



Next Generation Indoor Location for Public Safety

Marc Linsner
Consulting Engineer
September 24, 2014



FCC TFNPRM

http://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db0318/FCC-14-13A1.pdf

“Consumers are increasingly replacing traditional landline telephony with wireless phones, and a majority of wireless calls are now made indoors. This increase in wireless usage is reflected in how Americans call for help when they need it: today, the majority of 911 calls come from wireless phones. In light of these circumstances, it is increasingly important for Public Safety Answering Points (PSAPs) to have the ability to accurately identify the location of wireless 911 callers regardless of whether the caller is located indoors or outdoors.”

Released 2/21/14

Comments were due 5/12/14, rebuttal comments 7/14/14

FCC TFNPRM

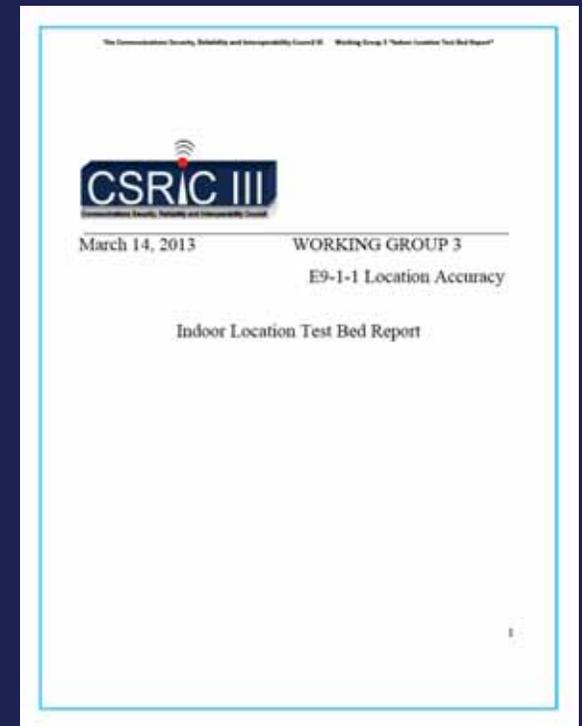
*“We believe that it is **now appropriate to propose measures designed to address public safety’s critical need for obtaining indoor location information**, and to ensure that wireless callers receive the same protection whether they place a call indoors or outdoors. In the following discussion, we propose a regulatory framework for addressing indoor location accuracy for wireless calls to 911 from indoors that includes a near-term requirement to achieve approximate indoor location information, comprised of horizontal (x- and y-axis) and vertical (z-axis) location information. We also seek comment on how to formulate a long-term requirement with an increased degree of location accuracy, sufficient to identify the caller’s specific address, floor level, and suite/room number within a building.”*

FCC TFNPRM

“Finally, we believe that any costs imposed by our rules might be mitigated, at least to some degree, by the fact that providers are already undertaking significant indoor location technology research and development on their own for commercial, non-911 reasons. We seek further comment on the degree to which commercial development – unrelated to any Commission indoor location capability requirement – could be leveraged to mitigate the costs of compliance.”

Industry/Policy Efforts

- CSRIC III and the FCC performed testing of various technologies in the fall of 2012 in an effort to provide more accurate indoor location for cellular 9-1-1 callers.
 - http://transition.fcc.gov/bureaus/pshs/advisory/csric3/CSRIC_III_WG3_Report_March_%202013_ILTestBedReport.pdf
- (3) different location determination technologies were tested
 - Polaris Wireless, NextNav, Qualcomm
- CSRIC IV WG!
 - Writing the specifications for future testing



CSRIC III Testing – Using outdoor mechanisms to locate devices that are indoors

The dense urban buildings used for indoor testing in this stage of the test bed were:

- Bldg. 1: Marriott Marquis Hotel, SF
- Bldg. 2: One Front Street, SF
- Bldg. 3: 201 Spear Street, SF
- Bldg. 14: The Hearst Office Building (699 Market Street), SF
- Bldg. 15: The Omni Hotel, SF
- Bldg. 16: One Embarcadero Plaza, SF

