

Internal

# GSM Fundamentals

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**Chapter 4 Channels on the Wireless Interface**

**Chapter 5 Radio Techniques**



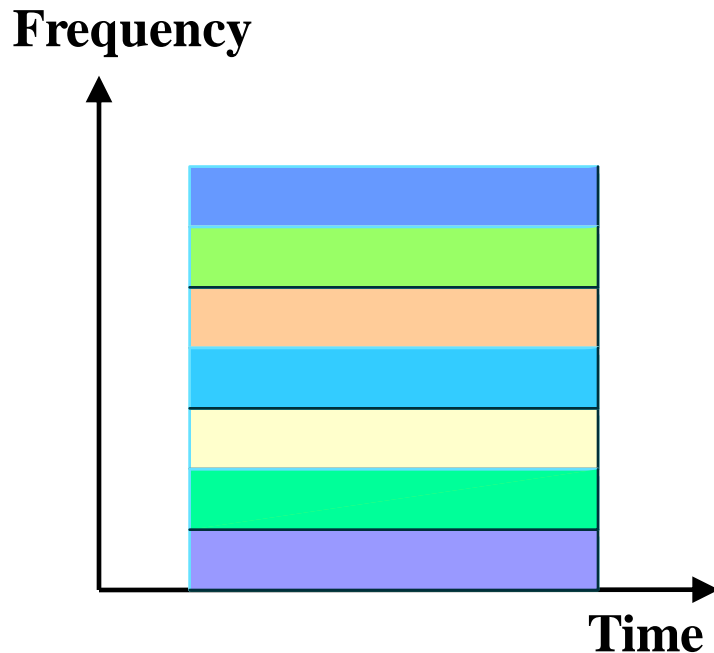
# GSM system overview

- The GSM system is a frequency- and time-division cellular system, each physical channel is characterized by a carrier frequency and a time slot number
- Cellular systems are designed to operate with groups of low-power radios spread out over the geographical service area. Each group of radios serve MSs presently located near them. The area served by each group of radios is called a CELL
- Uplink and downlink signals for one user are assigned different frequencies, this kind of technique is called Frequency Division Duplex (FDD)
- Data for different users is conveyed in time intervals called slots , several slots make up a frame. This kind of technique is called Time Division Multiple Access (TDMA)

# Multiple Access Technique

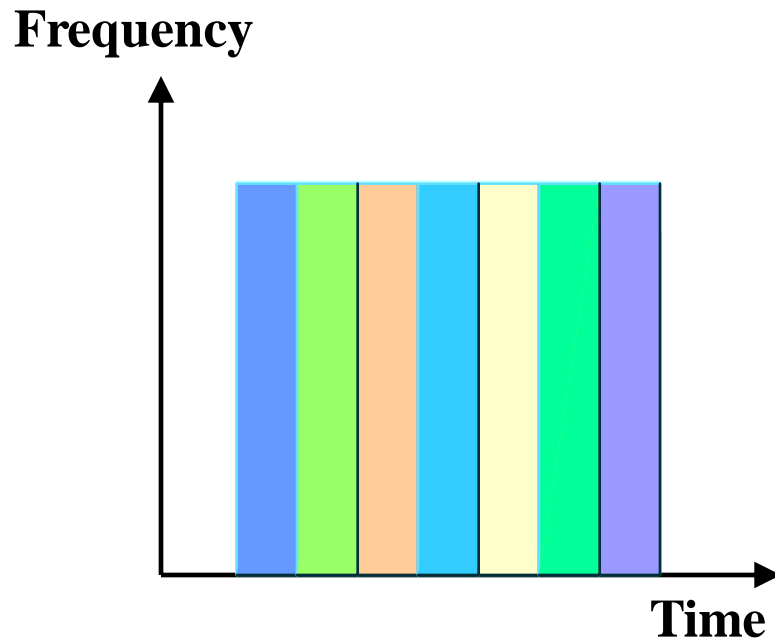
- Multiple Access Technique allows many subscribers to use the same communication medium.
- There are three kinds of basic Multiple Access Technique :  
FDMA , TDMA and CDMA.
- GSM system adopt FDD-TDMA (FDMA and TDMA together).

# FDMA



- FDMA uses different frequency channels to accomplish communication.
- The whole frequency spectrum available is divided into many individual channels (for transmitting and receiving), every channel can support the traffic for one subscriber or some control information.

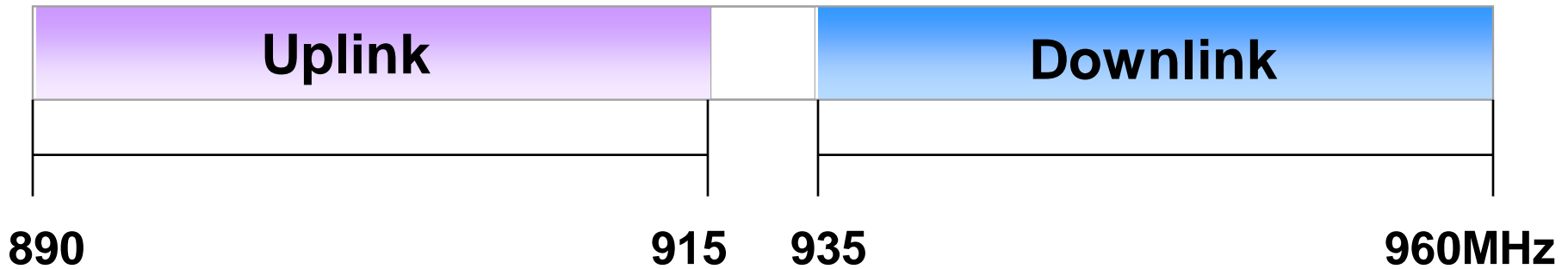
# TDMA



- TDMA accomplishes the communication in different timeslot.
- A carrier is divided into channels based on time. Different signals occupy different timeslots in certain sequence , that is , many signals are transmitted on the same frequency in different time.

