2nd Opportunistic RF Localization for
Next Generation Wireless Devices
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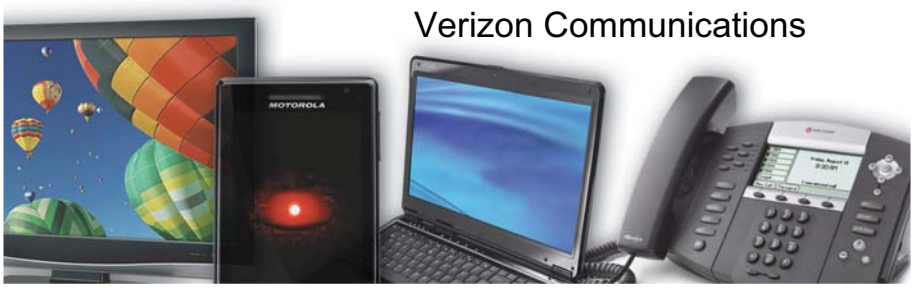
The Role of Standards and Progress Made

Gerry Flynn
Verizon Communications



E911 History

- **The US FCC released a 'Report and Order' in 1996 (94–102) to provide:**
  - a call-back number and cell/sector identification ('Phase I').
    - J-STD-034 "Wireless Enhanced Emergency Services PSAP Perspective"
  - more accurate location ('Phase II').
    - J-STD-036-B "Enhanced Wireless 9-1-1 Phase 2"
- **This was revised in 1999 and allowed handset-based location technologies (i.e., GPS-based)**
- **FCC also had a schedule for handset replacement if using a handset-based solution**
- **FCC had service providers declare which type of location technology they were going to use (handset based or network based)**
  - CDMA providers typically chose handset-based
  - GSM providers typically chose network-based

FCC Mandate Requirements

- **Wireless CDMA Handset Solution**
- **9-1-1 call must**
  - Route based on public safety instructions
  - Deliver the address of the originating cell sector
  - Callback number must be delivered regardless of subscriber network registration status or calling ID blocking settings. The callback number delivered to public safety include:
    - For registered callers, the Mobile Directory Number (MDN)
    - For non-registered callers, 911+the last 7 digits of the ESN or MEID
- **E911 Phase II**
  - Deliver longitude and latitude (X-Y coordinates) of the mobile phone to the PSAP based upon a "re-bid" request
  - Accuracy Requirements for the handset solution:
    - 67% of the calls within 50 meters
    - 95% of the calls within 150 meters

3GPP2 LBS Specifications

- **C.S0022-A (TIA-801-A) Position Determination Service for cdma2000 Spread Spectrum Systems**
  - CDMA air interface – supports 1x and HRPD
- **X.S0002-0 (TIA-881-1) MAP Location Services Enhancements**
  - Network standard to support control plane LBS
- **TSG-X X.S0009-0 (TIA-843) Wireless Intelligent Network Support for Location Based Services**
  - Defines several services using WIN (e.g., Location based routing)
  - Not deployed
- **X.S0024-0 (TIA-1020) IP-Based Location Services**
  - Similar to OMA Location (SUPL)
  - Not deployed

3GPP Standards for LTE Location

Requirements	
22.071	LCS Service Description

Architecture and Feature Description	
23.271	Functional Description of LCS
36.305	Functional Spec of UE Positioning

Core Network Interfaces and Services	
29.171	LCS-AP MME ↔ E-SMLC; SLs Interface
29.172	ELP GMLC ↔ MME; SLg Interface
29.173	Diameter-based SLh interface for CP LCS
24.030	Supplementary Service Operations

Operations and Maintenance	
32.171	Telecom Mgt; Charging Mgt; LCS Charging

LTE Physical Layer (impacted by LCS)	
36.211	Physical Channels and Modulation
36.214	Physical Layer Measurements

RAN Protocols (impacted by LCS)	
36.331	RRC Protocol Specification

RAN ↔ Core Network Protocols	
36.355	LTE Positioning Protocol (LPP)
36.455	LTE Positioning Protocol A (LPPa)
24.301	NAS protocol for EPS
24.413	S1-Application Protocol (S1-AP)

Performance Requirements	
36.133	Requirements for support of RRM
36.171	Requirements for Support of A-GNSS

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3GPP Standards Impacted for IMS Emergency Call Support in LTE

Requirements	
22.101	Service Aspects; Service Principles

Architecture and Feature Description	
23.167	IMS Emergency Service Architecture
23.228	Functional Description of IMS
23.203	Policy and Charging Control Architecture
23.401	Evolved Packet Core for E-UTRAN Access
33.401	SAE: Security Architecture