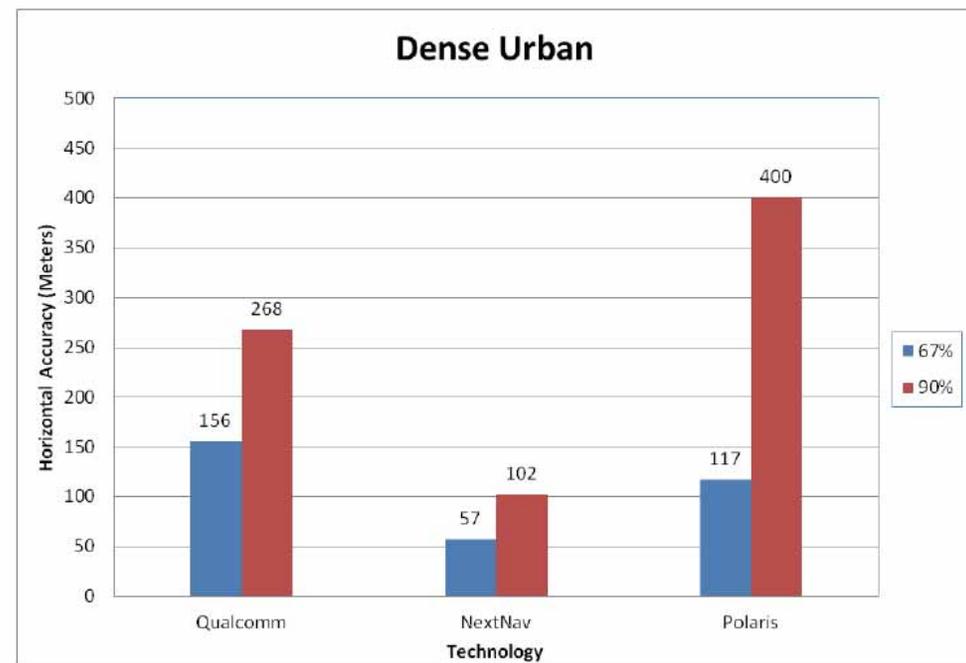


Figure 7.3-2 Accuracy Percentiles in the Dense Urban Environment

A "dispatch-able" location?

- Current and tested technologies deliver an X, Y, Z coordinate
 - Requires reverse geocoding for dispatch
 - How does the Z coordinate equate to a floor number?
- X, Y, Z is good for outdoors, but not indoors
- Cisco office at:
 - 601 Pennsylvania Avenue, N.W. North Building
 - Suite 900
 - Washington, District of Columbia, 20004
- Public Safety would get:
 - 38 53.599' N 77 01.216' W
 - Elevation 149'



In addition to a *dispatch-able* (civic) location, a URI with floor plan and target indicators can be delivered.



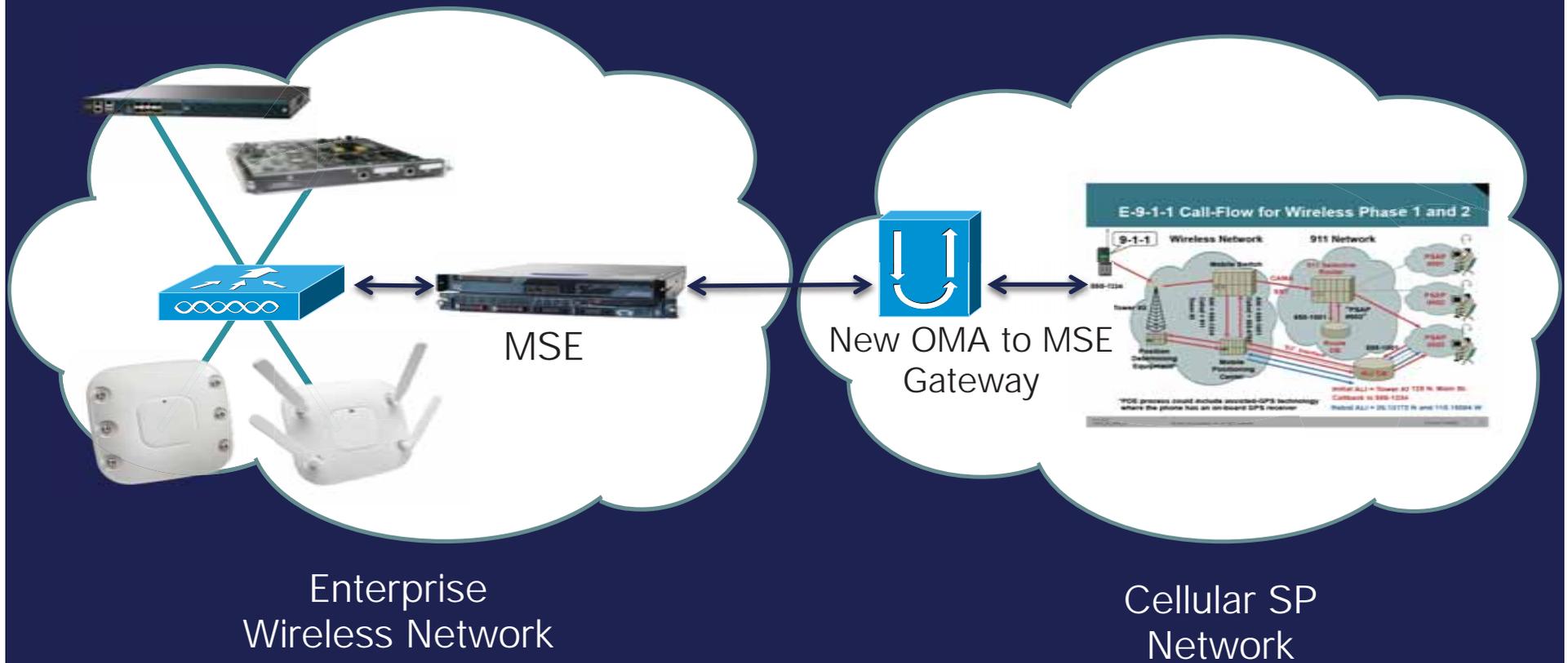
802.11 location uses existing radios and rf spectrum