# The Frequency Spectrum

**GSM 900**

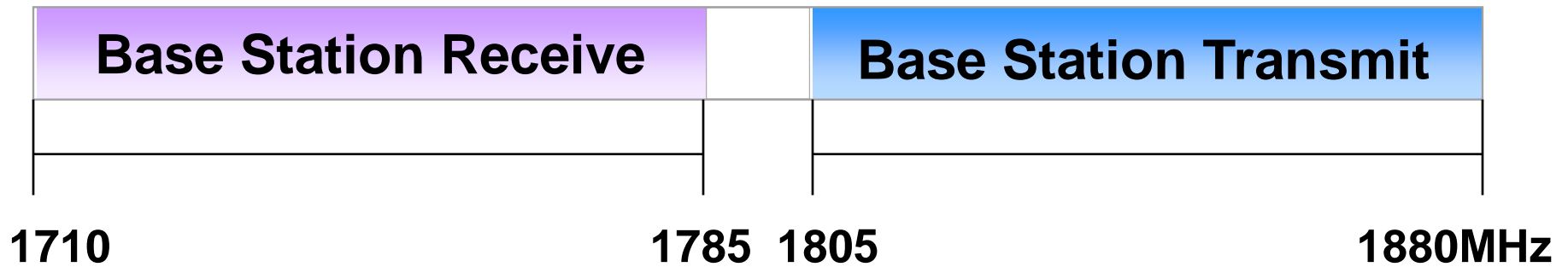


**Duplex Separation: 45MHz**

**Channel Bandwidth: 200KHz**

# The Frequency Spectrum

**GSM 1800**



**Duplex Separation: 95MHz**

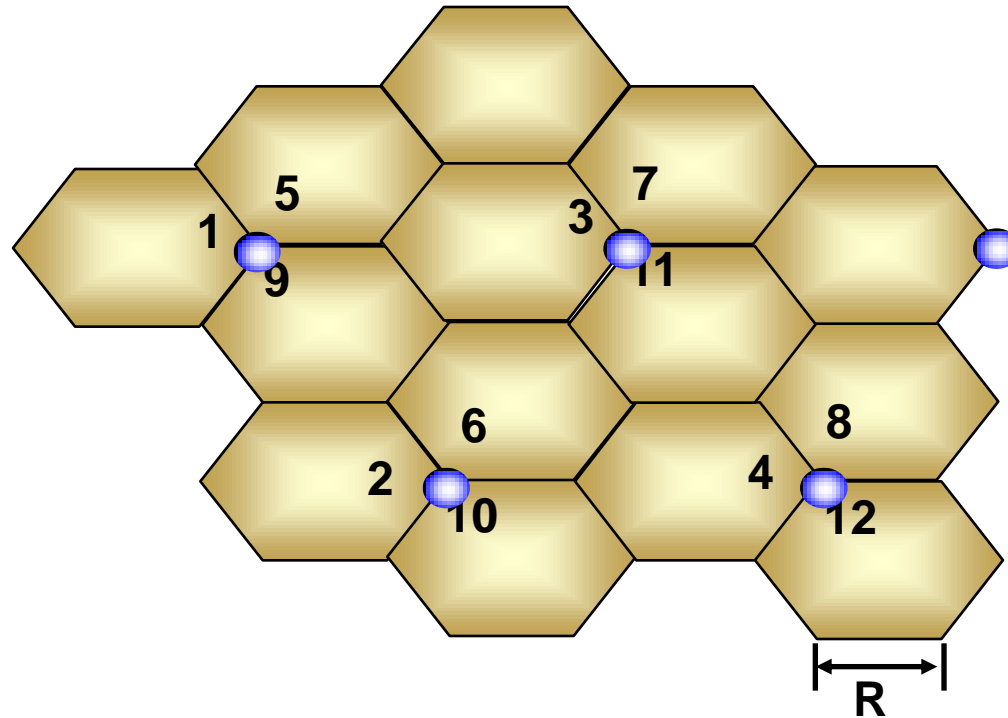
**Channel Bandwidth: 200KHz**



# Frequency Reuse

- The frequency resource of mobile system is very limited.
- The different Subscribers can use the same frequency in different places.
- The quality of communication must be ensured.

# Frequency Reuse



**4 site X 3 cells reuse**

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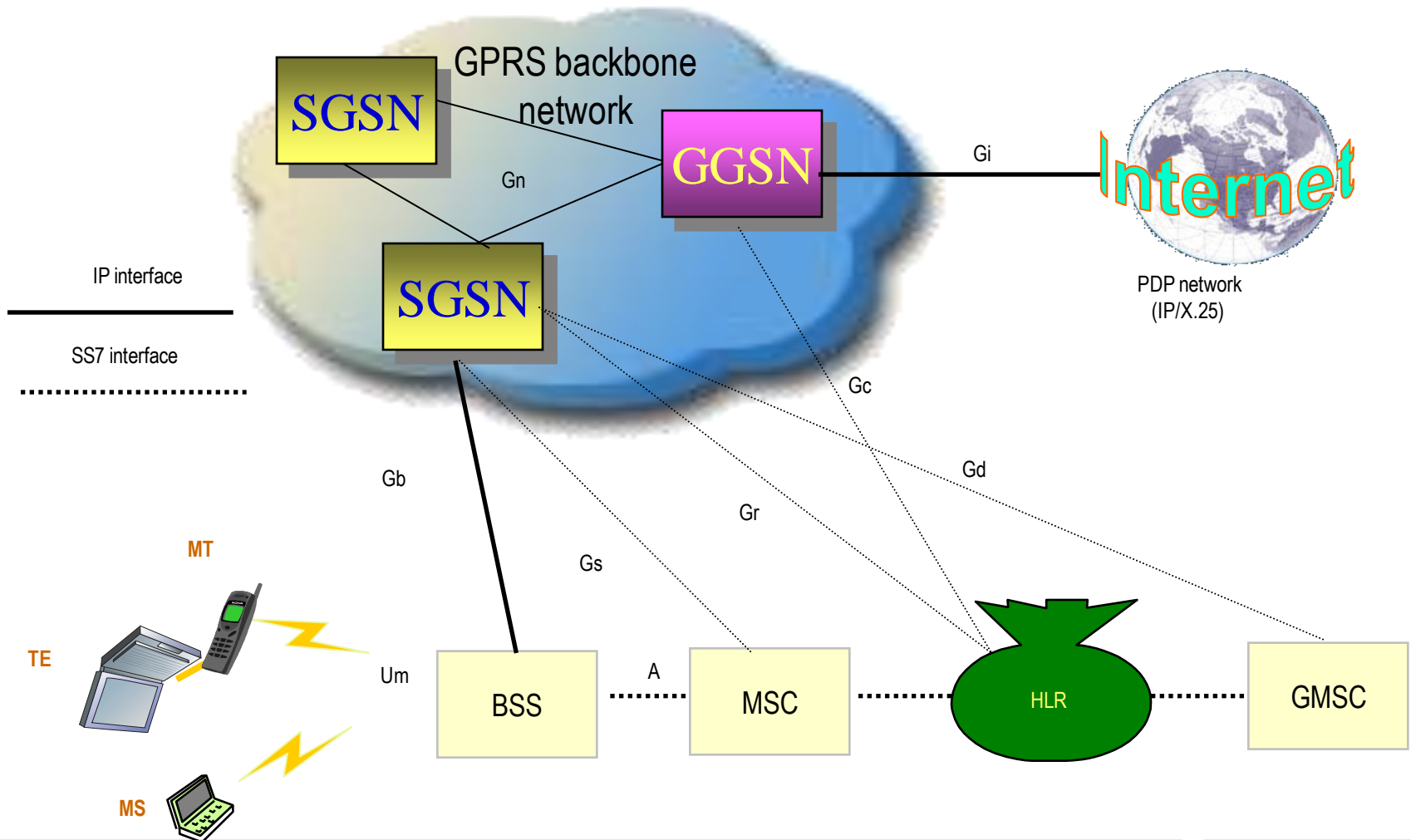
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# Network interface types

