Advanced Field Exercise

ERF

Quantico, Va.

April 7-10, 2008

Questions?

- Next Presentation
  - [redacted] Work Book

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Exercise Overview
Co-op Missions
Day 2

2.01

Equipment Day 1 and Day 2

- [redacted]
- Student Disk

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CELL-OTD 01982

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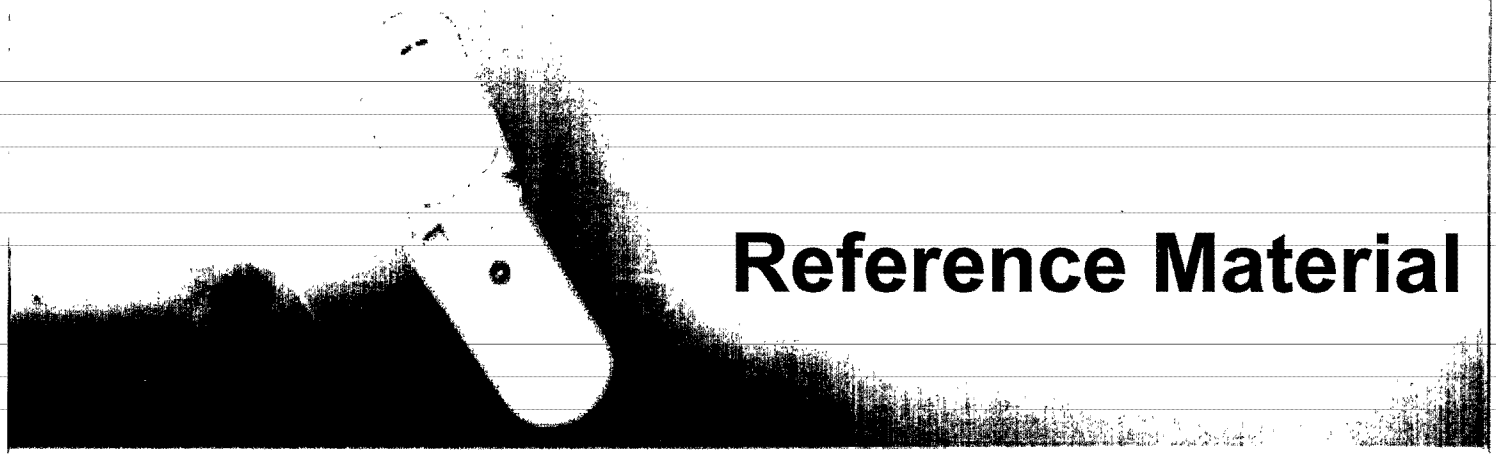
CELL/OTD 02.82



Reference Material

Technology Matrix

TECH	NATIONWIDE SERVICE PROVIDERS	EQUIPMENT

Reference Materials

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- The following are technical reference materials

- Use CALEA Information
-
- CALEA

Questions

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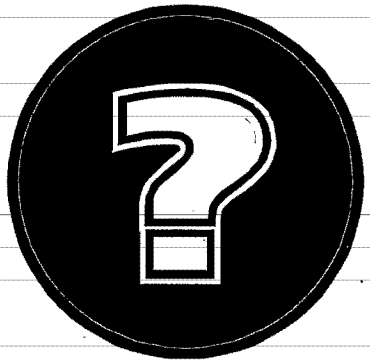
CELL/OTD 02450



Reference Materials

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- THE FOLLOWING MATERIAL IS FOR TECHNICAL REFERENCE

CELL/OTD

[redacted]

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CELL (CTD)

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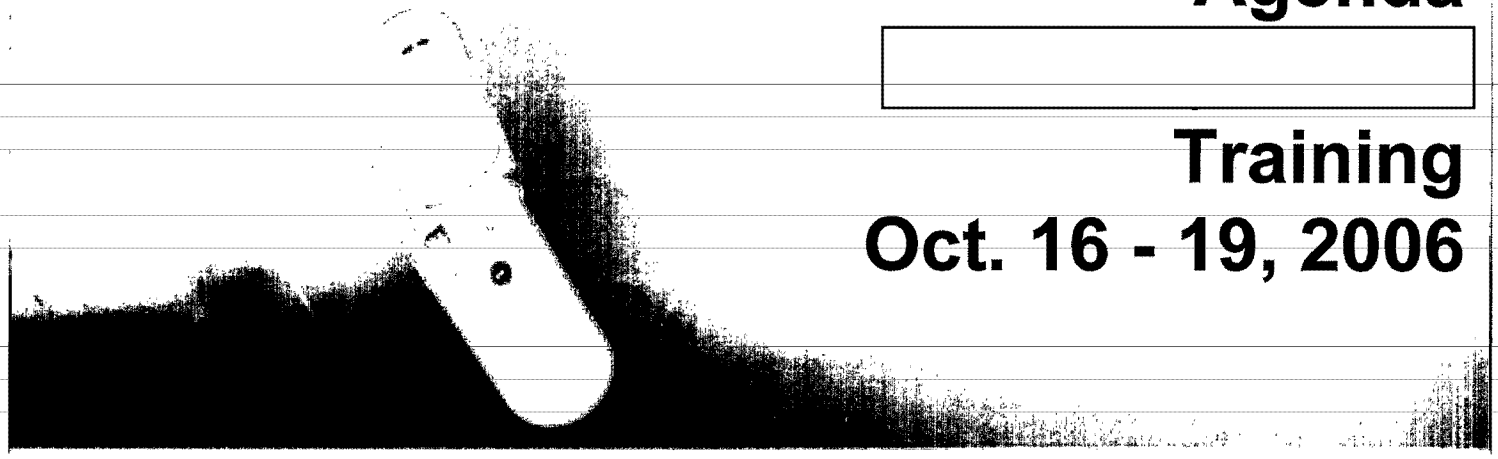
Agenda

[redacted]

Training
Oct. 16 - 19, 2006



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Agenda

Day 1:

- Introductions
- [redacted]

Day 2:

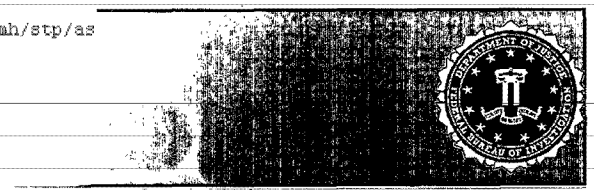
- [redacted]

Day 3:

- Legal Brief
- [redacted]

Day 4:

- [redacted]
- Wrap up and course review



The Federal Bureau of Investigation,

[redacted] presents:

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Overview

Course Overview

This course intends to provide an understanding of the information needed in order to

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CELL/OTD 024391

Course Overview

- The course organization is as follows:
  - Antennas and Antenna Sectors
  - Cellular Network Architecture
  - Frequency Bands and the Cellular Air Interface
  - Introduction to
  - Introduction to
  - Introduction to
  - Reference materials
  - Course exam

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Antennas and Antenna Sectors

Why do they call it Cellular?

