



Motorola Labs

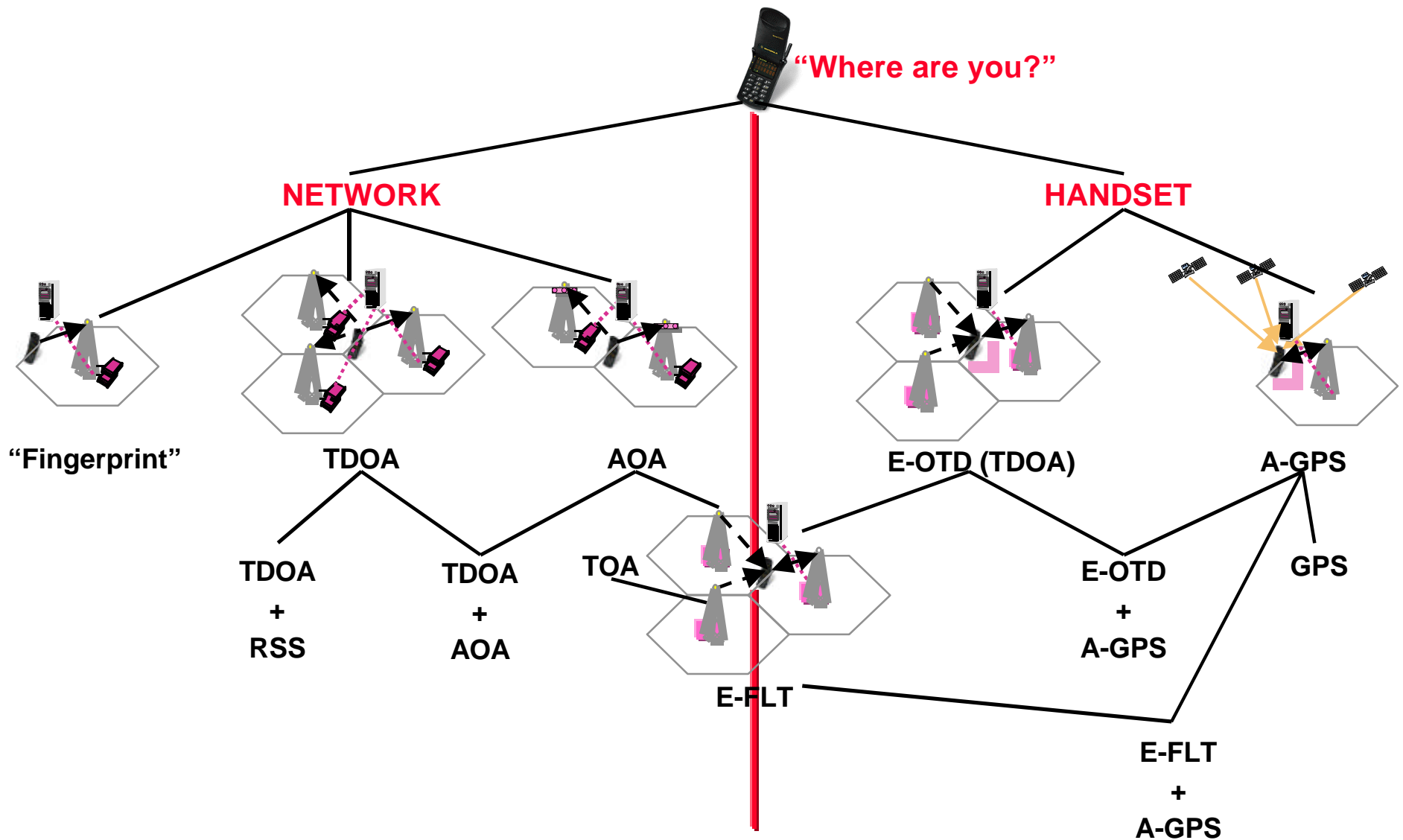
E911 PHASE 2 LOCATION SOLUTION LANDSCAPE