Core Network Interfaces and Services	
23.003	Numbering, Addressing and Identification
24.301	NAS protocol for Evolved Packet System
24.229	IMS Call Control protocol based on SIP and SDP Protocol spec for MI interface between E-CSCF and LRF
29.212	PCC over Gx Reference point
29.213	PCC Signaling Flows and QoS parameter Mapping
29.214	PCC over Rx Reference point
29.272	Diameter interface between MME and HSS; S6a
29.274	EPC: Evolved GPRS Tunneling Protocol (GTPv2-C)

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OMA Location Specifications

- **OMA SUPL 2.0 – Secure User Plane for Location**
  - Defines a user plane transport to support variety of access technologies and geolocation mechanisms
    - E.g., CDMA, GSM, UMTS, LTE, WiMAX
    - MS-based, Network-based, A-GPS, AFLT, EOTD…
  - Version 2.0 added Emergency Call support
    - An LTE capable SET and SLP shall support RRLP and/or TIA-801 if A-GPS or A-Galileo positioning is supported."
    - New "LTE cell info" and "LTE areaID" were added, and "LTE" was added to the list of network types that could be supported.
    - A reference to 3GPP 36.331 "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification

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OMA Standards for LTE Location

Requirements	
OMA-RD-SUPL-V2_0	Secure User Plane Location Requirements
OMA-RD-MLS-V1_2	Mobile Location Service Requirements
Architecture	
OMA-AD-SUPL-V2_0	Secure User Plane Location Architecture
OMA-AD-MLS-V1_2	Mobile Location Service Architecture
Protocol	
OMA-TS-ILP-V2_0	Internal Location Protocol
OMA-TS-ULP-V2_0	User Plane Location Protocol
OMA-TS-MLP-V3_3	Mobile Location Protocol
OMA-TS-RLP-V1_1	Roaming Location Protocol
Device Management	
OMA-TS-SUPL_MO-V2_0	OMA Management Object for SUPL
Conformance	
OMA-EICS-SUPL_Client-V2_0	Enabler Implementation Conformance: Client Implementation of SUPL
OMA-EICS-SUPL_Server-V2_0	Enabler Implementation Conformance: Server Implementation of SUPL

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Backup Slides

Glossary and Acronyms

- Callback Number (CBN) **– Providing the telephone number of the emergency caller allows calls to be made back after the emergency call (e.g., to obtain more information)**
  - A pseudo-call-back number is provided for non-subscribers, based on the ESN, IMEI or MEID. It allows identification of the caller, but not call-back.
  - Call-back uses standard inter-system call delivery (e.g., based on ANSI/TIA-41)
- Public Safety Answering Point (PSAP) **– the ability to support 9-1-1 service depends on the establishment of "Public Safety Answering Points" which vary in size and structure from locality-to-locality; notably, the geographic territory served by these PSAPs range from a single municipality, to a large city, to a county-wide or regional district, to an entire state.**
- Automatic Number Identification (ANI) **– technology used to capture the calling number by the switching equipment in the central office; relayed to the PSAP along with the emergency call to provide the call taker with the callback number**
- Pseudo ANIs (pANIs) **– a set of non-dialable telephone numbers assigned to each cell site/antenna sector to facilitate routing**
- Selective Routing Database (SRDB) **– contains information to determine what particular PSAP relates to the pANI (and to its associated cell site/sector)**
- Master Street and Address Guide (MSAG) **– links the street address associated with the telephone number to a particular PSAP and provides information about the different emergency service agencies that respond to that location**
- Automatic Location Identification (ALI) Database **– contains the necessary association between the telephone number and the name and address information; usually situated at a central location in the network and serves numerous PSAPs**
- "nomadic" **– scenario where a VoIP subscriber can take her phone with her and use it around the world, making the provision of information difficult at times**
- Position Determining Equipment (PDE) **– estimates the position of a wireless subscriber placing the 9-1-1 call both at the start of the call and, if needed, during the progress of the call**
- Mobile Switching Center (MSC)
- Mobile Positioning Center (MPC) – services provided by a third-party (TCS, Intrato), in the case of VZW

Acronyms

- A-GPS – Assisted GPS
- AFLT – Advanced Forward Link Trilateration
- E-SMLC – Evolved Serving Mobile Location Center
- GMLC – Gateway Mobile Location Center
- SGW – Serving Gateway
- PGW – PDN Gateway
- MME – Mobility Management Entity
- E-CID – Enhanced Cell ID
- OTDOA – Observed Time Difference of Arrival
- LPP – LTE Positioning Protocol
- LRF – Location Retrieval Function
- RDF – Routing Determination Function
- SUPL – Secure User Plane
- OMA – Open Mobile Alliance
- MLP – Mobile Location Protocol
- CSCF – Call Session Control Function
- ENUM – Electronic Number Mapping
- DNS – Domain Name Server
- TrFO – Transcoding Free Operation
- NNI – Network-to-network Interface