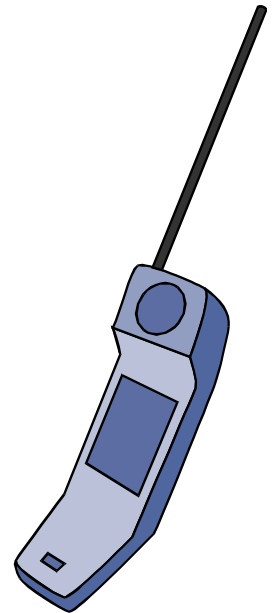


# Mobile Station—MS

$$MS = ME + SIM$$

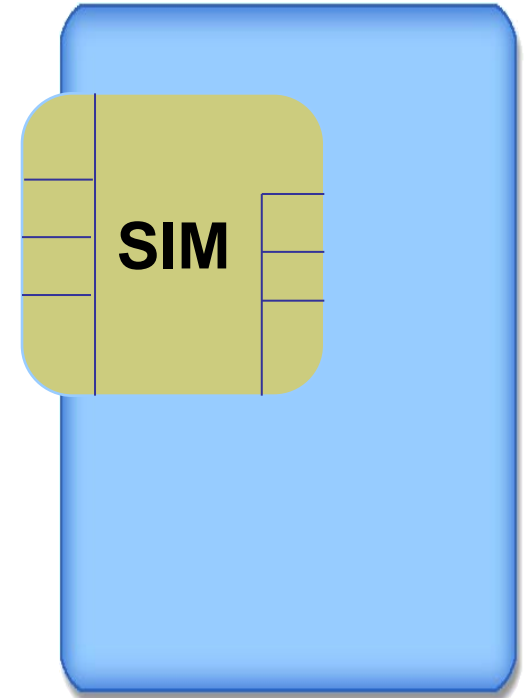
International Mobile Equipment Identity (IMEI)  
– Mobile Equipment

International Mobile Subscriber Identity (IMSI)  
– Subscriber Identity Module



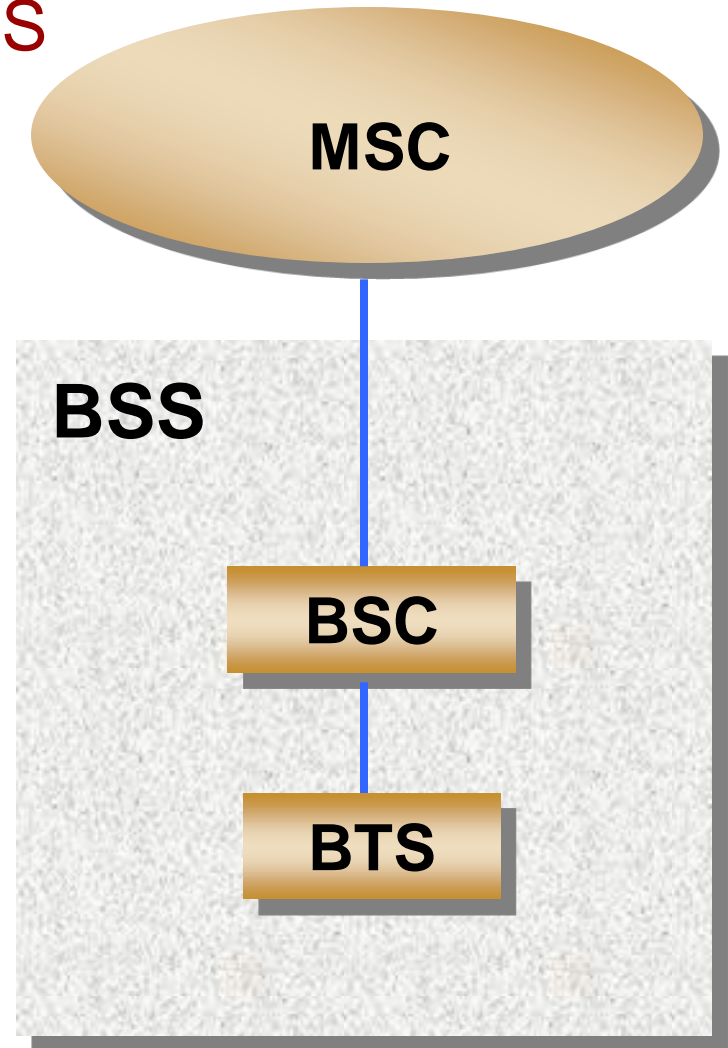
# Subscriber Identity Module – SIM

- **International Mobile Subscriber Identity (IMSI)**
- **Temporary Mobile Subscriber Identity (TMSI)**
- **Location Area Identity (LAI)**



# Base Station Subsystem – BSS

- The Base Station Controller – BSC
- The Base Transceiver Station – BTS



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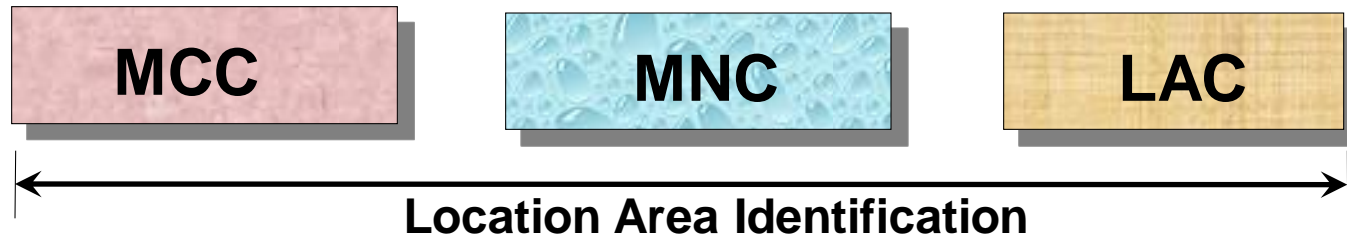
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## LAI



The LAI is the international code for a location area.

- MCC:** Mobile Country Code, It consists of 3 digits .  
For example: The MCC of China is "460"
- MNC:** Mobile Network Code, It consists of 2 digits .  
For example: The MNC of China Mobile is "00"
- LAC:** Location Area Code, It is a two bytes hex code.  
The value 0000 and FFFF is invalid.  
For example: 460-00-0011

# CGI

## **CGI: Cell Global Identification**

The CGI is a unique international identification for a cell  
The format is LAI+CI

