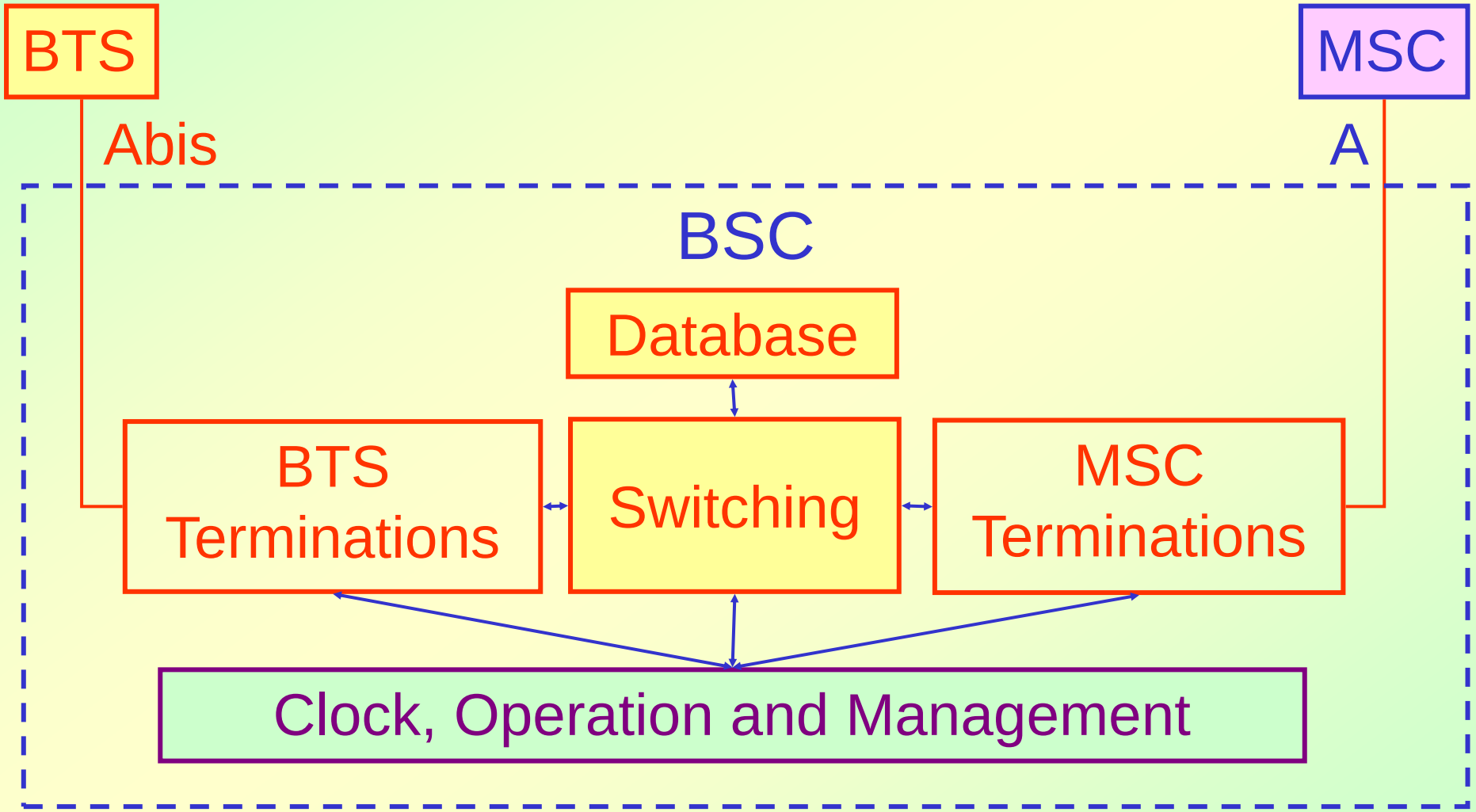
Base Station Subsystem (BSS): Base Station Controller (BSC)

- Controls the connected Base Transceiver Stations (BTS)
- Performs Base Station management
- Handover – forward phone calls and data transmission when user moves to another Base Station

Base Station Subsystem (BSS): Base Station Controller (BSC)

- Acts as a switch connecting the MSC channels (through the A-interface) to the BTS channels (through the Abis-interface)
- Assigns and release traffic and signaling channels
- Keeps records of all connections in a local database.

Base Station Subsystem (BSS): Base Station Controller (BSC)



Operation and Maintenance System

- Network may need to monitor the network components, and to control and adjust their performance, using Operation and Maintenance Center
  - Fault management
  - Configuration management
  - Performance management
  - Administrative management
  - Remote access to other network components
  - Performance optimization

Mobile and Wireless Networks

Between two evils choose neither; between two goods choose both.

"The world stands aside to let anyone pass who knows where he is going."
– David Starr Jordan

"Hell and earth cannot diminish those who heaven will increase"
– Matthew Henry