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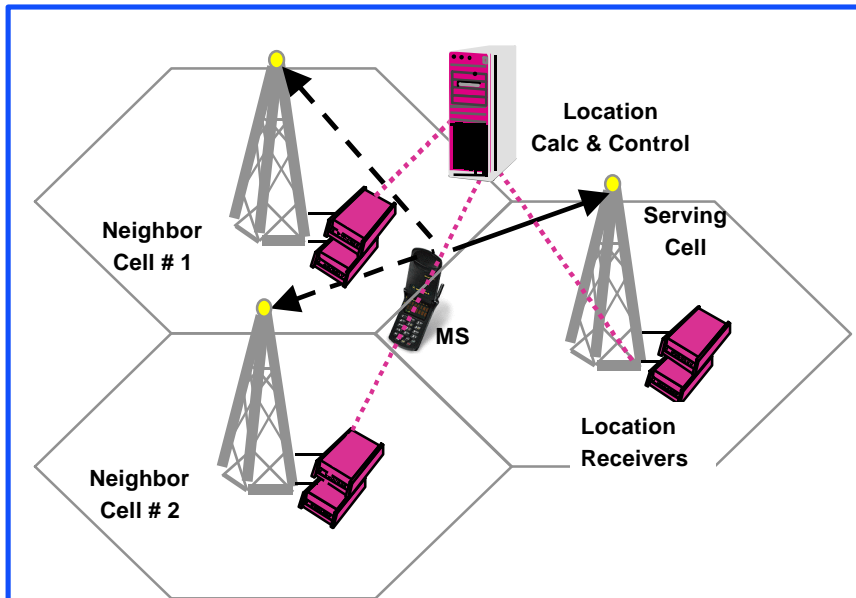
ACRONYMS

- **A-GPS**
 - Assisted Global Positioning System
- **AOA**
 - Angle of Arrival
- **E-FLT**
 - Enhanced Forward Link Triangulation
- **E-OTD**
 - Enhanced Observed Time Difference
- **RSS**
 - Received Signal Strength
- **TDOA**
 - Time Difference of Arrival
- **TOA**
 - Time of Arrival

LOCATION SOLUTION "FAMILY TREE"



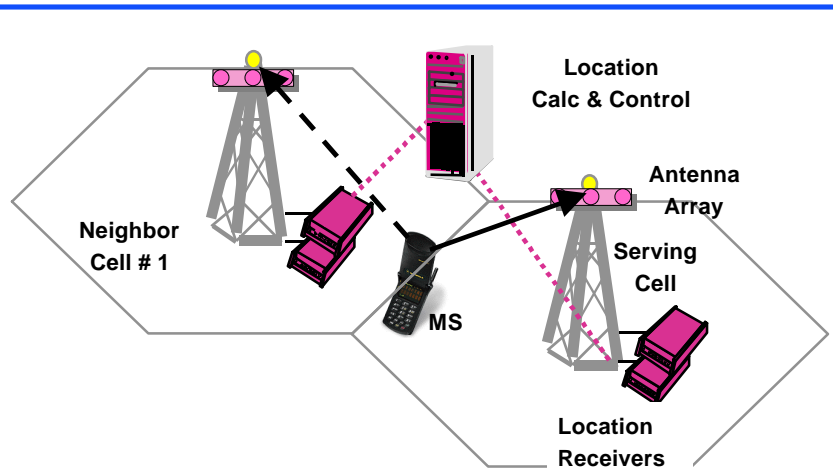
NETWORK BASED: TDOA



- **TDOA: Time Difference of Arrival**
 - Minimum of 3 sites measure arrival time of MS transmission
 - Location solution based on apparent arrival time differences between pairs of sites

- **Network impact**
 - Location calculation and control
 - Network interconnection (digital systems)
- **Site impact**
 - Location receivers
- **Handset impact**
 - None
- **Systems addressed**
 - Shipping product: AMPS
 - Announced product: [need data]
 - Under development: [need data]
- **Legacy handsets**
 - Covered

NETWORK BASED: AOA



- **AOA: Angle of Arrival**

- Minimum of 2 sites measure arrival angle of MS transmission
- Location solution based on apparent signal arrival angle

- **Network impact**

- Network interconnection (digital systems)
- Location calculation and control

- **Site impact**

- Location receivers
- Additional antenna arrays plus cables

- **Handset impact**

- None

- **Systems addressed**

- Shipping product: [need data]
- Announced product: [need data]
- Under development: [need data]

- **Legacy handsets**

- Covered

NETWORK BASED: MULTIPATH FINGERPRINT



- **Multipath Fingerprint**

- Minimum of 1 site measures attributes of received signal (i.e., “multipath fingerprint”)
- Location solution based on matching of received signal fingerprint with predetermined location/fingerprint data base