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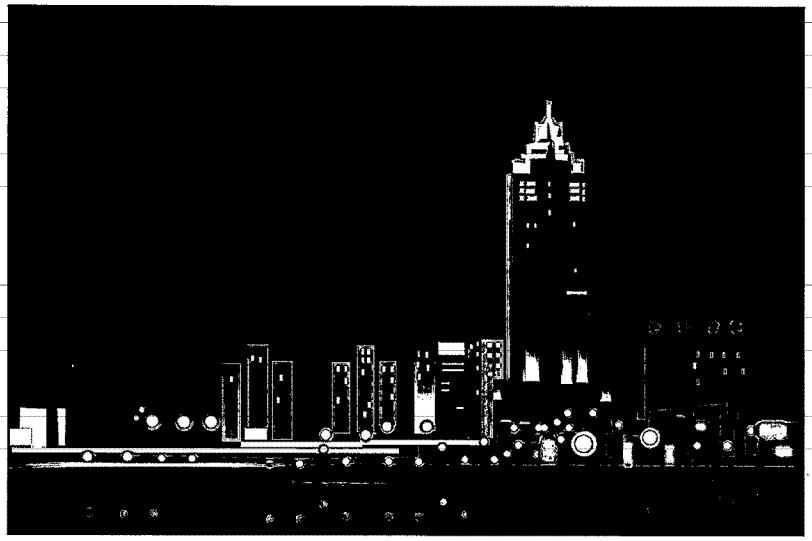
During the early days of mobile communications, systems used high powered transmitters and very tall antenna sites. Equipment was expensive and bulky. One tower might service an entire city. This proved to be very inefficient use of the radio frequencies available. For instance, during the 1970s the entire mobile phone system in New York City could handle only twelve simultaneous calls.



During the early 80's, the FCC made additional frequencies available for use in mobile communications. It was after this addition that the cellular systems began to come into being. A cellular system uses shorter towers spaced closer together and lower powered equipment.

Makeup of a Cell Site

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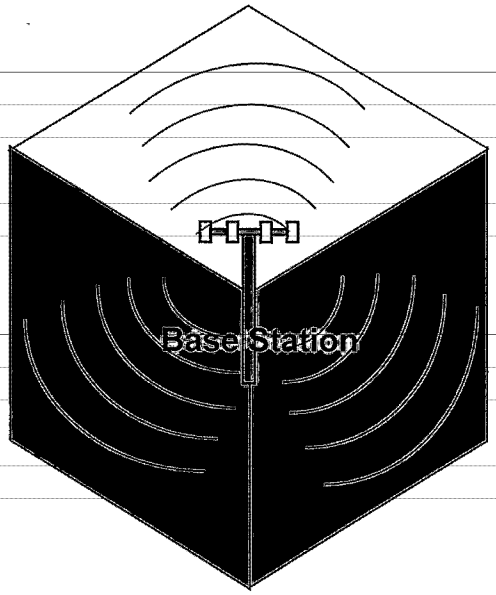

Most Cell Sites transmit in three equal sectors from the tower. Each sector can send different information to the users. A Cell site is also known as a Base Transceiver Station, or BTS.

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Cell Sector ID's

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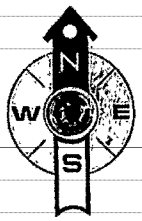

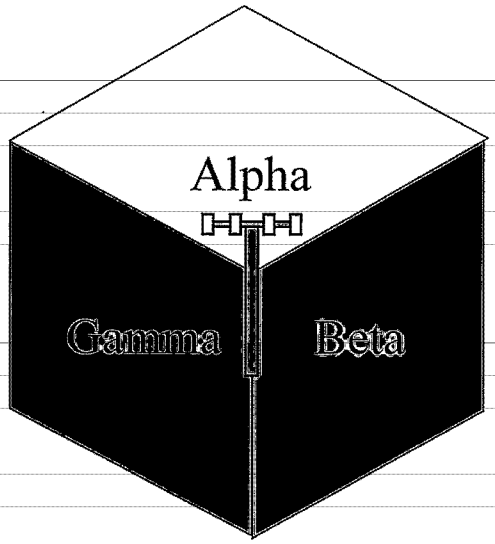

The cell sectors of a tower are numbered sequentially, usually with the designators: Alpha, Beta, and Gamma. The Alpha sector usually faces North. Sometimes, the service provider uses other means, such as 1,2,3, or a,b,c. to identify sectors. Each Tower site will have a unique number identifier in the system.

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Pattern Reuse

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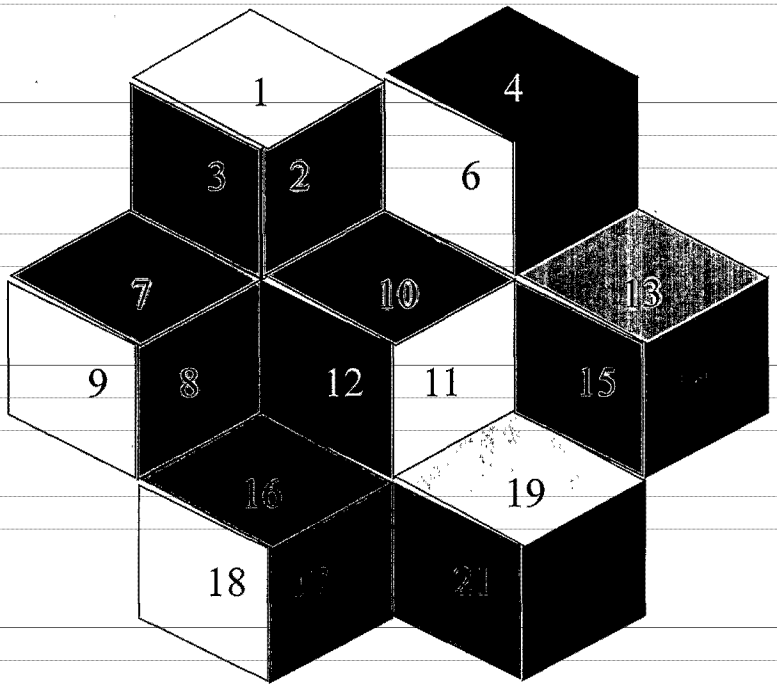

- This seven tower layout uses twenty one different sectors.

CELL/OTD 024399

Cell Sites and Sectors

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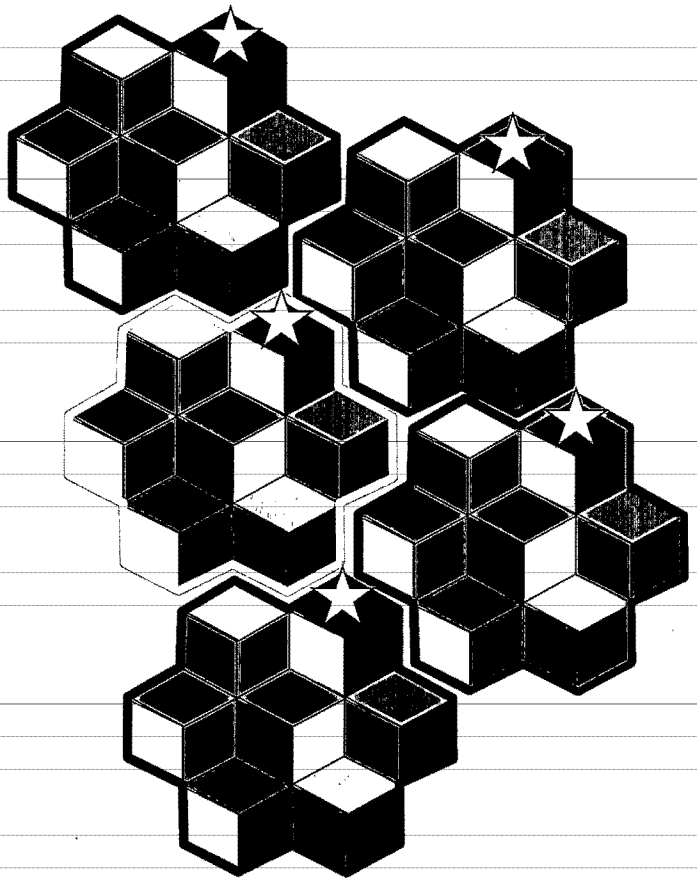

The benefit of having multiple low powered towers allows for the same RF channel to be reused over a relatively short distance. This increases the number of users that the system can process.

