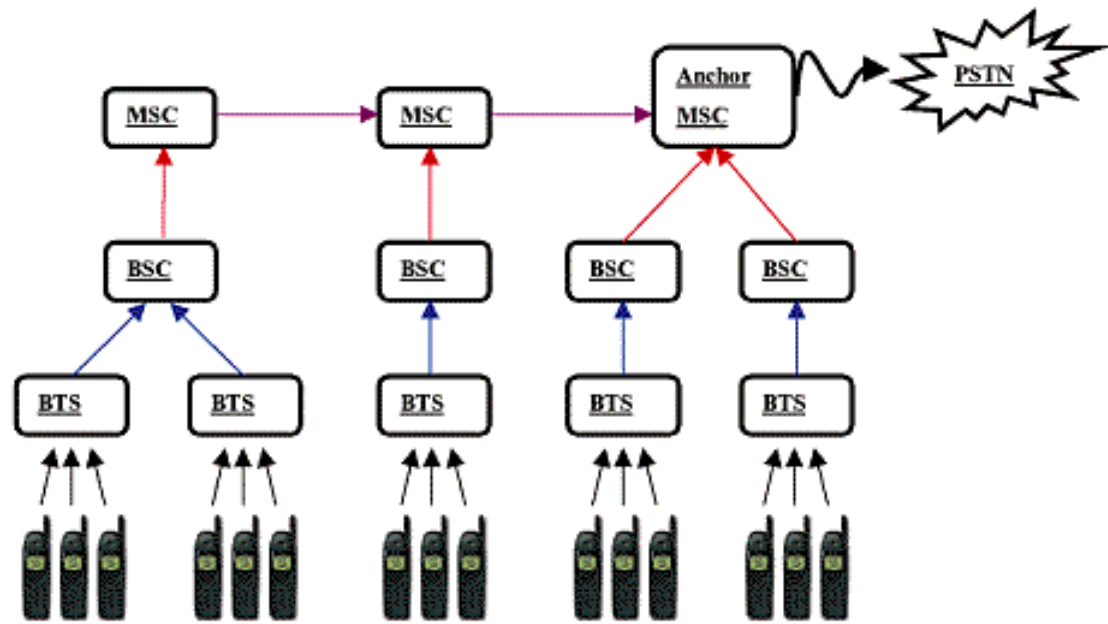


Cellular Network



Call management

Call setup

Call termination

Different Service: voice over IP, call forwarding, ...

User Information Transport

Modulation

Duplexing

Multiple Access

Frequency Bands

Above factors define channels

Physical channels

Logical channels

traffic channel vs. control channel

Mobility Management

“How do you find users when calls arrive for them?”

Registration to keep track of users (HLR/VLR)

Paging to connect calls

Authentication and Encryption for Network Security

Need to have better security and privacy than wired line

Radio Resource Management

Channel Reservation for handoff calls

Maintaining call quality: power control

Resource efficiency

Operation, Administrations and Maintenance (OAM)