- The primitives for device location have been standard in 802.11 control plane for several years
 - Enterprises are using this
 - Asset tracking
 - Customer habit awareness
 - Adoption is on the upswing
- 60% of cellphones are now smartphones with WLAN interfaces
 - Up from 40% just a couple of years ago
- No need to 'join' the WLAN, location determination works on 'probes'
 - Yes, the WLAN interface needs to be on.
 - There are ways to assure that during 9-1-1 call

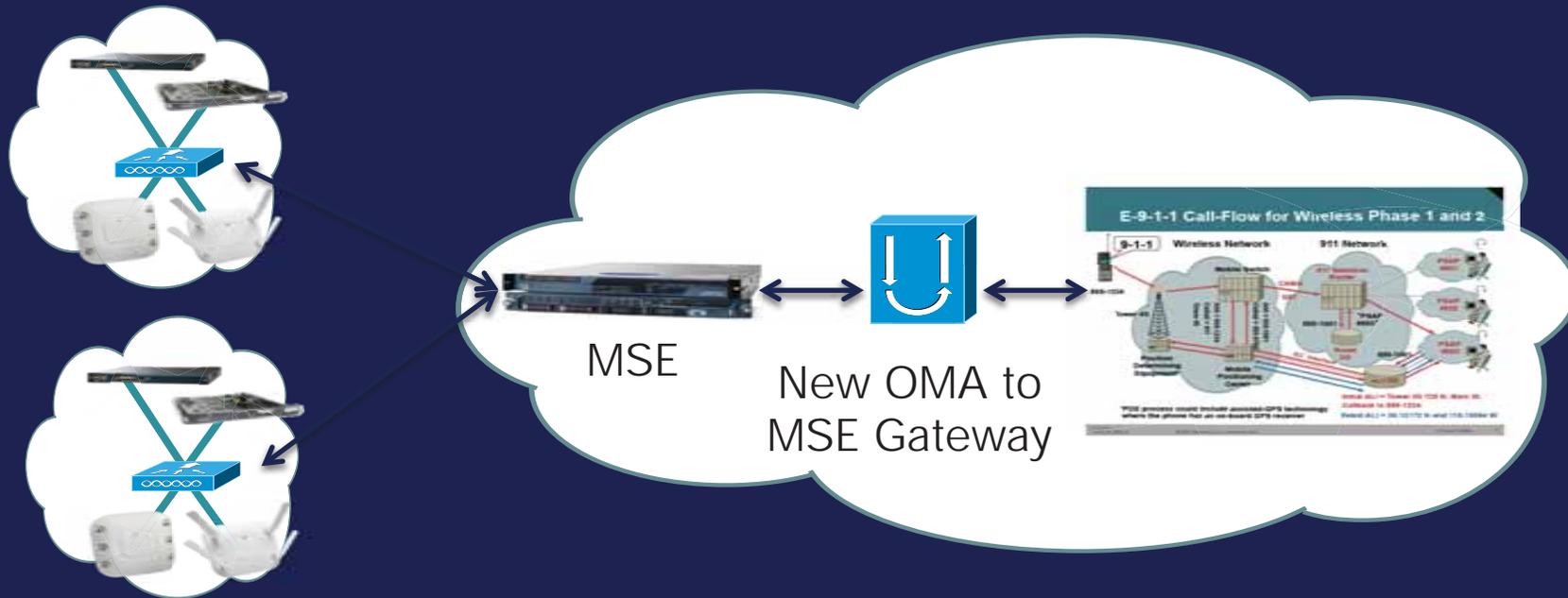
802.11 location – “Connect the Dots”