☆ - Same RF channel

Metropolitan Coverage

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Cell sites are not always evenly distributed. Service providers have to account for the topography of the area, as well as high usage areas, such as urban areas or along expressways.

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Cell Tower Orientation

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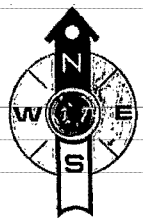

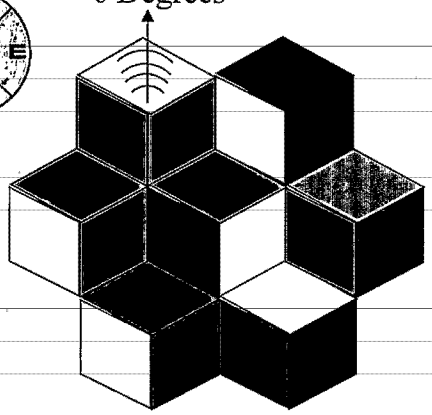

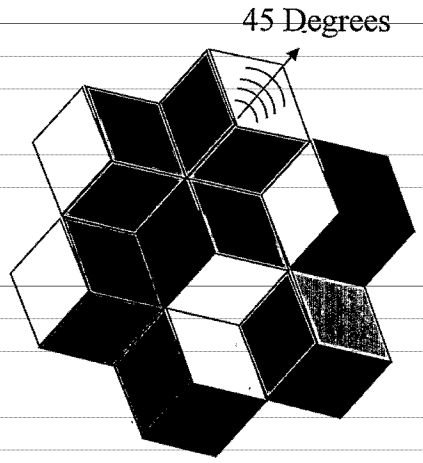

Service providers can arrange their systems any way they choose. Some systems have the Alpha tower face pointing Northward, while others may rotate their antennas away from true North.

CELL/OTD 024402

Cell Towers

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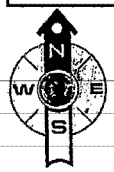
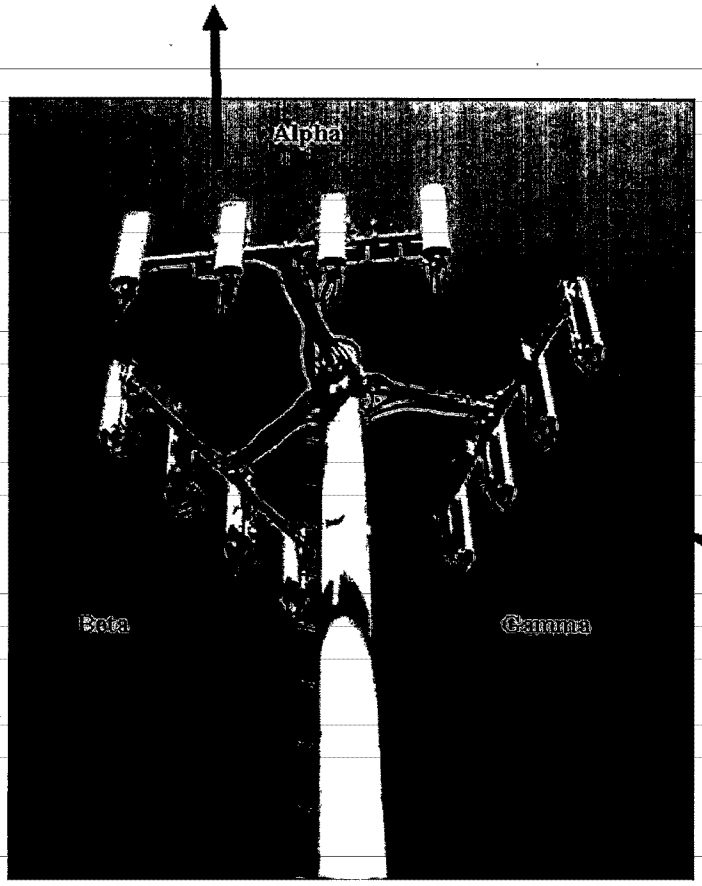
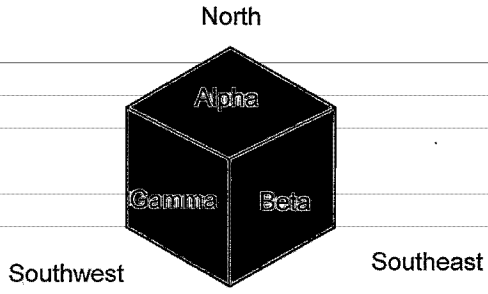




A typical three sector tower antenna arrangement

If the Beta and Gamma sectors seem reversed in the photo, remember that you are looking up at the tower from below. Cell maps are drawn as if you are looking at the towers from above

CELL/OTD 024403



Cell Towers

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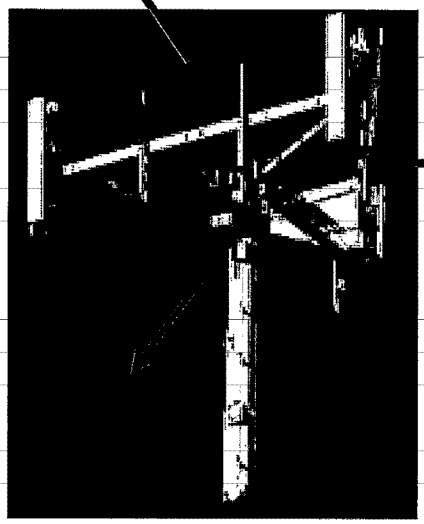
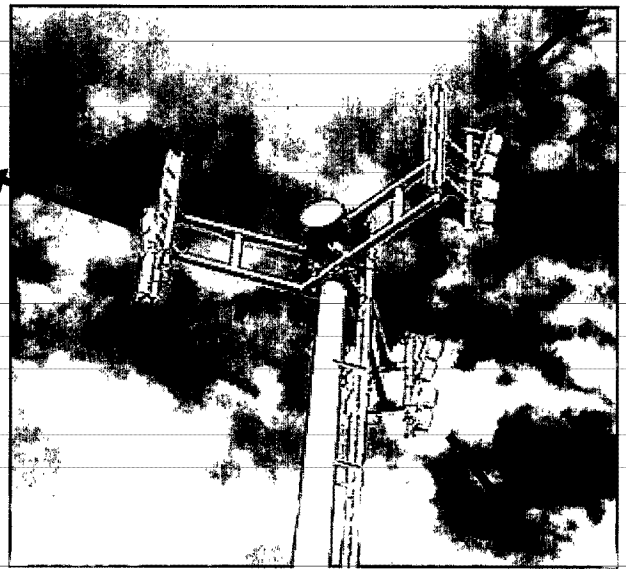
Direction of Coverage



Antenna



CELL/QTD 024404

When observing towers that just have antennas on the tips of the triangle pay close attention to which direction the broader side of the panel is facing. This is the direction indicator for the sector.

