FCC Workshop

E9-1-1 Phase II Location Accuracy Overview

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Enhanced 9-1-1 Compliance

Sprint is committed to providing Enhanced 9-1-1 ("E9-1-1") service to our customers and to make available accurate location information to Public Safety that meets or exceeds current obligations. The Sprint nationwide wireless network is compliant with the current FCC location accuracy rules on a per-county basis:

- *50 meters for 67 percent of calls*
- *150 meters for 80 percent of calls*
  - *Sprint does not currently exclude any counties from the 150 meter requirement based upon heavy forestation*

Looking ahead, Sprint is working toward compliance with the 2016 FCC benchmark -- 150 meters for 90% of calls. Approximately 80% of Sprint's nationwide wireless network already complies. (CALNENA claims Phase II performance for December 2012 was 21% . . .)

Enhanced 9-1-1 Compliance

Sprint has concluded that wireless Phase II location data is widely available within our national network, but agrees that some clarification surrounding the information that is sent with a call and how the call & data flow is processed needs to be reviewed/clarified.

Next few slides will cover:

- *Technology Standard for Enhance 9-1-1 call delivery*
- *Delivery of Phase II information*
  - *Statistics on re-bidding for Phase II data*
- *How to interpret the Phase II data available*

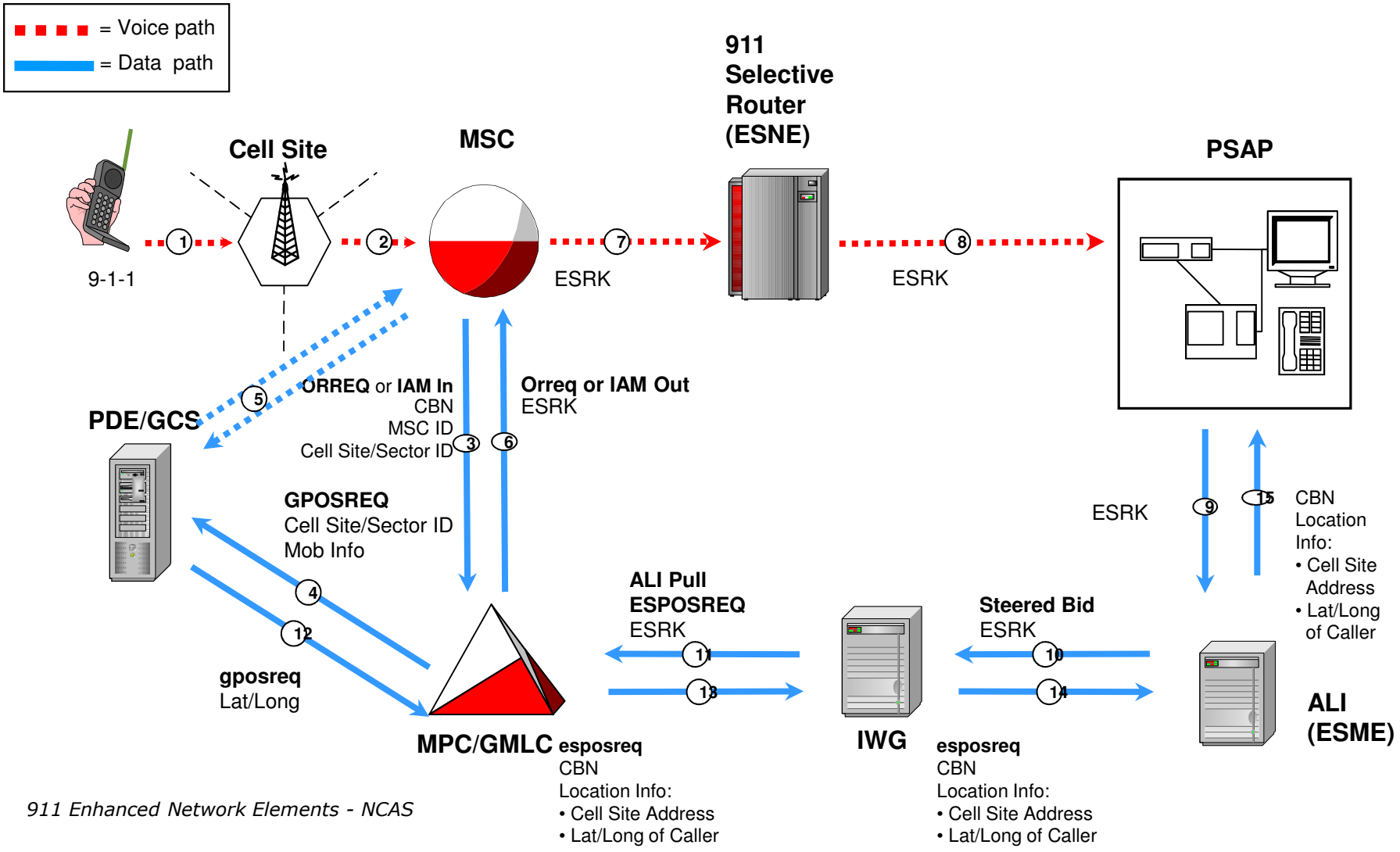
Technology Standard for E9-1-1 Call Delivery