Traffic Monitoring

Quality Monitoring

Networking is system dependent

AMPS is an example

It's not cellular system

It's an air-interface standard

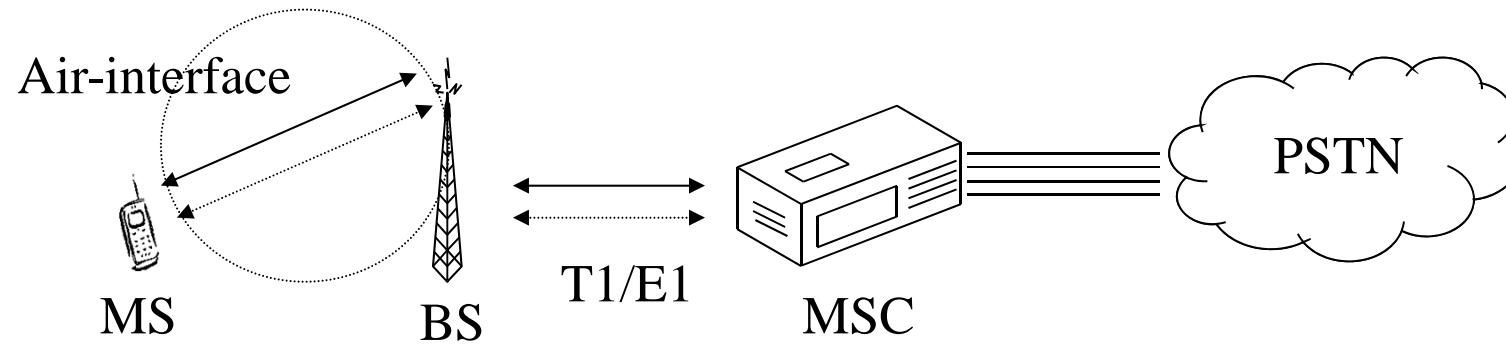
i.e. Protocol between mobile unit and BS

Traffic channel: analog

Control channel: digital

Network Components

Wireless and Mobile
Chae Y. Lee



Air-Interface between Mobile and BS

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Traffic channel

Dedicated Control channel: call setup

Intra-call Control channel: Handoff calls, Power control

Traffic channel

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xDMA/xDD

Modulation: FM in AMPS

Channel spacing: 30kHz in AMPS,
25 kHz by CEPT

Frequency Band

Dedicated Control channel

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For call setup, frequency assignment, handoff

Forward control channel (FOCC): paging channel

Reverse control channel (RECC): Access channel

Every cell site has one dedicated control channel in each direction

Dedicated Control channel

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A digital channel with ECC

In AMPS, 10kbps/30kHz

Repeat every message 5 times: A form of time diversity

Standard Block ECC

Forward (40, 28) code: 1.215 kbps after overhead

Reverse (48, 36) code: 1.250-1.442 kbps

Intra-call Control Channel (Voice channel)

Wireless and Mobile
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In-band signaling over the voice channel to convey system control message

- 1) SAT (Supervisory Audio Tone)
- 2) ST (Signaling Tone)
- 3) Blank and Burst

Broadcasting signals

Constantly monitors signal strength of on-going calls

Locator receiver is used for handoff calls

Radio link is a trunked system

No trunking over the wired line from BS to MSC

Switching function

Administration/control function

Database for billing

Database for locations of users either in the system (HLR)
or out of the system (VLR)

Database for state of the system

- cells, adjacent cells
- available channels in every cell site
- users signal that is degrading and requires handoff

Authentication task for billing, verification of valid
users

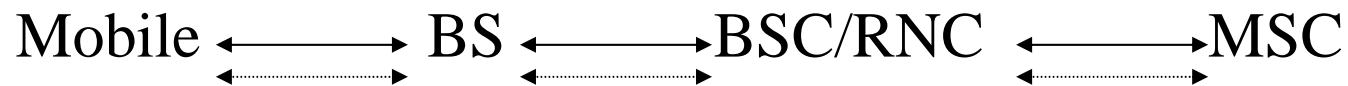
Trend

1) Centralized core function to MSC

Billing, Authentication

2) Distributed function to BSC/RNC

Handoff, call control, channel assignment



AMPS consists of

- 1) Cellular idea
- 2) Spectrum allocation
- 3) Air-Interface standard

Spectrum Allocation

824-849 MHz: Mobile tx

869-894 MHz: Mobile rx

$50\text{MHz}/30\text{kHz} = 1664 \text{ ch}$

$\div 2 = 832 \text{ Duplex ch}$

$\div 2 = 416 \text{ Duplex ch/ carrier}$

21 control, 395 traffic

Air-interface standard

AMPS developed by AT&T

AMPS adopted by EIA and TIA: EIA/TIA 553 Standard

EIA/TIA 533 standard

Modulation scheme

Voice filtering

Power control

Call setup/termination, Handoff protocol

Structure of message

1st Generation Cellular: AMPS (Analog)

2nd Generation Cellular: (Digital)

GSM: One Pan-European Standard

Increase Capacity over Analog

USDC (IS-54): Increase Capacity over AMPS

CDMA (IS-95): Increase Capacity over AMPS

3rd Generation Cellular: UMTS/IMT-2000 (Digital)

WCDMA: voice, video telephony, web document, VOD

CDMA2000

All 2nd Generation Digital standards introduce

ECC

Interleaving

Equalization (not in CDMA)

Low rate vocoding (LPC, ...)