Cell tower examples

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Panel antennas on roofs are common

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Cell tower examples

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Pole top antennas

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Cell tower examples

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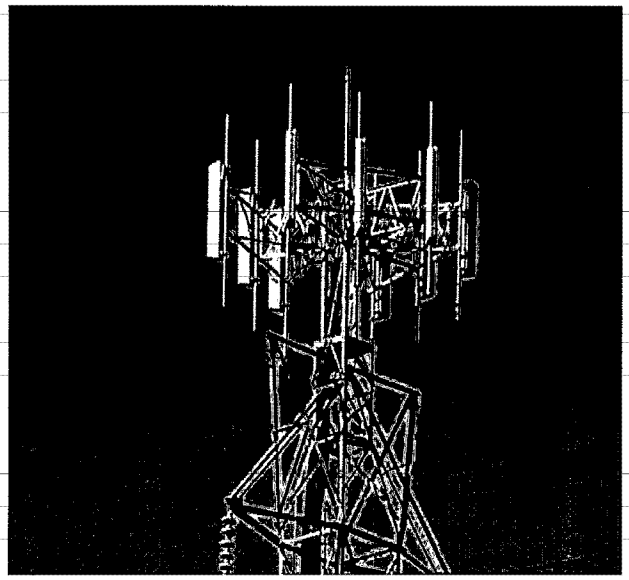
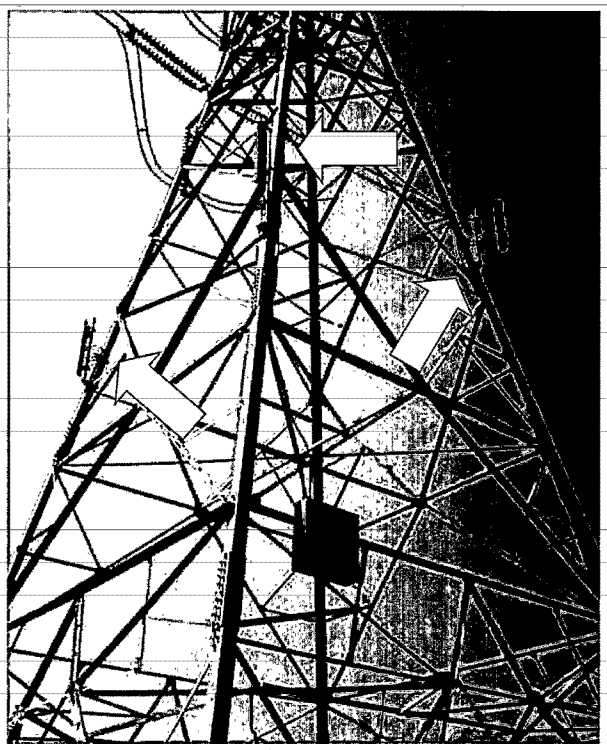
High Tension line towers being used for sites





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Cell tower examples

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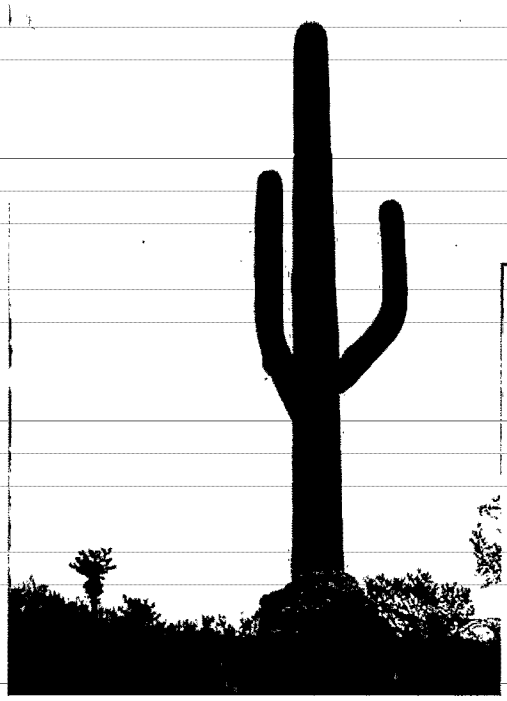
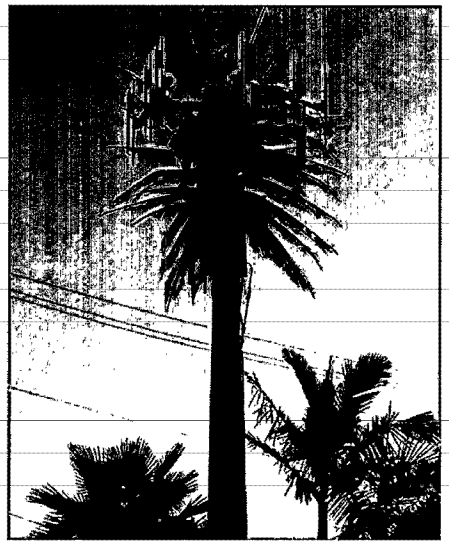
With strict zoning laws, antenna makers are becoming more creative





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Cell tower examples

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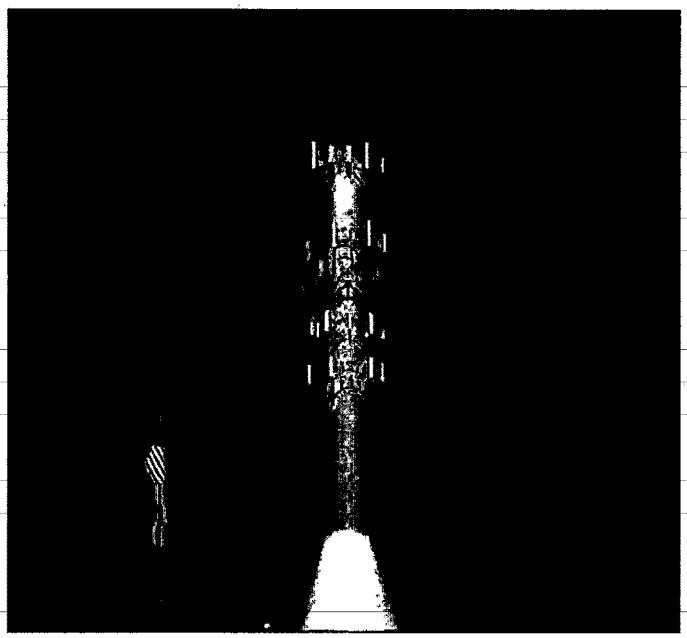
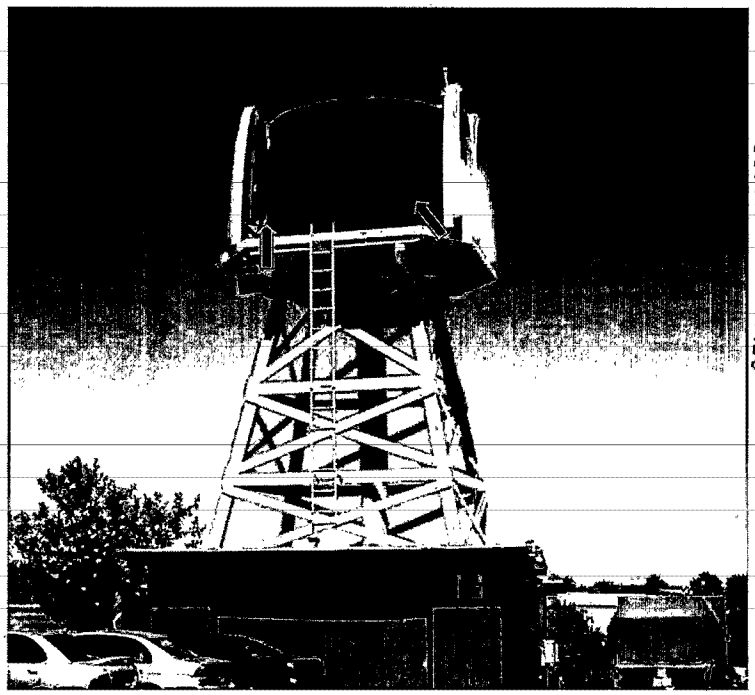