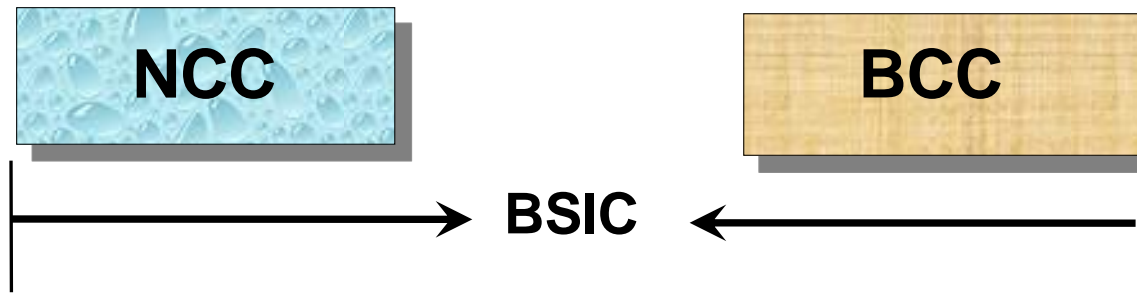
**LAI:** Location Area Identification

**CI:** Cell Identity. This code uses two bytes hex code to identify the cells within an LAI.

For example : 460-00-0011-0001

# BSIC

## BSIC (Base Station Identification Color Code)

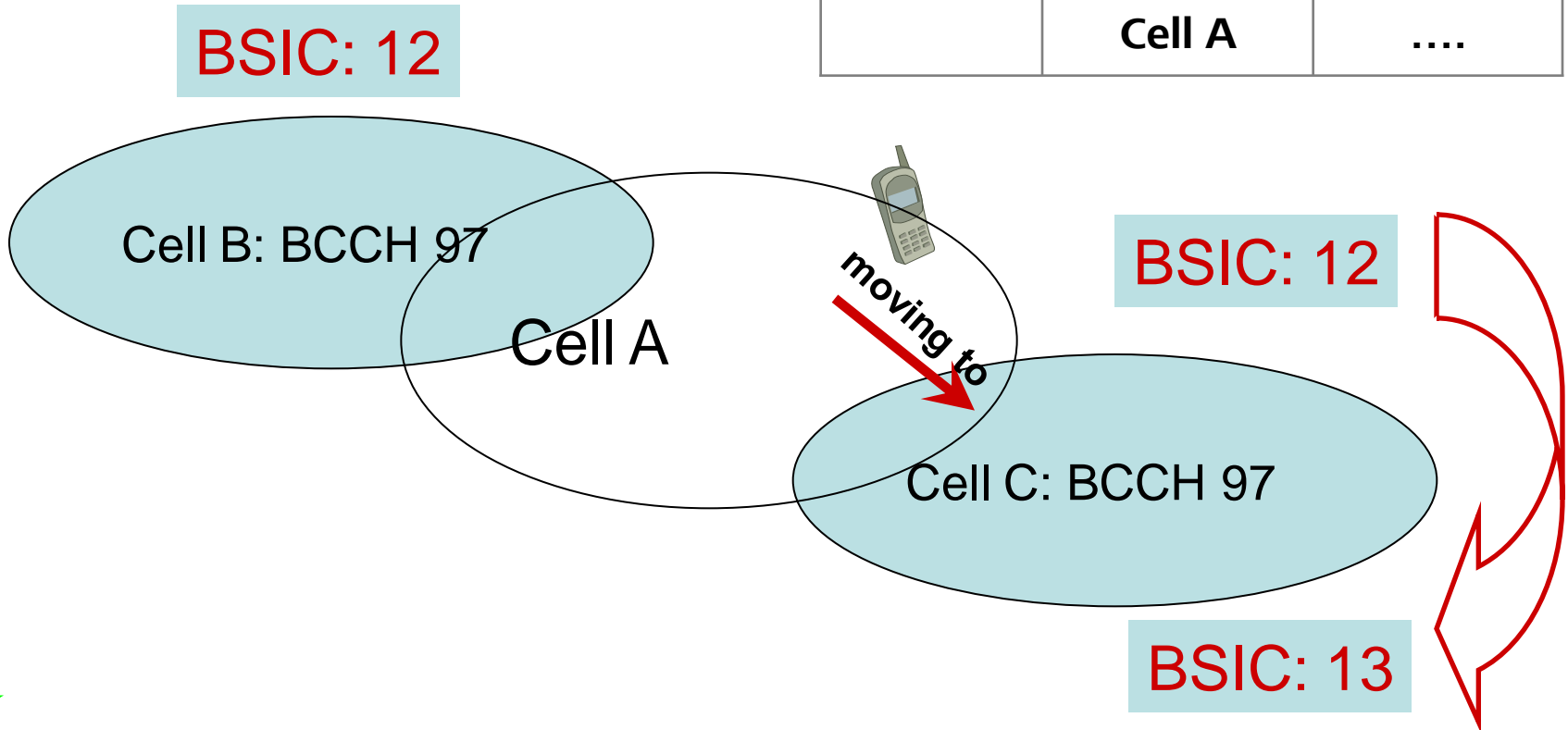


**NCC:** PLMN network color code. It comprises 3 bit. It allows various neighboring PLMNs to be distinguished.

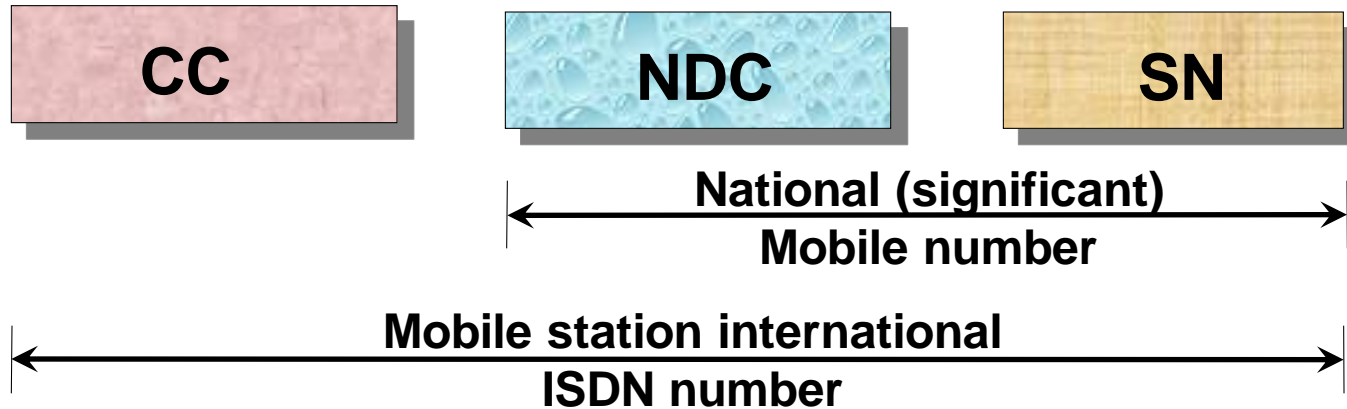
**BCC:** BTS color code. It comprises 3 bit, used to distinguish different cells assigned the same frequency!

# Co-BCCH and co-BSIC in adjacent area

	Serving cell	Neighbor
Neighbor list	Cell A	Cell B
	Cell A	....