- The wireless network makes Phase I (cell site/sector) location information available at the Mobile Positioning Center ("MPC").
- Phase I location information is typically available at the same time as the initial E9-1-1 voice call to the PSAP.
- The PSAP must then retrieve the Phase I location information from the MPC using the Emergency Services Routing Key ("ESRK") associated with the wireless call.
- The PSAP must affirmatively "bid" for Phase I location information, either manually or automatically, depending on PSAP capability and configuration. This is generally known as the "initial bid."
- The PSAP can determine the Class of Service ("COS") of the call, as it is displayed on their screen.

Technology Standard for E9-1-1 Call Delivery

- The wireless network calculates more accurate Phase II location information and makes it available at the MPC.
- Phase II location information calculation at the PDE generally takes 15-20 seconds, but could take up to 30 seconds or more, and will not be available to the PSAP until it is calculated.
- The PSAP must then retrieve the Phase II location information from the MPC using the ESRK associated with the wireless call.
- The PSAP must affirmatively "bid" for Phase II location information, either manually or automatically, depending on PSAP capability and configuration. This is generally known as the "re-bid."
- If necessary, the PSAP can "re-bid" multiple times, but should wait at least thirty seconds between each attempt to allow the system time to calculate.
- The PSAP can determine the COS of the call, as it will be refreshed and displayed on their screen with the re-bid.

Enhanced 9-1-1 Call Flow



911 Enhanced Network Elements - NCAS

PSAP s Bidding Frequency

Sprint has analyzed actual 9-1-1 call data for several of the PSAPs which submitted data to the FCC website, including five (5) PSAPs mentioned in the CALNENA report, and has come to the following conclusions based on 'live' call data regarding the frequency with which PSAPs are 'bidding' for the Phase II data:

- Overall, PSAPs appear to be re-bidding approximately 12-35% of the time.
- Overall, Phase II data appears to be available approximately 77-89% of the time.

Location Data Available

Phase I data:

- *Call back number*
- *Cell Site location*
  - *Physical street address of site*
  - *Latitude & Longitude of the centroid of the cell sector*
- *Confidence*
- *Uncertainty*

Phase II data:

- *Call back number*
- *Latitude & Longitude of the handset/device*
- *Confidence*
- *Uncertainty*

Confidence & Uncertainty

Uncertainty is an *estimation* of the amount of position error present in the fix solution and has no meaning without an associated confidence level.

Uncertainty is a distance or a region, centered at the reported position, within which the position determining system has a set confidence level that the true position falls within this distance or region.

Uncertainty is typically presented separately for the horizontal plane and the vertical axis. Horizontal uncertainty is expressed either as a circle or an ellipse.

Uncertainty has no meaning without an associated "confidence level."

Confidence & Uncertainty

Wireless carriers networks currently use several different technologies to calculate the position of a caller dialing 911. Because position determining equipment is, by definition, creating an estimation of a caller's location, wireless carriers also provide information designed to assist public safety in assessing the quality of the position information. This information, expressed through confidence and uncertainty values, is specific to the technology deployed by a particular carrier.

Public Safety officials have expressed concern that the differences between the manner in which different carriers express confidence and uncertainty makes interpretation of location information overly complex for individual call takers.