- We just need to connect the existing radio control planes to the cellular location infrastructure
 - Needs to be done securely!
 - We know how to do that!
 - Enterprises need assurance this is only for emergency calling!
 - We know how to do that!
 - PS need assurance 802.11 location is trustworthy and accurate
 - Enterprises deploying LA networks do so for their own benefit
 - Enterprises manage and maintain their location infrastructure as it's \$\$ to them.
- No new hardware, no new asics, uses existing devices and infrastructure

Enterprise Owned/Operated Location Aware Infrastructure



SP Owned/Operated Location Aware Infrastructure as Value-Add

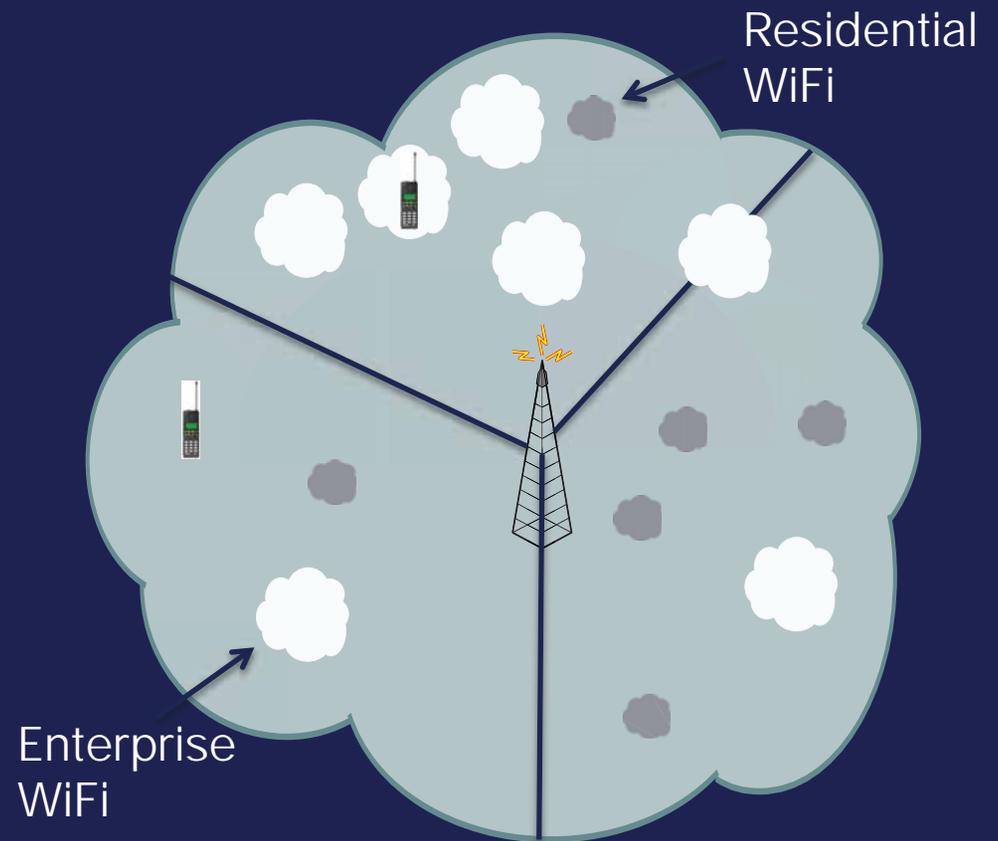


Enterprise Wireless Networks

Cellular SP Network

How does it work?