# MSISDN



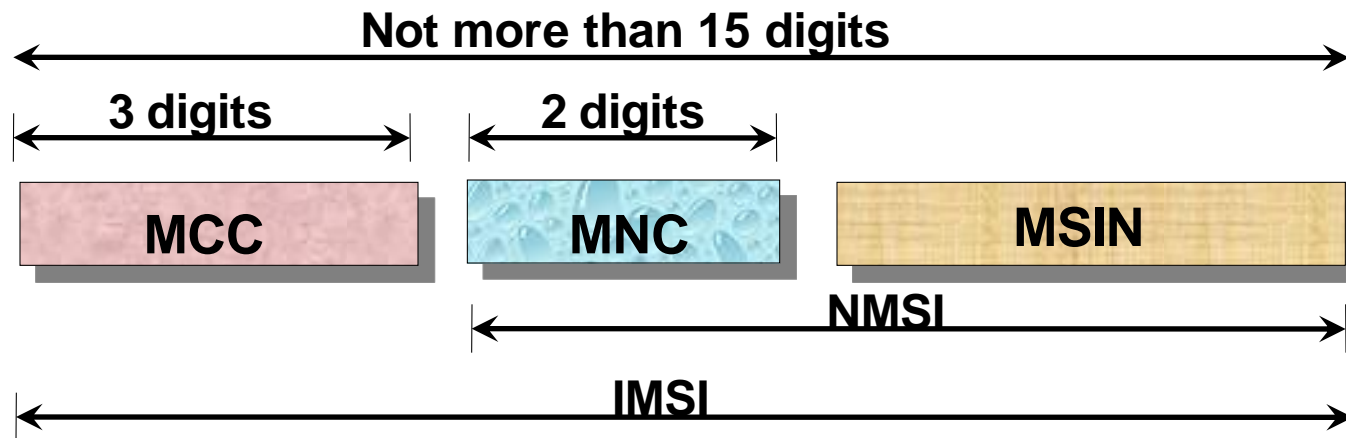
**CC:** Country Code. For example: The CC of China is "86".

**NDC:** National Destination Code. For example: The NDC of China Telecom is 139, 138, 137, 136, 135.

**SN:** Subscriber Number.

Example: 86-139-0666-1234

# IMSI



**MCC:** Mobile Country Code, It consists of 3 digits .  
For example: The MCC of China is "460".

**MNC:** Mobile Network Code, It consists of 2 digits .  
For example: The MNC of China Telecom is "00".

**MSIN:** Mobile Subscriber Identification Number. H1H2H3 S ABCDEF  
For example: 666-9777001

**NMSI:** National Mobile Subscriber Identification, MNC and MSIN form it together.

For Example of IMSI : 460-00-666-9777001

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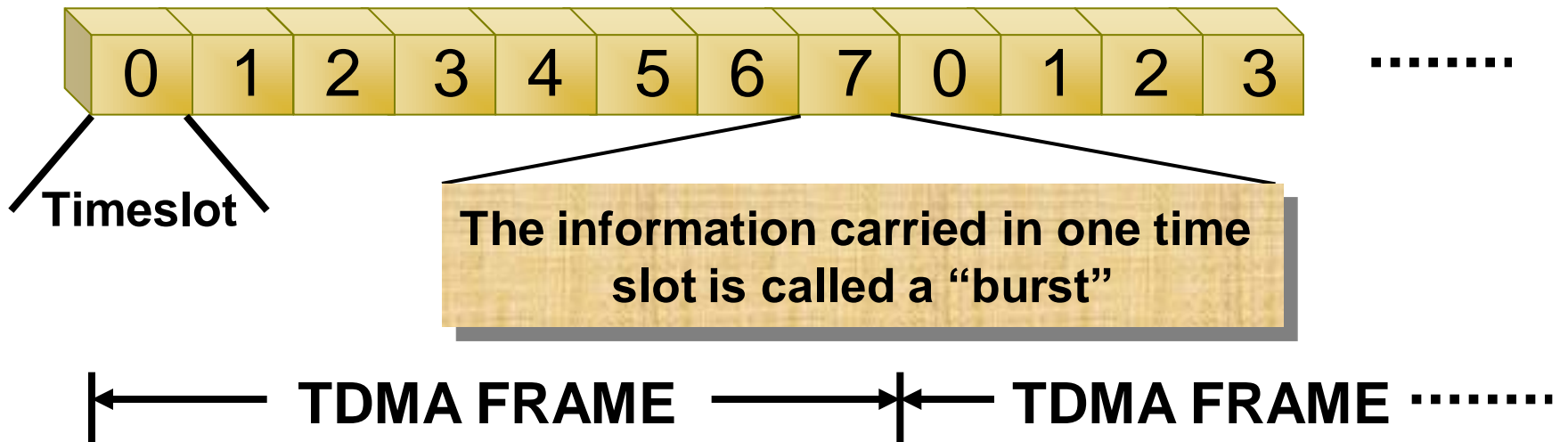
**Chapter 5 Radio Techniques**



# Physical Channel and Logical Channel

The **physical channel** is the medium over which the information is carried: **200KHz** and **0.577ms**

The **logical channel** consists of the information carried over the physical channels





## Two types of Logical Channel

**Traffic Channel (TCH) :**

**Transmits traffic information, include data and speech.**

**Control Channel (CCH) :**

**Or Signaling Channel, transmits all kinds of control information.**

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# Frequency Reuse

## Frequency to be used by TRX (must be unique within a BTS)

initialFrequency (FREQ)