- **Network impact**

- Network interconnection (digital systems)
- Location calculation and control

- **Site impact**

- Location receivers

- **Handset impact**

- None

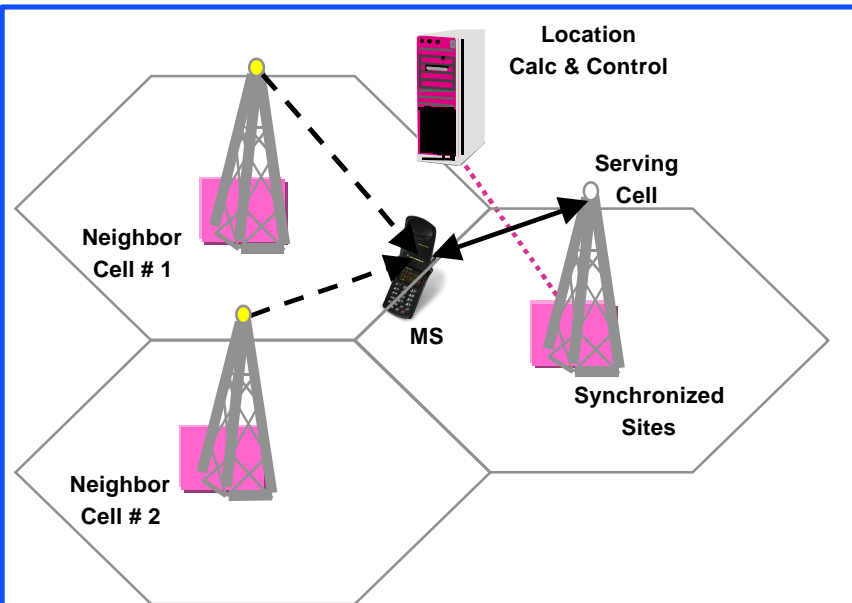
- **Systems addressed**

- Shipping product: [need data]
- Announced product: [need data]
- Under development: [need data]