- Cellular 9-1-1 calls are routed based on cell sector
 - A PSAP assigned to each sector
- Overlay the enterprise WLAN coverage on the sector polygon
- Send to each enterprise, *"do you see this device?"*
 - Very fast query
 - Scalable to hundreds
- If you get a positive response, query further for accurate location and floor plans/map.



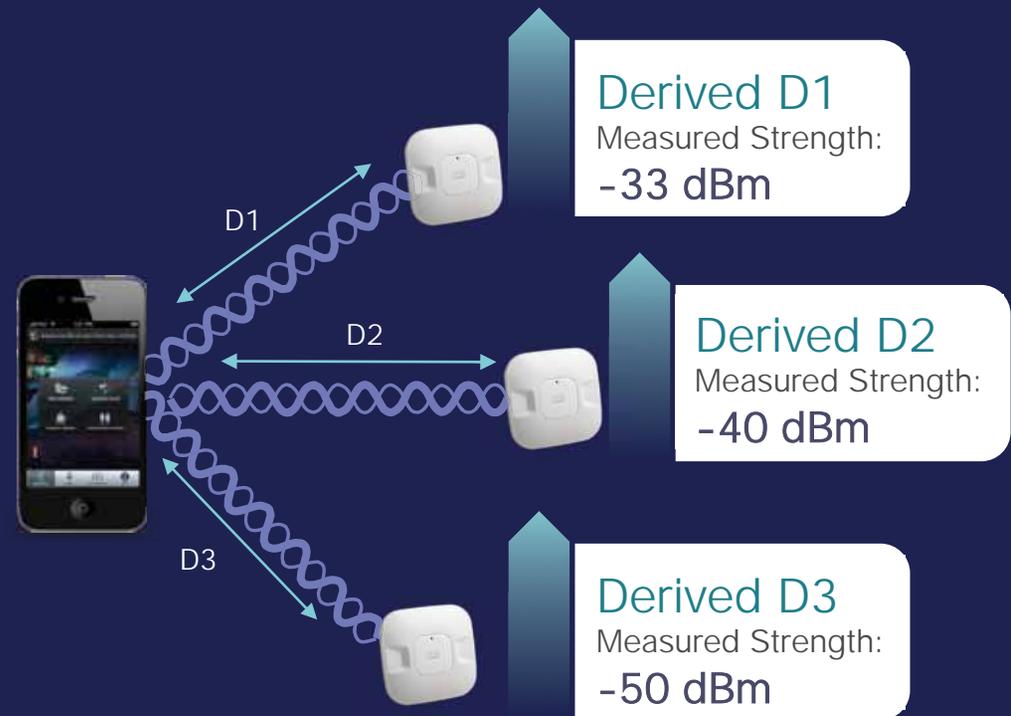
Veracity of location data received

- Public Safety is nervous about using device OS derived location
 - Can be spoofed
- The trustworthiness of location data follows a hierarchy, most to least trusted:
 - SP Network determined location
 - Including on-device GPS
 - Enterprise Network determined location
 - Crowd-Sourced Location
 - Google
 - BB SP determined location
 - End device OS-based location determination

How Location Is Calculated with FastLocate

Higher Scalability: Device Probing and Data Packets

- Access points detect mobile devices or tag signals and measure received signal strength indication (RSSI) from all frames sent over Wi-Fi.
- Controllers send RSSI information signal to the MSE for location calculation.
- RF fingerprinting and triangulation, based on signal strengths, are used to calculate device location.



This is not a Cisco-only Story

TCS engineers are working with Aruba engineers to integrate AirWave Wireless Management System into this solution.



In early talks with Ruckus Wireless to integrate their cloud-based solution.

Where's the 9-1-1 caller?

The screenshot displays the TCS GEM911 web interface. At the top, there is a navigation bar with the TCS GEM911 logo, a 'Help' link, and a 'Sign Out (Lance Pitt)' link. The main content area is divided into three columns. The left column shows a list of active sessions, including 'My Active Sessions' with one session for '1-206-321-7809' by 'Lance Pitt', and 'Other Active Sessions' with two sessions for '1-425-877-4300 (1)' and '1-206-518-0767' by 'Rod Robinson'. The middle column displays a 'Message Transcript: 1-206-321-7809' with a blue message bubble saying 'Testing outdoor 911 location' and a green response bubble saying 'You have reached 911. Where is the emergency?'. Below the transcript is a 'Select an immediate response' dropdown menu with the selected option 'You have reached 911. Where is the emergency?', a text input field for 'Enter text to be sent', and 'Send Message' and 'Clear' buttons. The right column features a map of a city area with a red location pin and a 'Refresh Location' button. Below the map, location data is provided: 'Located At: Sep 18 7:44:10 PDT', 'Latitude: +38.89417', 'Longitude: -77.02028', 'Hor Uncertainty: 148', 'Position Source: 135', and 'Status: Location Found'.