Water Towers



CELL/OTD 024409

Cell tower examples

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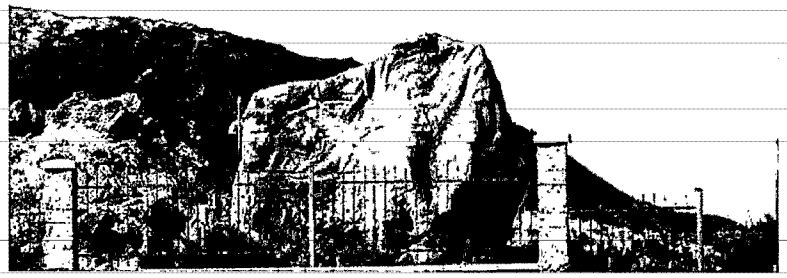
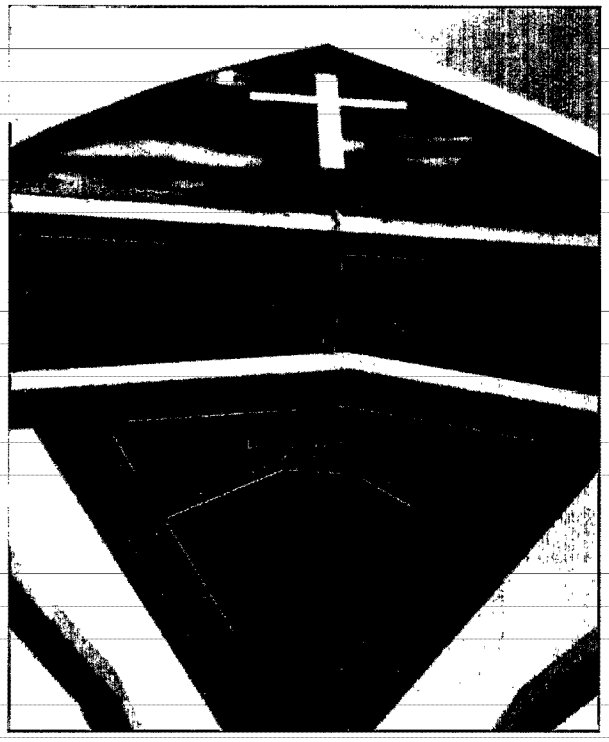
Church Steeple



Entire cell site including base electronics and power supply housed inside a fiberglass boulder



CELL/OTD 024410

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Cellular Network Architecture

CELL/OTD 024411

Cellular Network Architecture

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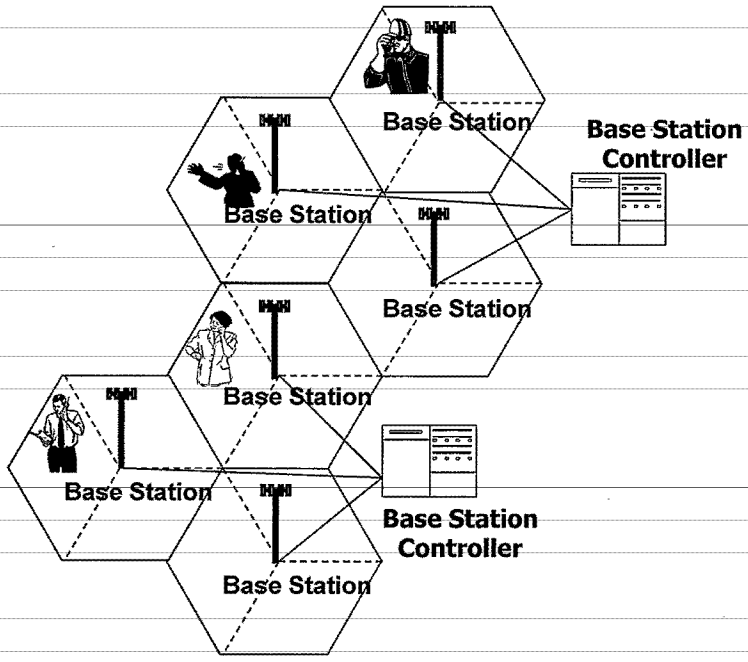

Cell towers blanket an area of coverage. Each tower is equipped with a base station transceiver. Multiple towers connect to a Base Station Controller. This link may consists of a hardwire connection or by microwave.

CELL/OTD 024412

Cellular Network Architecture

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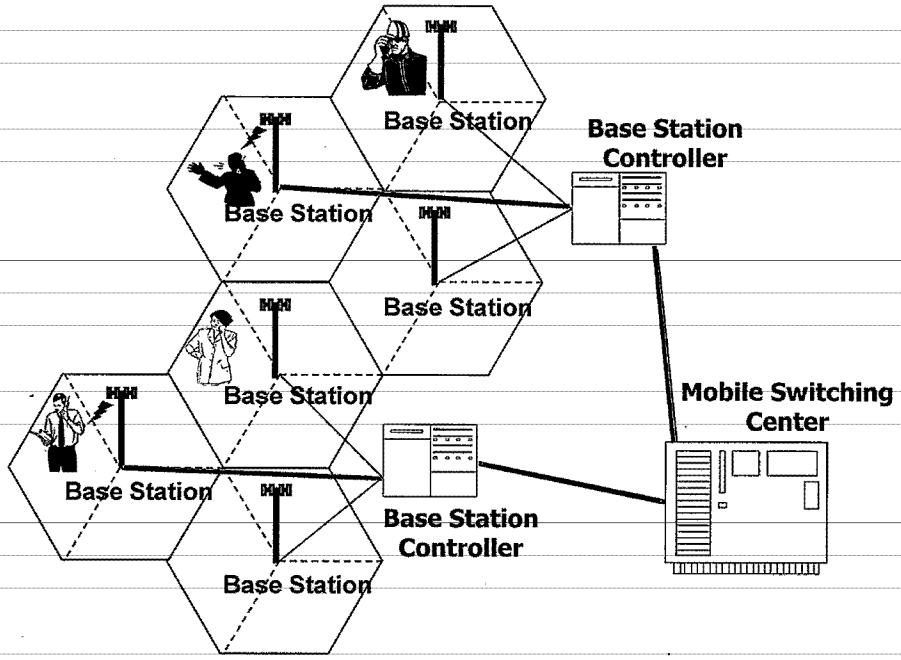

Multiple Base Station controllers connect to the Mobile Switching Center (MSC) (also referred to as a Mobile Telephone Switching Office, MTSO). The MSC controls the call traffic in the system.