Encryption

Embedded data channel

MAHO

Group System Mobile, Global System Mobile

Goal

1. Pan-European standard (full international roaming)
2. To provide many different services
voice, data service, pager
3. Security
4. Increased capacity:

GSM is a comprehensive standard

Air-interface standard: Mobile-BS

Interface between BS and MSC

BS system (to serve micro-cells)

BTS: radio equipment

BSC: network control operation and signal processing

Two 25 MHz Band

890-915: uplink 935-960: down link

TDMA/FDD

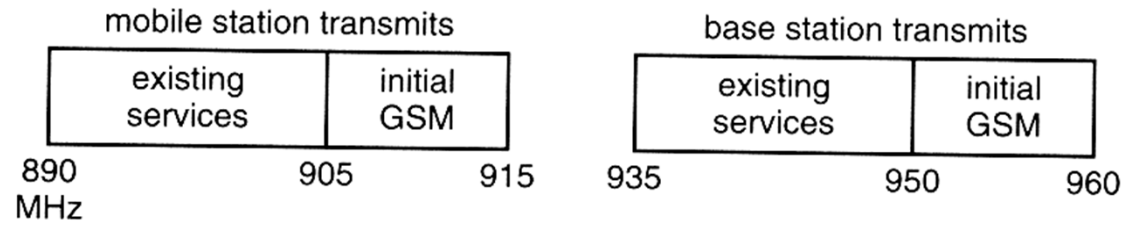
200kHz radio carrier

1 frame (26frame/120ms) with 8 time slots

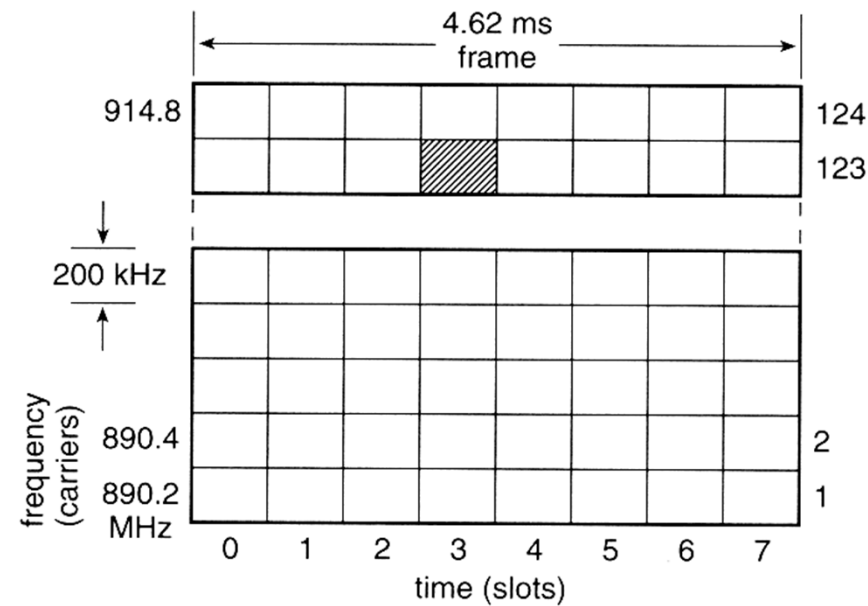
Reverse frame is 3 TS retarded relative to the forward frame: unnecessary for a terminal to tx and rx simultaneously