Where's the 9-1-1 caller?

indoor location

Campus: Washington DC 20004
Building: NW North Building Suite 9000
Floor: 601 Pennsylvania Ave
Uncertainty Radius: 19.51 meters
Zoom:



End Session Font Size:

Session established

Message Transcript: 1-408-202-4255
Carrier: verizon

This is Scott. Attempt 8
 1-408-202-4255 Wed Sep 10 2014 11:18:47 PDT

✓ **response to attempt 8**
Wed Sep 10 2014 11:22:46 PDT gem user one

✓ **911, what's your emergency?**
Wed Sep 10 2014 11:25:38 PDT gem user one

Select an immediate response

Enter text to be sent

Send Message Clear

characters used = 28 | remaining = 226

Transfer



Located At: Sep 10 11:18:48 PDT
Latitude: +38.89328
Longitude: -77.02083
Horizontal Uncertainty: 9 meters
Status: ✓ Location Found

Request Indoor Location

Issues – as cited from filed comments

Issue	Remedy	Status
Wi-Fi radio may not be enabled on a smartphone when user dials 911	Operating system upgrades by OS vendors to turn on Wi-Fi when 911 digits are dialed; increase “probe rate” to increase ability of APs to see client device; carriers can also commit to support Wi-Fi and Bluetooth in VoLTE handsets in the future	
Identification of MAC address to locate Wi-Fi transmitter	SP could register the MAC address of the phone at service provisioning; or, upgrade the OS to change the MAC when 911 is dialed to match the phone number	

Issues – as cited from filed comments

Issue	Remedy	Status
911 Service Provider cannot interact with enterprise Wi-Fi networks	Build a gateway device that 911 Service Providers can use to query enterprise Wi-Fi networks	TCS prototype done and being used in demonstrations
Enterprises must “buy in” to the system by allowing 911 Service Providers to query their networks.	Large enterprises and retail will have incentive to do so (safety) & therefore issue for this group is awareness; smaller enterprises may not see a need for location-based technology & so need to make it inexpensive & easy for them to participate; long term possibility could include changes to local building codes (similar to sprinkler systems)	Evaluation of “location-lite” technology for use in enterprises with no business need or interest in location awareness

Issues – as cited from filed comments

Issue	Remedy	Status
Communication to enterprise location-aware equipment is not standardized	Standardize location technologies for enterprise (interoperability)	911 Service Provider can manage this environment today; longer term (18 months), IETF standards can be developed
Use of commercial technologies would take years to deploy in sufficient density	Wi-Fi & cLBS is already deployed where people live, work and play; supported by VNI data	
Some consumers don't have or don't want smartphones that have Wi-Fi	VNI data shows otherwise; corroborated by industry analyst reports on growth of smartphones; smartphone pricing falling	

Issues – as cited from filed comments

Issue	Remedy	Status
Unmanaged Wi-Fi in residential MDUs	Unmanaged Wi-Fi in residential MDUs	
Residential or small business – moving APs to new locations	Crowd source database can discover new locations quickly	
Residential unit or small business locations without Wi-Fi APs	No issue for single family home or small stand-alone business structure (GPS good enough); in MDUs, client device likely to be seen by other APs	

Issues - brought by others

Issue	Remedy	Status
Enterprise WLANs don't work during power outages	Enterprise APs are PoE devices, hence powered from the wire closet. Enterprise needs to put a UPS in the wire closet.	
Location/address validation - how do we know the Enterprise supplied location is valid?	The NENA NG architecture supports location validation, but this doesn't mean Enterprises will participate. Possibly the every 18-month Fire Marshall walk-thru includes spot tests of Enterprise location values?	
How does a PSAP access the floor map?	NG includes mechanisms to pass URI with the call. Dereferencing the URI will give access to the map.	

Other Issues?

Questions?

Thank you.