1...1023

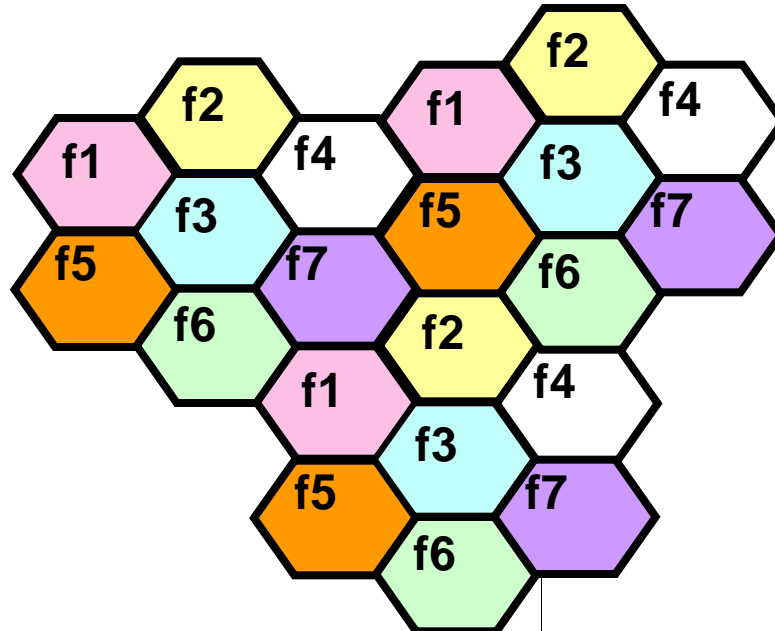
Setting of ARFCNs

GSM 800: 128 .. 251

GSM 900: 1..124 and 975..1023, 0

GSM 1800: 512..885

GSM 1900: 512..810

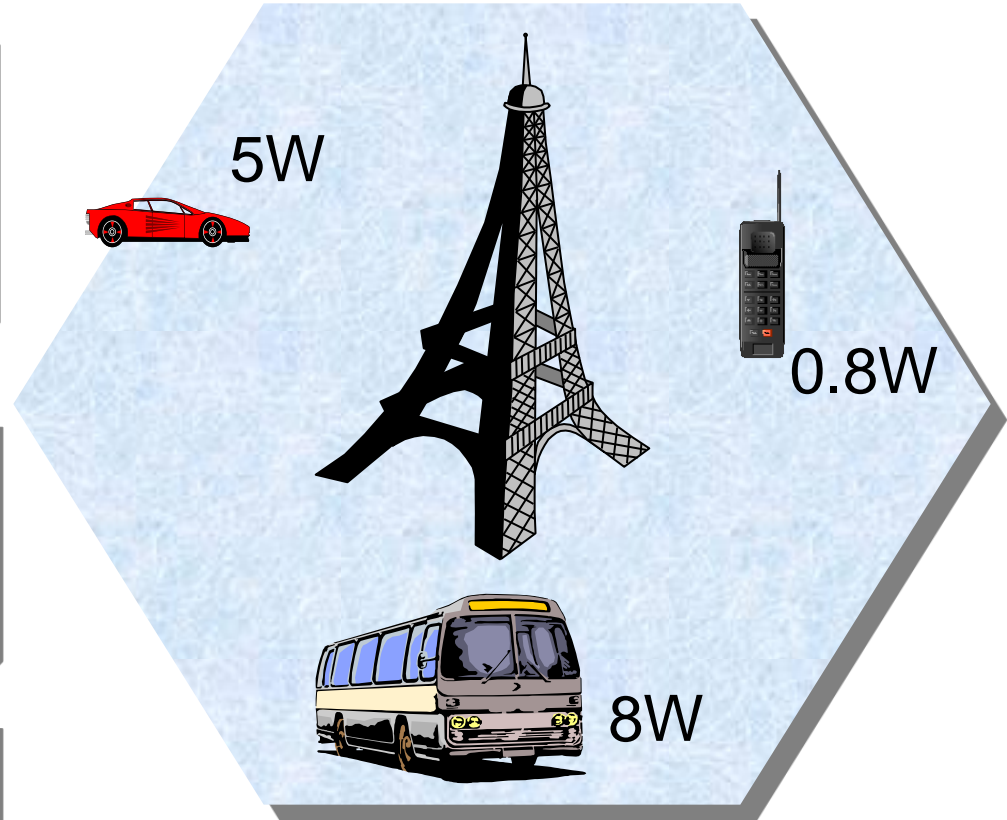


# Power Control

Both Uplink and Downlink power settings can be controlled independently and individually.

Saves battery power  
Reduces co-channel and adjacent channel interference

**BCCH -----**  
**Does not attend Power control**

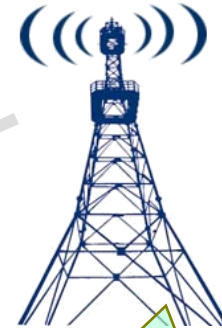


# Classification

Power control includes uplink power control and downlink power control and they are performed **separately**.