CELL/OTD 024413

Cellular Network Architecture

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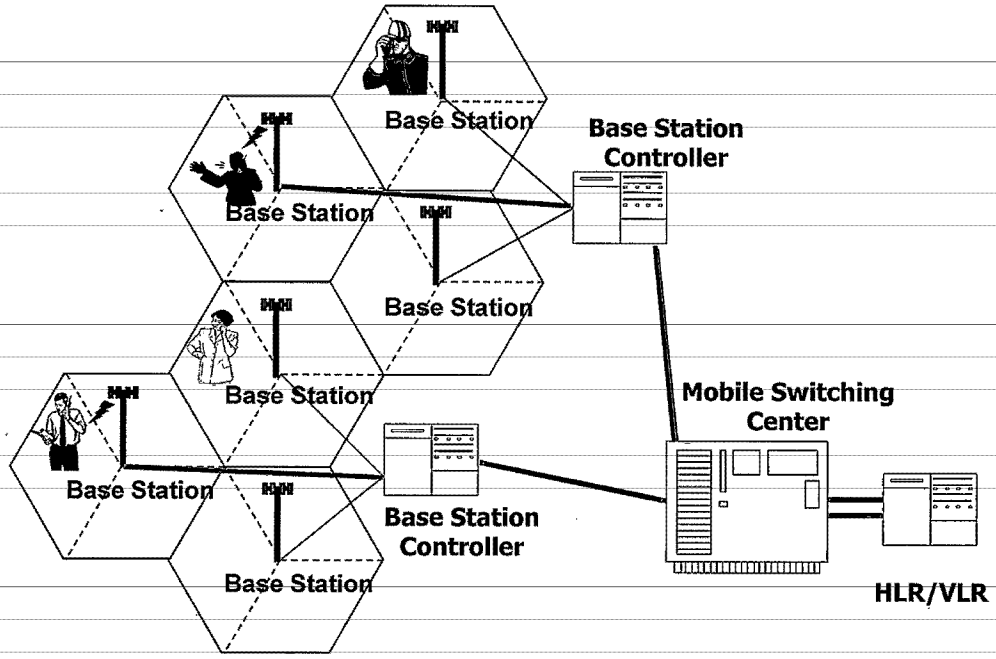

When a Mobile Station (cell phone) powers on and off, it sends a message to the system with it's identity and parameters. This is called a registration. The information is recorded in the HLR. The handset repeats sending a registration message periodically as determined by the network.

Within the MSC resides the Home Location Register, (HLR) and the Visitor Location Register (VLR). (HLR is a separate entity and is not part of the MSC however the VLR is often integrated into the MSC.) Each time a call is placed, the subscriber record is checked to see that the subscriber requesting service has a valid account and the prescribed service features are made available to them.

CELL/OTD 024414

Cellular Network Architecture

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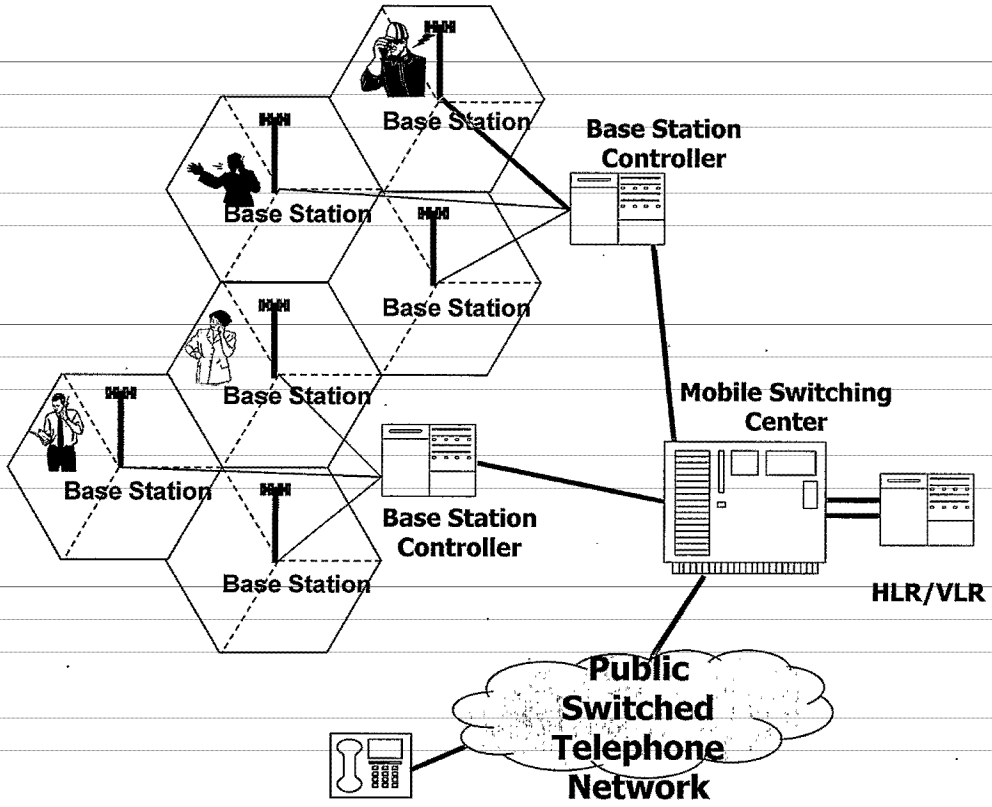
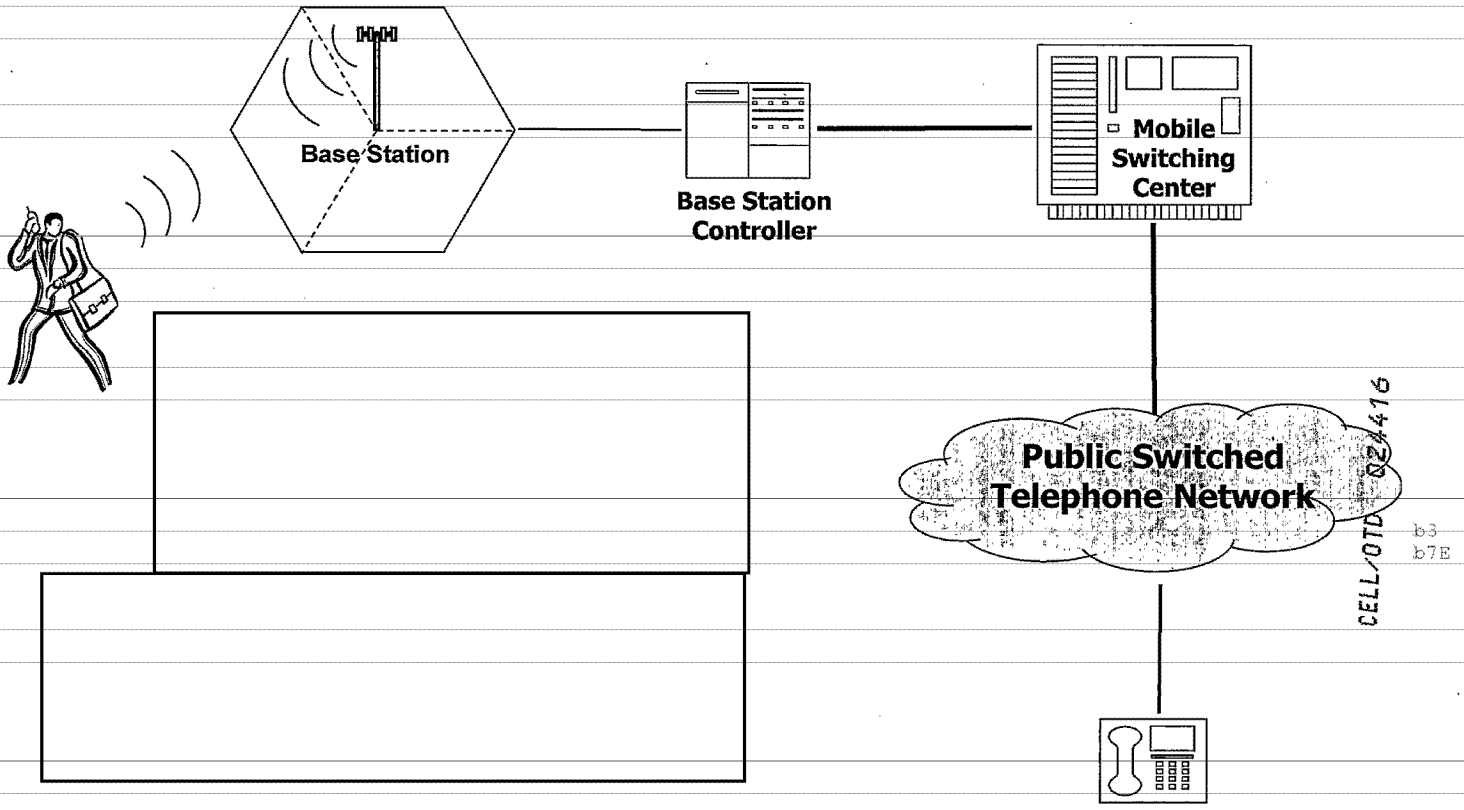


