

Overview of Location Technologies

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November 19, 2002

Important Terminology

AGPS – Assisted GPS

AFLT – Advanced Forward
Link Trilateration

AOA – Angle of Arrival

BTS – Base Transceiver
Station

EFLT – Enhanced Forward
Link Trilateration

EOTD – Enhanced Observed
Time Difference

GPS – Global Positioning
System

ID – Identifier

LMU – Location
Measurement Unit

MS – Mobile Station

MSC – Mobile Switching
Center

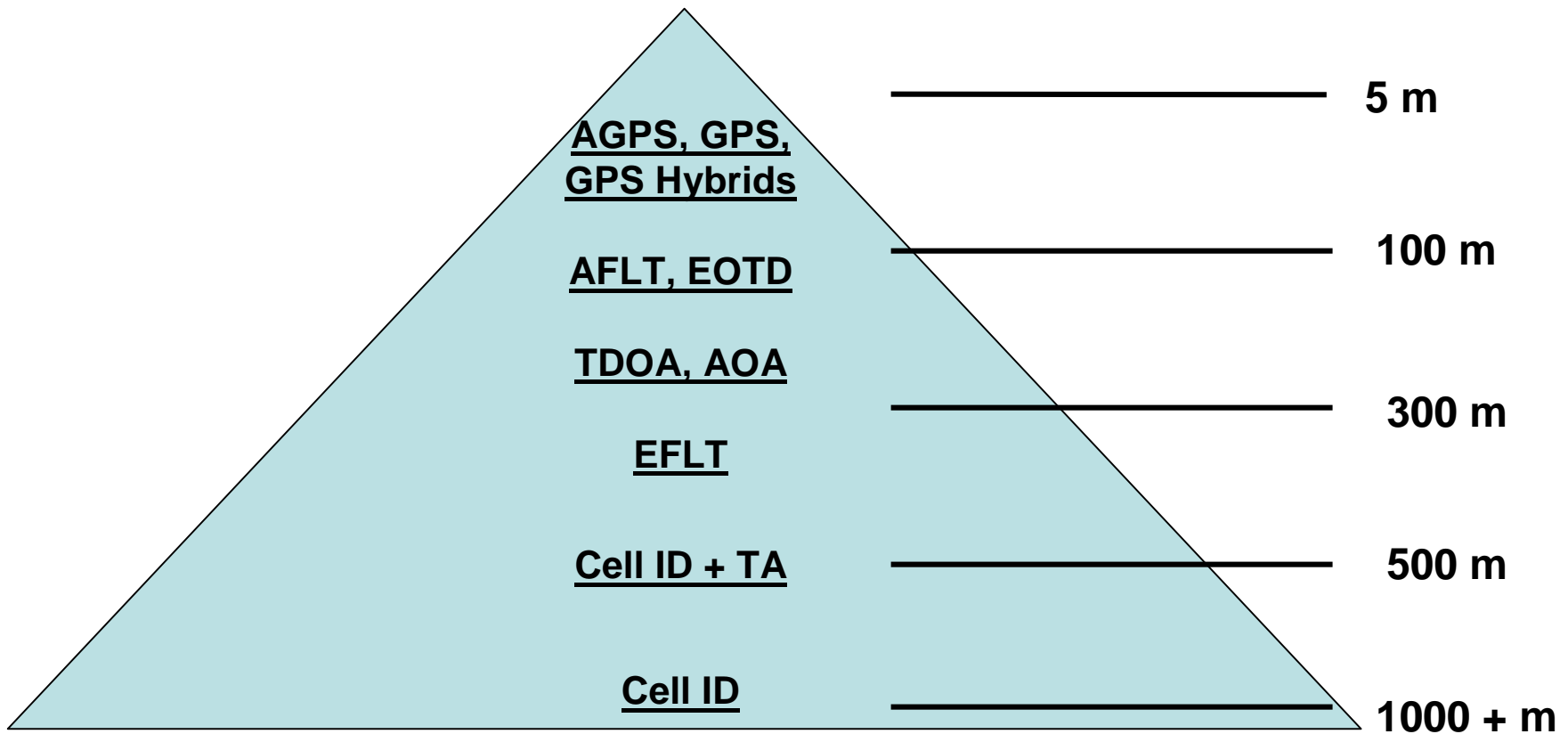
PDE – Position
Determining Entity

TA – Timing Advance

TDOA – Time Difference of
Arrival

Location Technologies Range of Coverage

Network-based, handset-based, and hybrid solutions are available



Cell ID – Available on All Networks

- Most basic wireless location technology
- Serving cell is used to locate the user
 - lat/long of the cell site => location
 - radius of coverage => uncertainty
- May be improved by techniques such as Timing Advance
- Relative accuracy is low and depends on size of cell