- Uplink power control

*adjust the transmit power of MS*



Value measured at uplink

- Downlink power control

*adjust the transmit power of BTS*



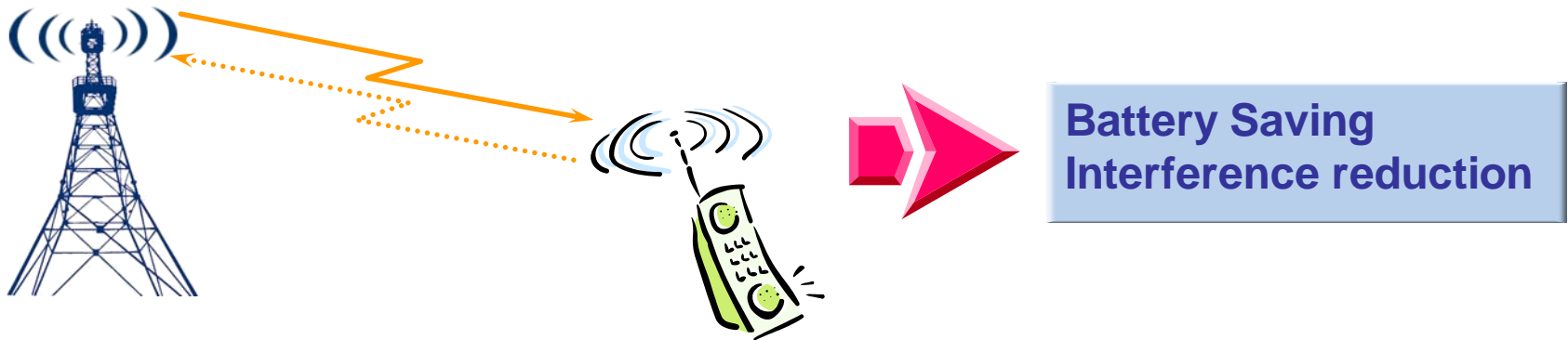
Value measured at downlink

- Based on channel
- Multiplexer supersaturating

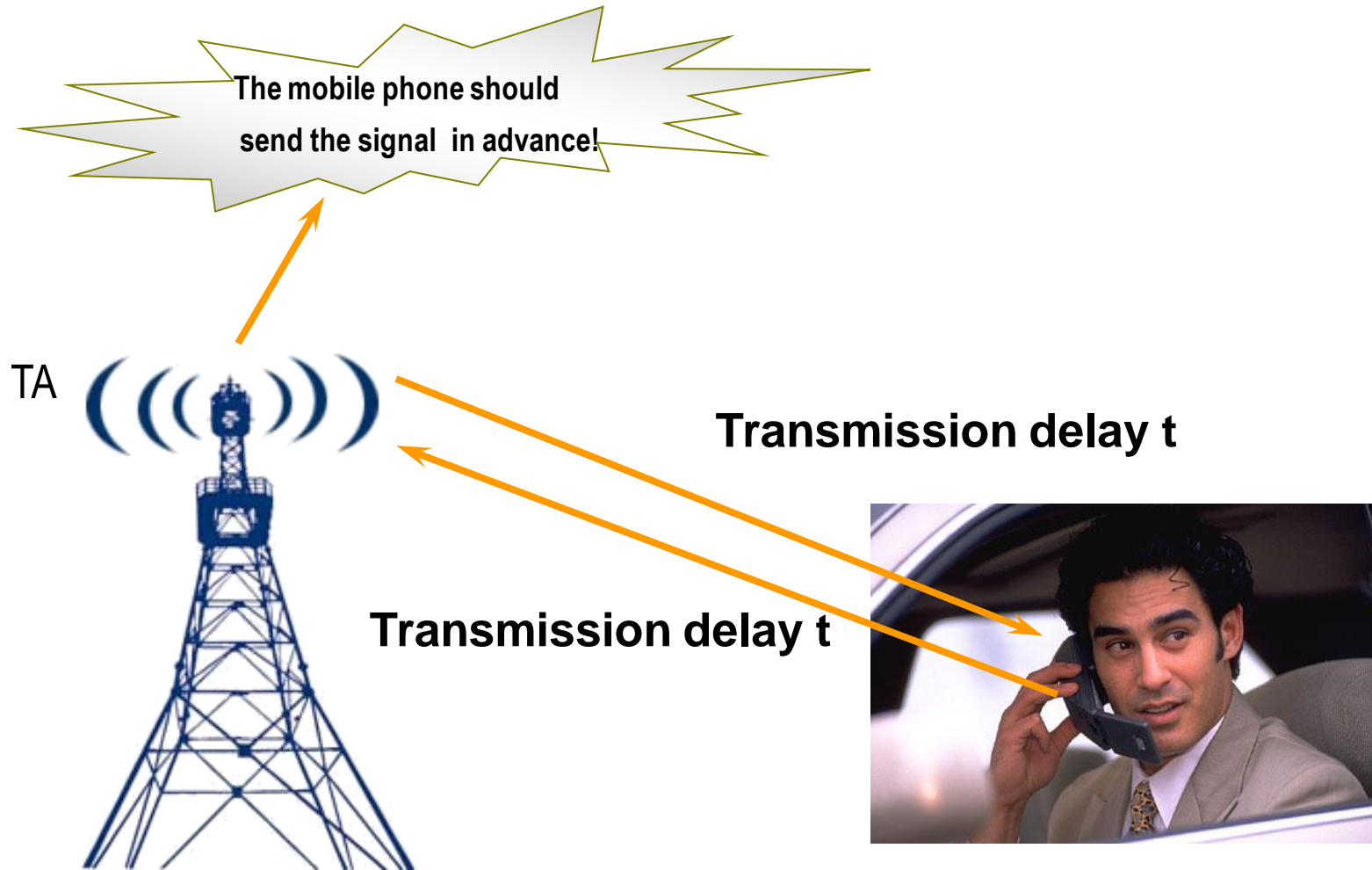
## DTX and VAD

Discontinuous Transmission – DTX

Voice Activity Detection – VAD

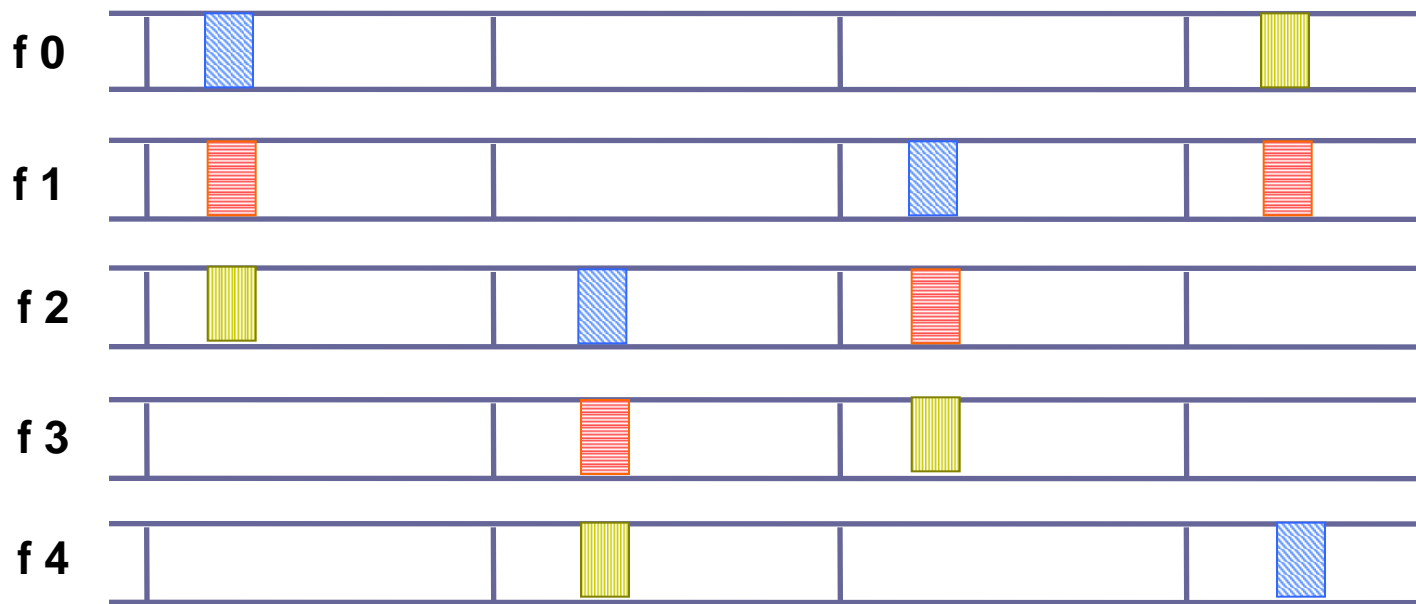


# Timing Advance (TA)



# Frequency Hopping

Frequency



Frame

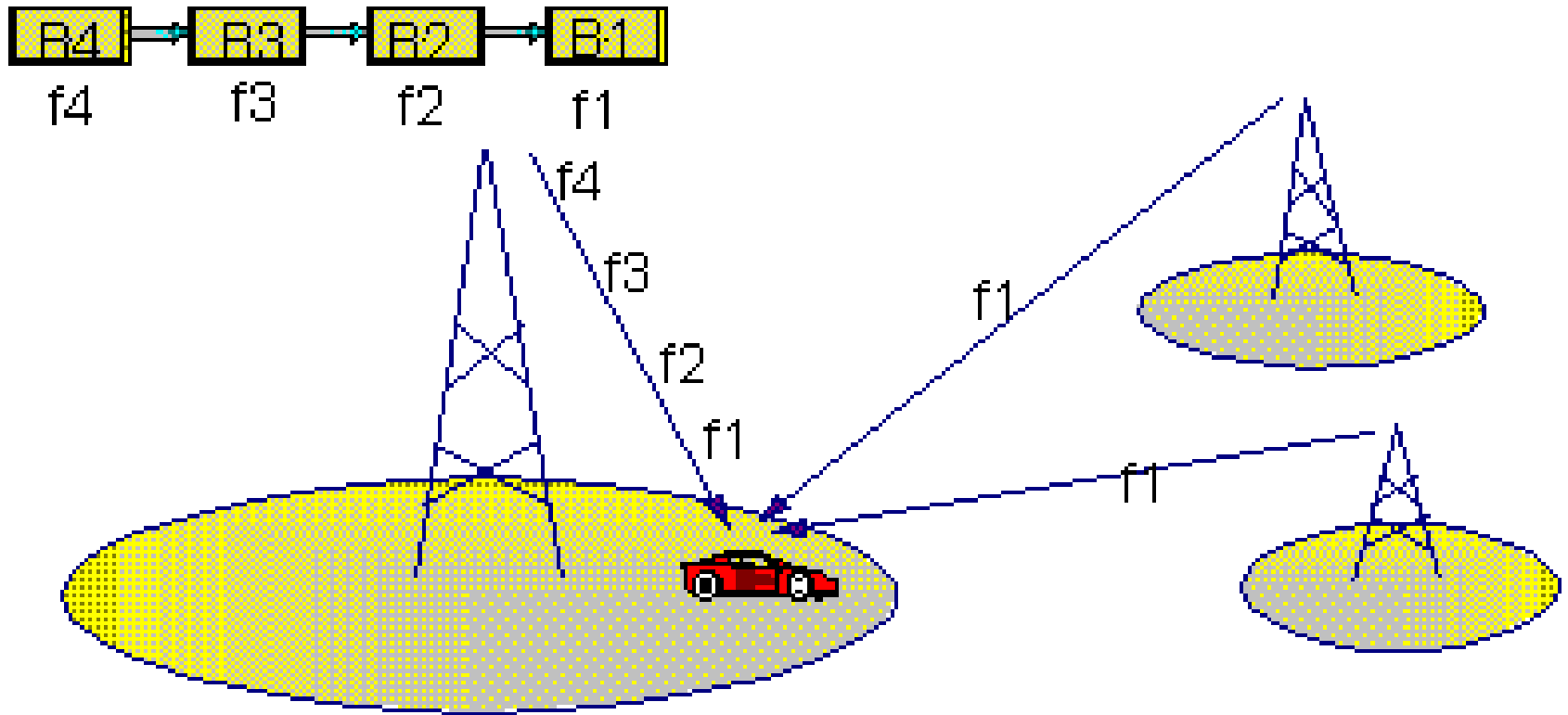
Time



## Advantages of Hopping

- Get an agreeable radio environment.