- **Legacy handsets**

- Covered

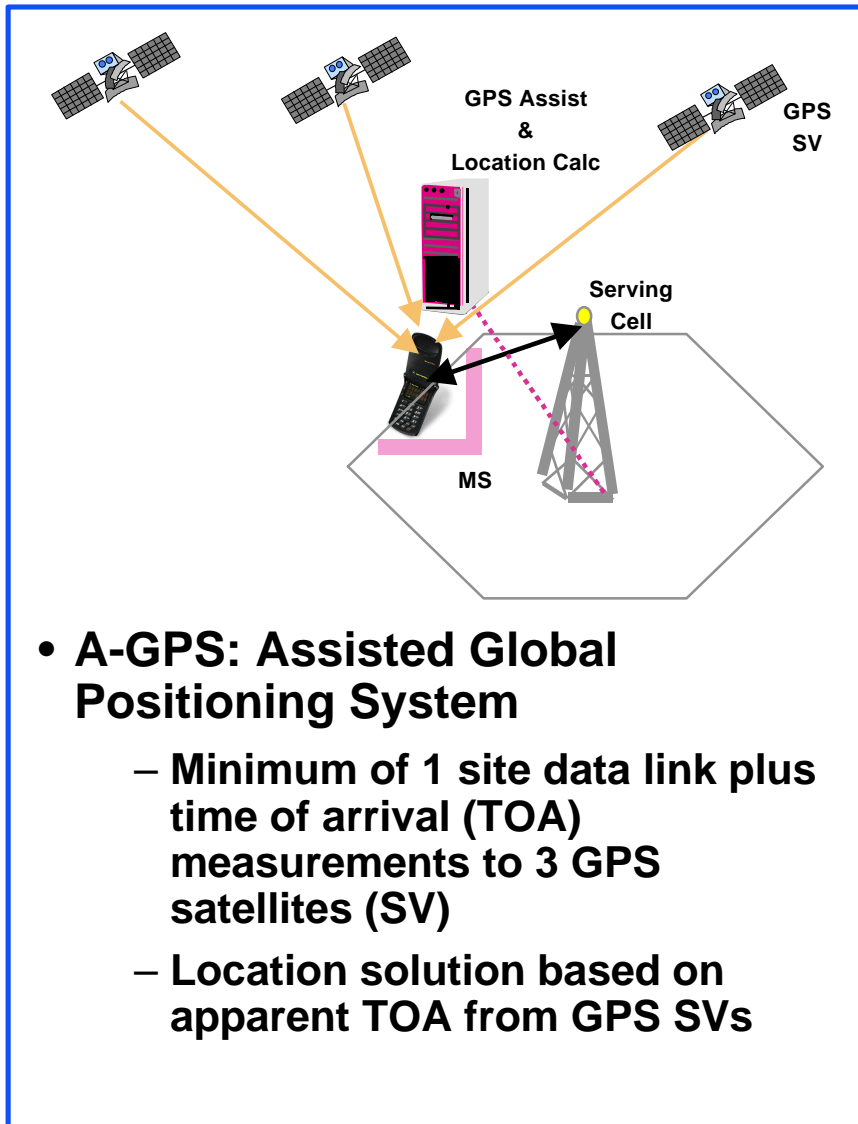
HANDSET/NETWORK BASED: E-FLT



- **E-FLT: Enhanced Forward Link Triangulation**
 - TDOA solution based on MS measurements
 - TOA ranging & coarse AOA via existing site antennas
- **CDMA unique solution**

- **Network impact**
 - Location calculation and control
- **Site impact**
 - Calibration of site sync
- **Handset impact**
 - None
- **Systems addressed**
 - Shipping product:
 - Announced product:
 - Under development: CDMA
- **Legacy handsets**
 - Covered

HANDSET BASED: A-GPS

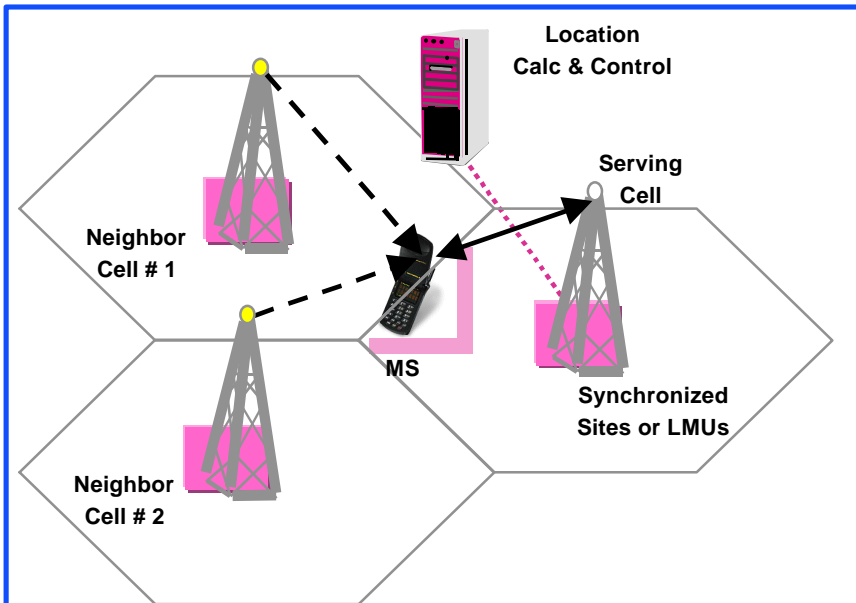


- **A-GPS: Assisted Global Positioning System**

- Minimum of 1 site data link plus time of arrival (TOA) measurements to 3 GPS satellites (SV)
- Location solution based on apparent TOA from GPS SVs

- **Network impact**
 - GPS assist and location calculation
- **Site impact**
 - Potential enhancements for non-synchronized systems
- **Handset impact**
 - Second GPS antenna
 - GPS RF front end & processing
 - Memory
 - Software
- **Systems addressed**
 - Shipping product: [need data]
 - Announced product: [need data]
 - Under development: [need data]
- **Legacy handsets**
 - Not covered

HANDSET BASED: E-OTD



- **E-OTD: Enhanced Observed Time Difference**
 - TDOA solution in handset
 - Arrival time of transmissions from a minimum of 3 sites
 - Location solution based on apparent arrival time differences between pairs of sites

- **Network impact**
 - Location calculation and/or control
- **Site impact**
 - EITHER time synchronization enhancement
 - OR site time error measurement and calibration (LMU's)
- **Handset impact**
 - Memory
 - Software
- **Systems addressed**
 - Shipping product: [need data]
 - Announced product: [need data]
 - Under development: GSM
- **Legacy handsets**
 - Not covered

COMPOSITE SYSTEMS

- **AOA + RSS (Received Signal Strength)**
- **AOA + TDOA**
- **E-OTD + A-GPS**
- **A-GPS + E-FLT**
- **Other?**