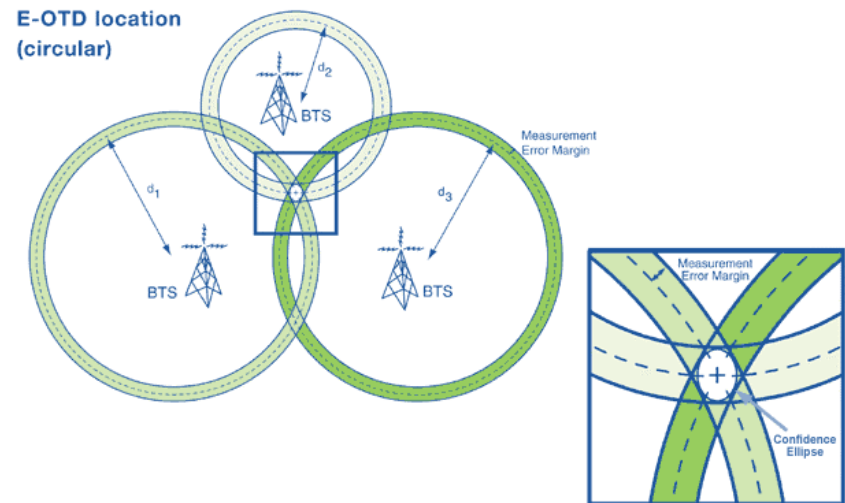


Cell Size 100-3000m

Triangulation – Overview and GSM Method

- Triangulates the location by measuring the time at which signals from three sources arrive
- Network-based solutions based on AOA (Angle of Arrival) and TDOA (Time Difference of Arrival)
- GSM Methods
 - EOTD (Enhanced Observed Time Difference of arrival)
 - Requires measurements from 3 BTS also measured by an LMU
 - Position of the MS is determined by comparing the time differences between the two sets of timing measurements.
 - May be a hybrid solution when combined with A-GPS

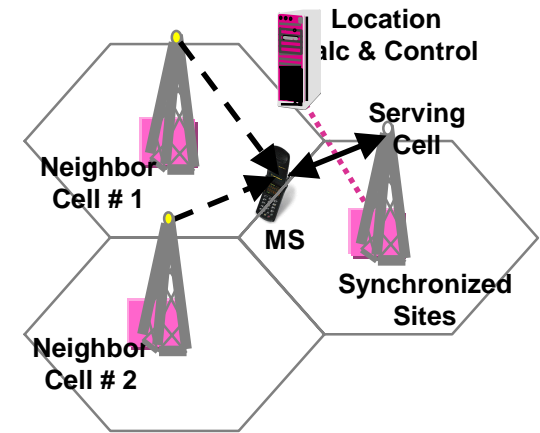
Accuracy 50-200m



Triangulation – CDMA Methods

- CDMA Methods
 - AFLT (Advanced Forward Link Trilateration)
 - 1/8 chip resolution reporting
 - Uses IS 801 messaging
 - Requires handset software changes
 - Commonly used as a hybrid with A-GPS
 - EFLT (Enhanced Forward Link Trilateration)
 - 1 chip resolution reporting
 - Uses existing PSMM from MS to BS
 - PSMM information sent from BTS to MSC then to PDE
 - Handles legacy handsets without any change in handsets
 - Typically used as a backup for non AFLT/A-GPS phones

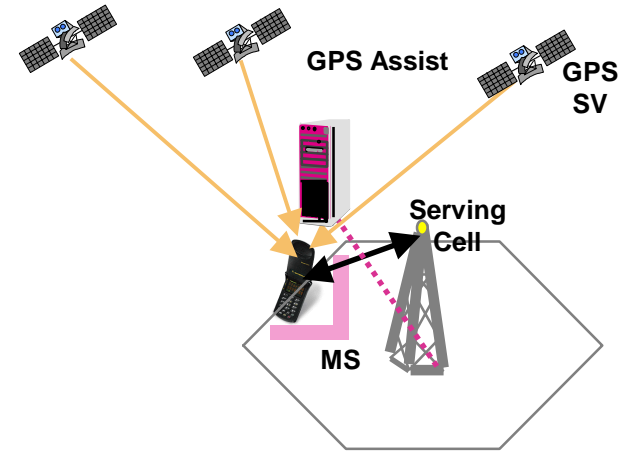
AFLT Accuracy 50-200m



EFLT Accuracy 250-350M

GPS – Most Accurate Locator

- **GPS**
 - Cold start takes several minutes to get a fix
 - Receivers require line of sight
 - Handset HW/SW required
- **Assisted GPS**
 - Network-assisted GPS
 - Reduces GPS search time from minutes to seconds
 - Allows use of weaker signals than non-assisted GPS
 - Handset HW/SW required



Accuracy 5-30m

Hybrids Solutions Improve Effectiveness

- Extends the coverage of a solution e.g. AGPS
- Common Hybrids
 - AFLT/AGPS
 - EOTD/AGPS
 - Cell ID/AGPS
- Benefits of both systems realized increasing the accuracy and availability of any single method

US Carriers

Carrier	Technology Type	Solution Type
Voicestream	GSM	E-OTD
Nextel	IDEN	AGPS
Cingular	GSM TDMA	E-OTD Trueposition (network based)
AWS	GSM TDMA	E-OTD Grayson (network based)
Verizon	CDMA	AGPS/AFLT
Sprint	CDMA	AGPS/AFLT
Qwest	CDMA	AGPS/AFLT
Alltel	CDMA	AGPS

Telecom Standards

Wireless Standard	Standards Body	Geolocation Technologies Used	Relevant Documents
GSM	ETSI SMG30	TOA AOA E-OTD A-GPS	GSM 03.71 GSM 04.71 GSM 09.31
GSM (North America)	T1P1.5 ETSI SMG31	TOA AOA E-OTD A-GPS	GSM 04.35
CDMA	TIA/EIA-95 cdma2000 TR45.5	A-FLT A-GPS	IS-801 IS-801A
TDMA	TIA/EIA-136 TR45.3	A-GPS	TIA/EIA-136

Summary

Technology	Networks	Handset impact	Accuracy
Cell ID	All	none	Depends on the size of the cell 100m – 3km
Cell ID + TA	GSM	none	Band size configurable. Default is 500m
EFLT	CDMA	none	250-350m
TDOA	All	none	100-200m
AOA	All	none	100-200m
AFLT	CDMA	yes	50-200m
EOTD	GSM	yes	50-200m
GPS/AGPS	All	yes	5-30m



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