- Provide a similar communication quality for every user.
- Tighter reuse patterns are possible to be used for larger capacity.

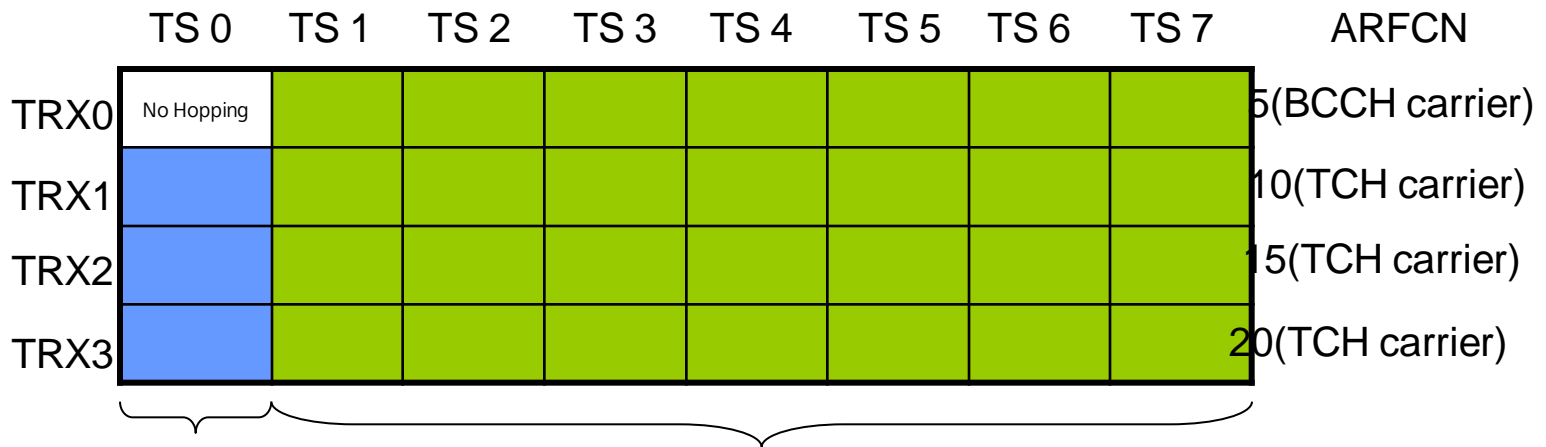
# Interference Diversity of Hopping



Smoothen and average the interference

# Base Band Hopping Principle

- BCCH carrier attends hopping, on which TS0 can not attend hopping

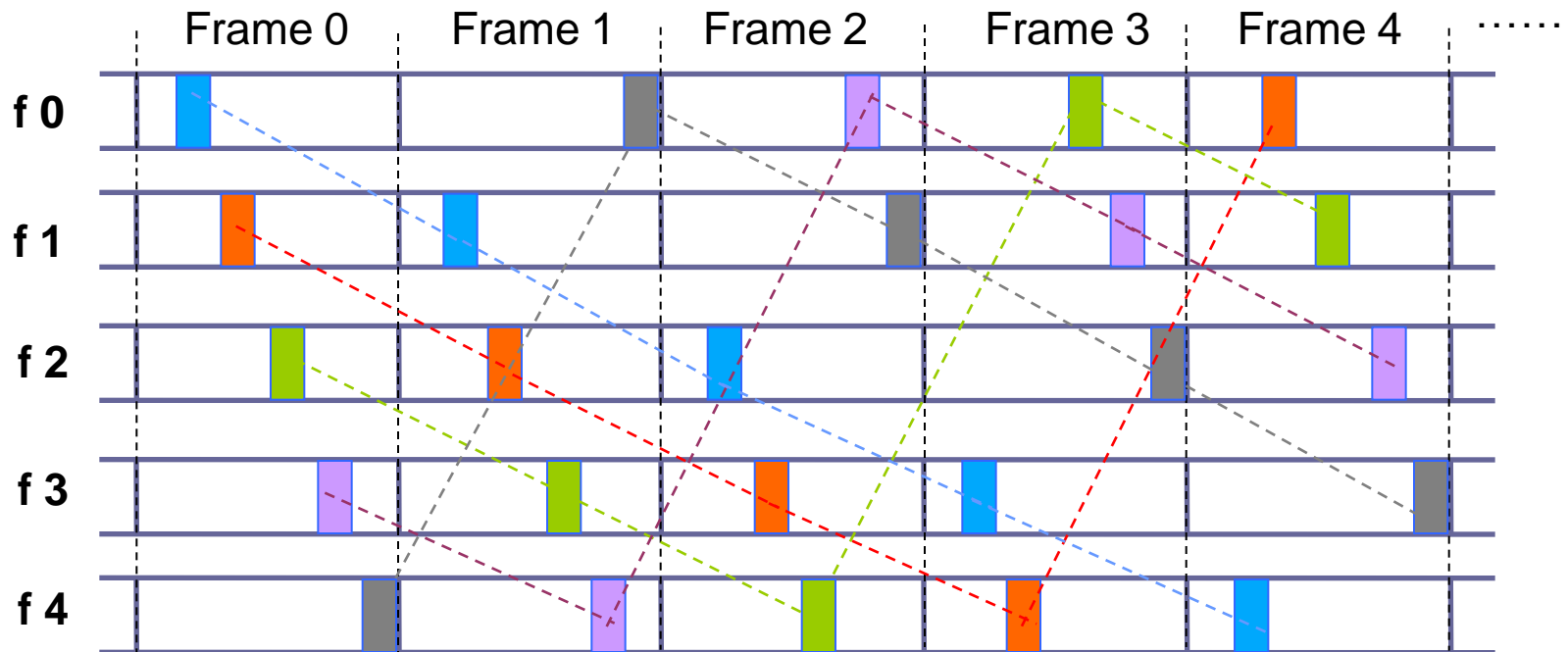


$MA=\{10,15,20\}$

$MA=\{5,10,15,20\}$

# Timeslot Hopping

- 5 timeslots on 1 TRX hopping on 5 frequencies



Thank You

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