GSM frequency bands and physical channel

Wireless and Mobile
Chae Y. Lee



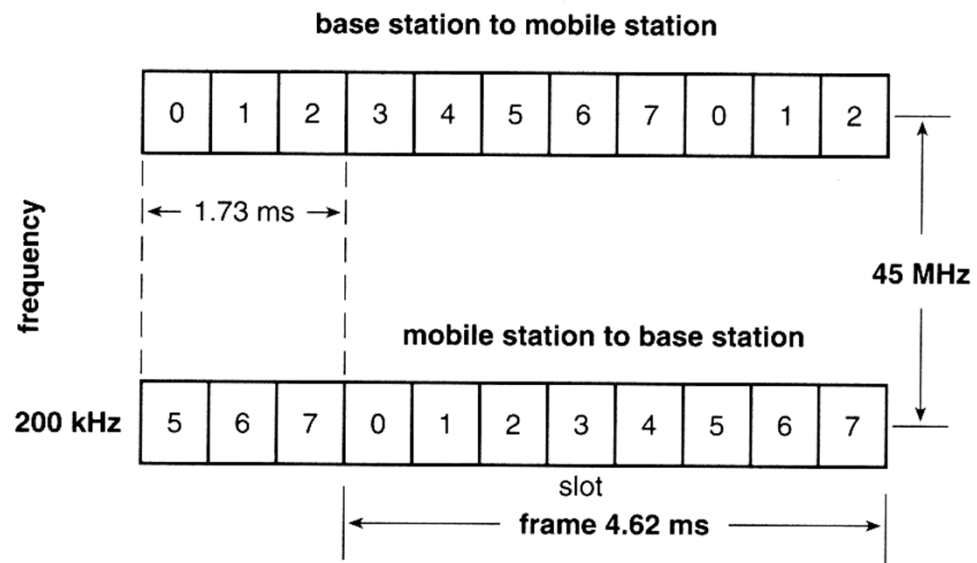
GSM frequency bands



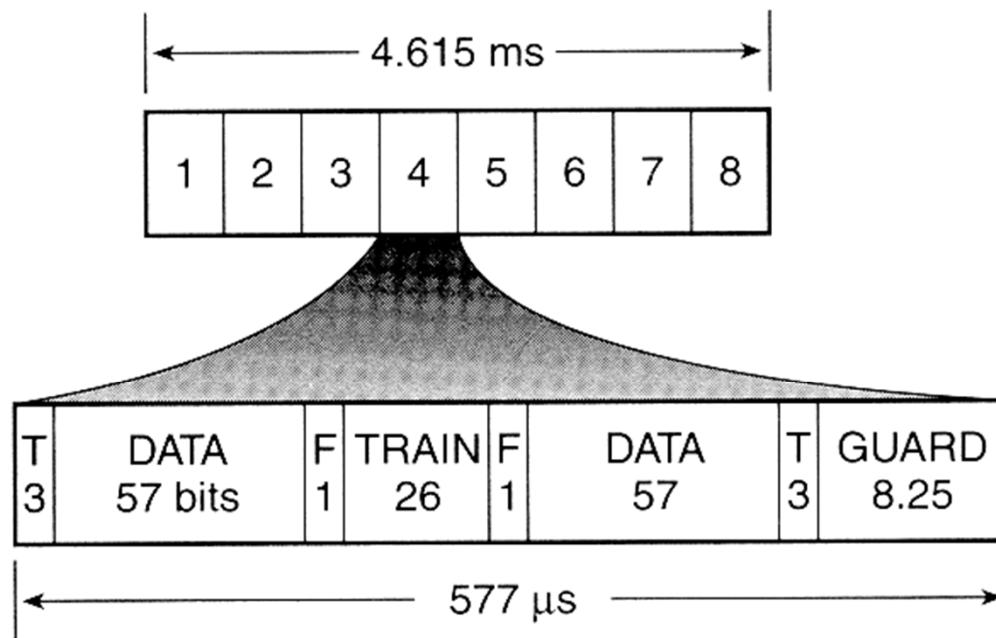
GSM physical channel

GSM frames and slots

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Contents of a GSM time slot



T: TAIL bits F: FLAG TRAIN: equalizer TRAINING sequence

Traffic channel:

TCH/F: 22.8 kbps TCH/H: 11.4 kbps

Control channel (signaling channel):

Broadcast channel:

Common control channel:

Dedicated control channel:

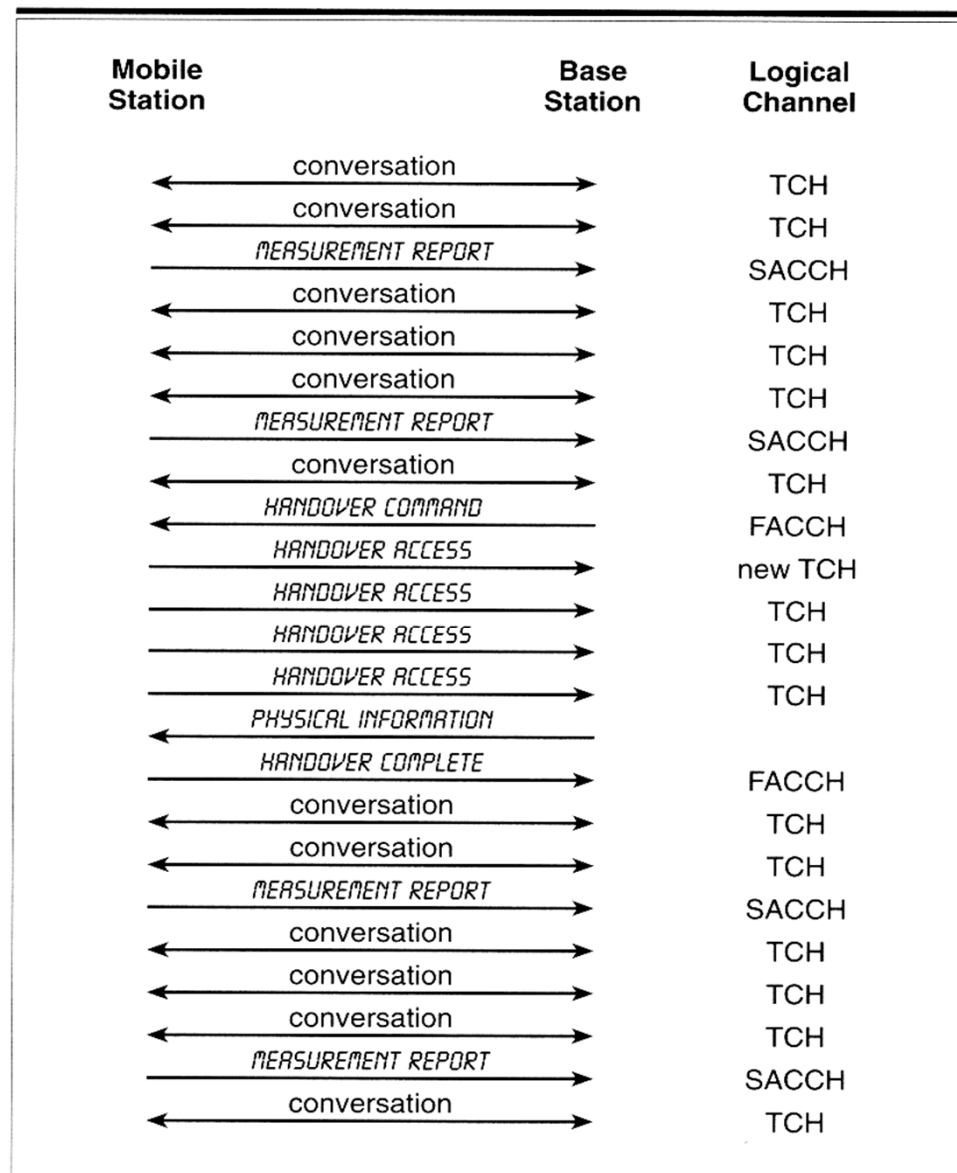


Figure 7.27 Mobile-assisted handover.