The MSC provides connectivity to the Public Switched Telephone Network (Landline phones), as well as connectivity to data services such as web, email, and multimedia for people with high speed data capable phones or cellular data cards.

CELL/OTD 024415

Cellular Network Architecture



CELL/OTD 02416

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Cell handoffs

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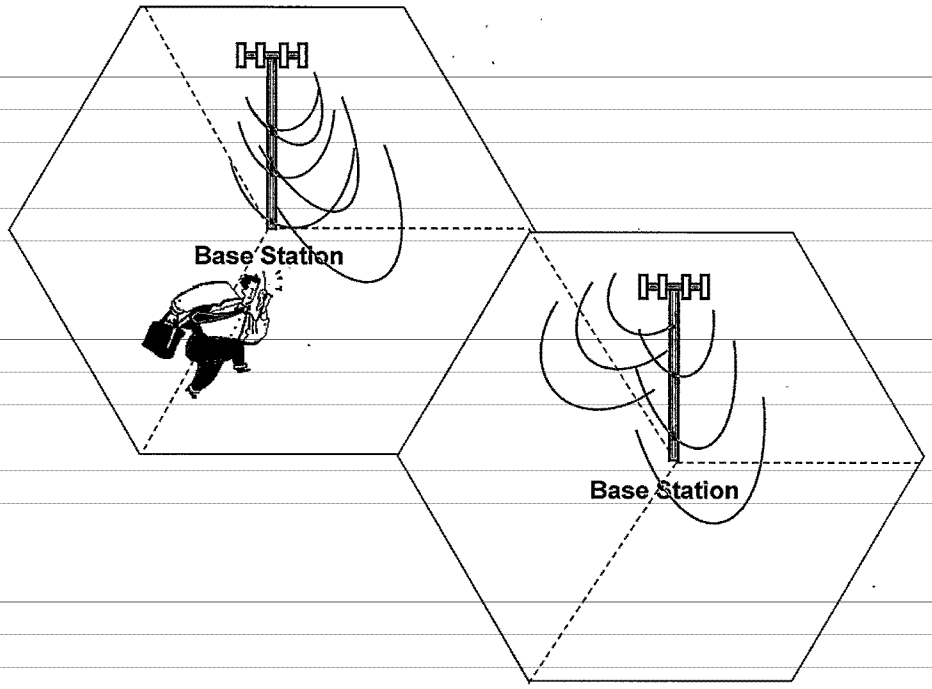

- Once a call is placed or received, the cellular user communicates with their service provider's closest cell tower
- As the user moves geographically, "handoffs" will occur between cell towers

CELL/OTD 024417

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Frequency Bands and the Cellular Air Interface

Frequency Bands

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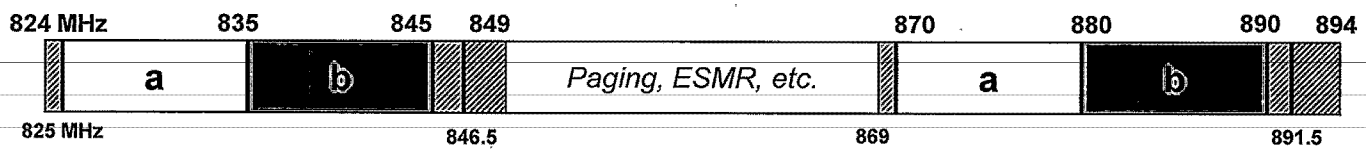
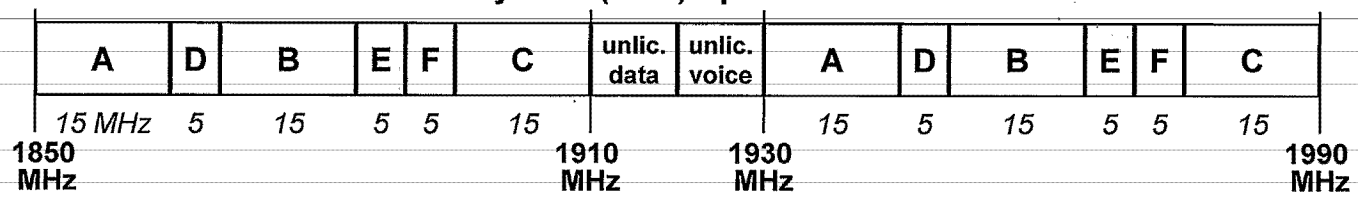
Communication between the mobiles and the network occur in two frequency bands in the United States, (800 & 1900MHz).* Overseas networks operate in the 900 & 1800MHz bands.

Cellular Spectrum Allocations in North America



Personal Communications System (PCS) Spectrum Allocations in North America



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Frequency Bands

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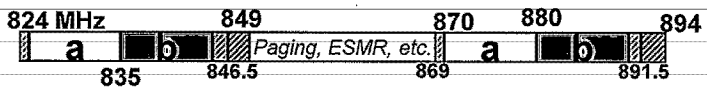
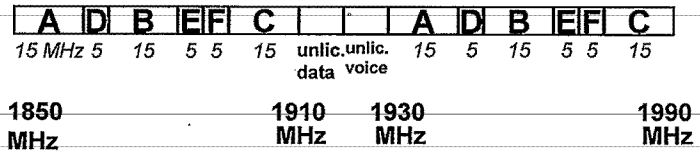
Cellular Spectrum



PCS Spectrum



- The 800 MHz Cellular band has two sections, small "a" and small "b". These were the original cellular frequencies.
- The PCS band is divided into six bands, large A-F. Bands A-C are 15 MHz wide, D-F are 5 MHz wide.
- Ownership of these blocks are not uniform. A service provider might operate in "b" in one market and "C" in another.