Confidence & Uncertainty

For uncertainty to have meaning, it must be associated with a "confidence level." Both the uncertainty magnitude and its associated confidence level must be considered when using a position fix. For the horizontal plane, uncertainty is expressed in one or both of the following two ways:

> 1. Horizontal Uncertainty Expressed as a *Circle*:
  - "The position determining system is ***c***% confident that the true position falls within the circle of radius ***u***, centered at the reported position", where ***u*** is the uncertainty in meters, and ***c*** is the confidence percentage.

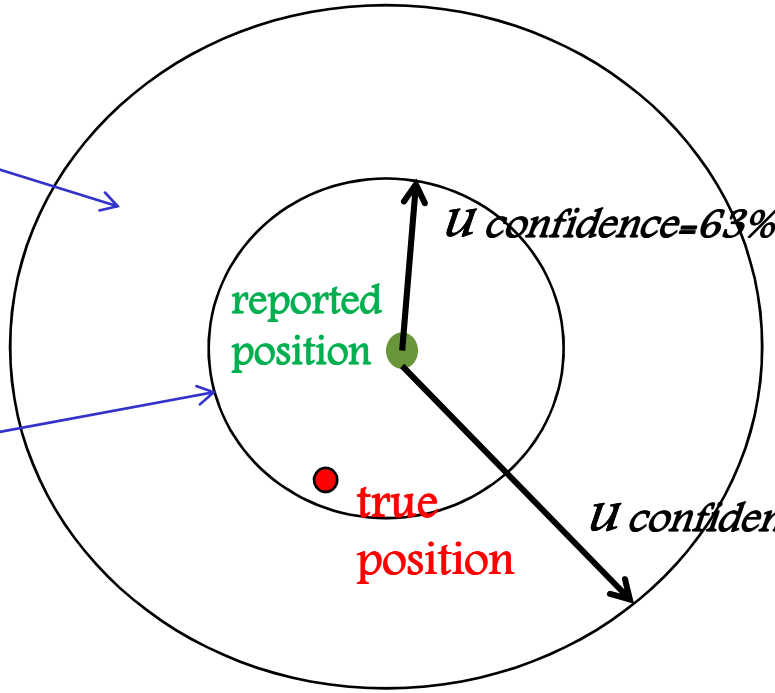
> 2. Horizontal Uncertainty Expressed as an *Ellipse*:
  - "The position determining system is ***c***% confident that the true position falls within the ellipse, centered at the reported position", where the size and shape of the ellipse is defined by the semi-major and semi-minor axes ***ua*** and ***ub*** in meters, and ellipse orientation angle ***utheta***, and ***c*** is the confidence percentage.

Relationship between Uncertainty and Confidence

Uncertainty and confidence level are related; changing one will change the other. It is intuitive that the uncertainty distance "*u*" must be longer for the confidence "*c*" to be higher. Likewise, with a lower confidence percentage "*c*", the uncertainty distance "*u*" can be shorter.

Position determining system is 95% confident that true position falls within this circle

Position determining system is 63% confident that true position falls within this circle



- The smaller the confidence percentage, the shorter the uncertainty distance.
- The larger the confidence percentage, the longer the uncertainty distance.

Confidence & Uncertainty

Table 3-3 – Transformation Methodologies for Common PDM Uncertainty Expressions

From	To	Transformation Methodology
Uncertainty Ellipse with 39% Confidence Level	HEPE with 63% confidence level	$HEPE \cong \sqrt{u_a^{\,2} + u_b^{\,2}}$
HEPE with 63% confidence level	Uncertainty Circle with 95% Confidence Level	$u_{95\%\_Conf} \cong 2 \cdot HEPE$ ξ
Uncertainty Ellipse with 39% Confidence Level	Uncertainty Ellipse with 95% Confidence Level	$u_{a\_95\%\_Conf} \cong 2.45 \cdot u_{a\_39\%\_Conf}$ $u_{b\_95\%\_Conf} \cong 2.45 \cdot u_{b\_39\%\_Conf}$

ξ To account for the difference between theory and real-world, for 95% confidence levels, uncertainties are scaled more conservatively then theory predicts (transformation ratio from HEPE of 2.0, verses the 1.75 ratio predicted by theory.)

(Information and formulas for Confidence & Uncertainty provided by Qualcomm.)