CELL/OTD 024420

RF Channels

Cellular and PCS frequency bands are subdivided into Radio Frequency (RF) channels for communication between base stations and mobiles. Mobiles transmit on one frequency and listen on another.

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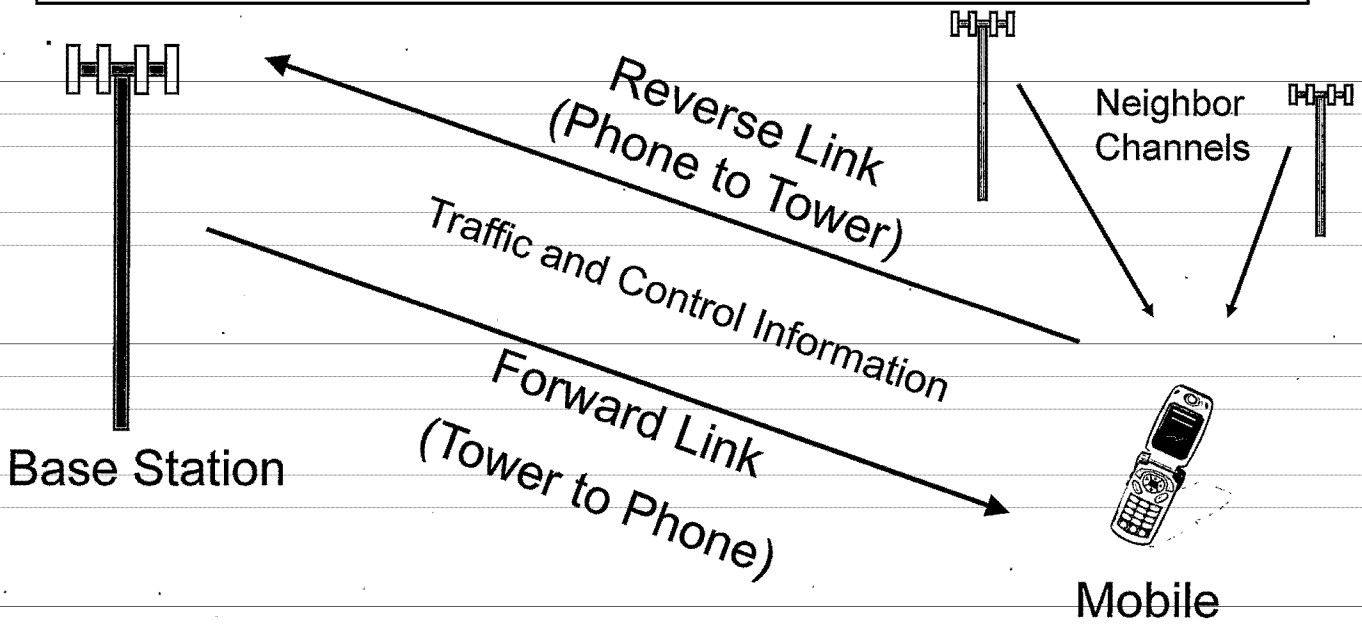

CELL/OTD 024421

Frequency Bands

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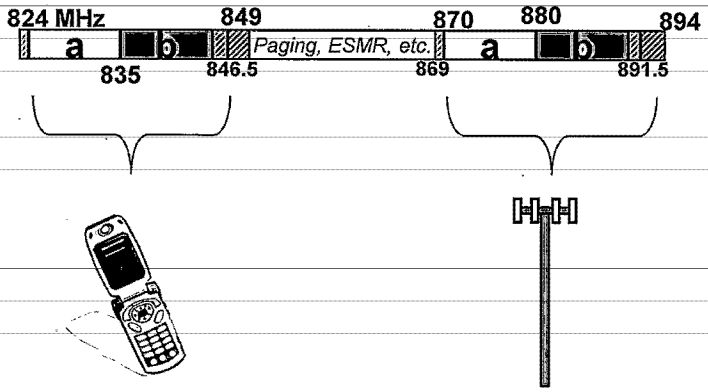
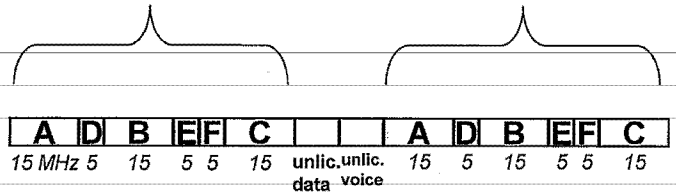
Cellular Spectrum



Reverse Channels **Forward Channels**



1850 MHz **1910 MHz** **1930 MHz** **1990 MHz**

PCS Spectrum

The lower set of spectrum in both the cellular and PCS bands correspond to the reverse channels transmitted by the cell phone to the tower. The upper regions correspond to the frequencies transmitted by the towers to the phones

024422

Basic Cellular Telephone Technology Overview

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Introduction to

CELL/OTD - 024437

Basic Cellular Telephone Technology Overview

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Introduction to

CELL/OTD 024448

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Reference Materials

CELL/OTD 024454

(Rev. 01-31-2003)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 03/07/2007

To: Operational Technology

From: Operational Technology
/ERFE
Contact:

Approved By:

Drafted By:

Case ID #: 268-HQ-1068430

Title:

Synopsis: To report the results of the meeting with on 01/29/2007.

Details: Electronics Engineers (EE) and traveled to

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CELL/OTD 020649

To: Operational Technology From: Operational Technology
Re: 268-HQ-1068430, 03/07/2007

LEAD(s):

Set Lead 1: (Info)

OPERATIONAL TECHNOLOGY

AT QUANTICO, VA

Read and clear.

CC: [redacted] QT-ERF
[redacted] QT-ERF
QT-ERF-E
QT-ERF-E
[redacted] QT-ERF-E
QT-ERF

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♦♦

CELL/OTD 020651

(Rev. 01-31-2003)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 06/13/2007

To: Operational Technology

From: Operational Technology
[redacted]/ERF-E
Contact: [redacted]

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 268-HQ-1068430

Title: [redacted]

Synopsis: To report details of travel to Atlanta, Georgia from 05/28/2007 - 05/31/2007.

Details: During the period of 05/29-31/2007, Electronics Engineer (EE) [redacted]

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EE [redacted]

[redacted]

[redacted]

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Version 7.0

25 March 2010

Law Enforcement Sensitive

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(i) Already known to the contractor prior to the commencement of the contract

(ii) Required by law, regulation, subpoena or government or judicial order to be disclosed, including the Freedom of Information Act.

No release of information shall be made without the prior written consent of the Office of Public Affairs and the Contracting Officer. The contractor and the author are warned that disclosure is not without potential consequences. The FBI will make every effort to review proposed publication in a timely manner to accommodate theses and other publications. Where appropriate, in accordance with established academic publishing practices, the FBI reserves the right to author/coauthor any publication derived from this contract. These obligations do not ease upon the completion of the contract.

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