



Wireless Indoor Location

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Public safety does not dispatch to a X/Y:

39° 41' 11.93" N Latitude
104° 58' 54.72" W Longitude
5M Point Radius Uncertainty

They dispatch to an address

Reverse Geocoding
Nearest Intersection

S Pennsylvania St & E Iowa Ave
Denver, CO

Reverse Geocoding
Address Range

1600-1650 S S Pennsylvania St
Denver, CO

Reverse Geocoding
Point Match

1615 S Pennsylvania St
Denver, CO 80210

Indoor location

- Dispatchable Location is the most useful form of location
- Addresses are most valuable if delivered with the 9-1-1 call
- PSAP systems (CAD / CPE) need to be able to accept X/Y/Z and Address together
- Cell site addresses often cause confusion for Telecommunicators
- There is no single technology that can increase the accuracy for all indoor 9-1-1 calls but rather there are many technologies that work together.

Technologies to help locate indoor 9-1-1 callers

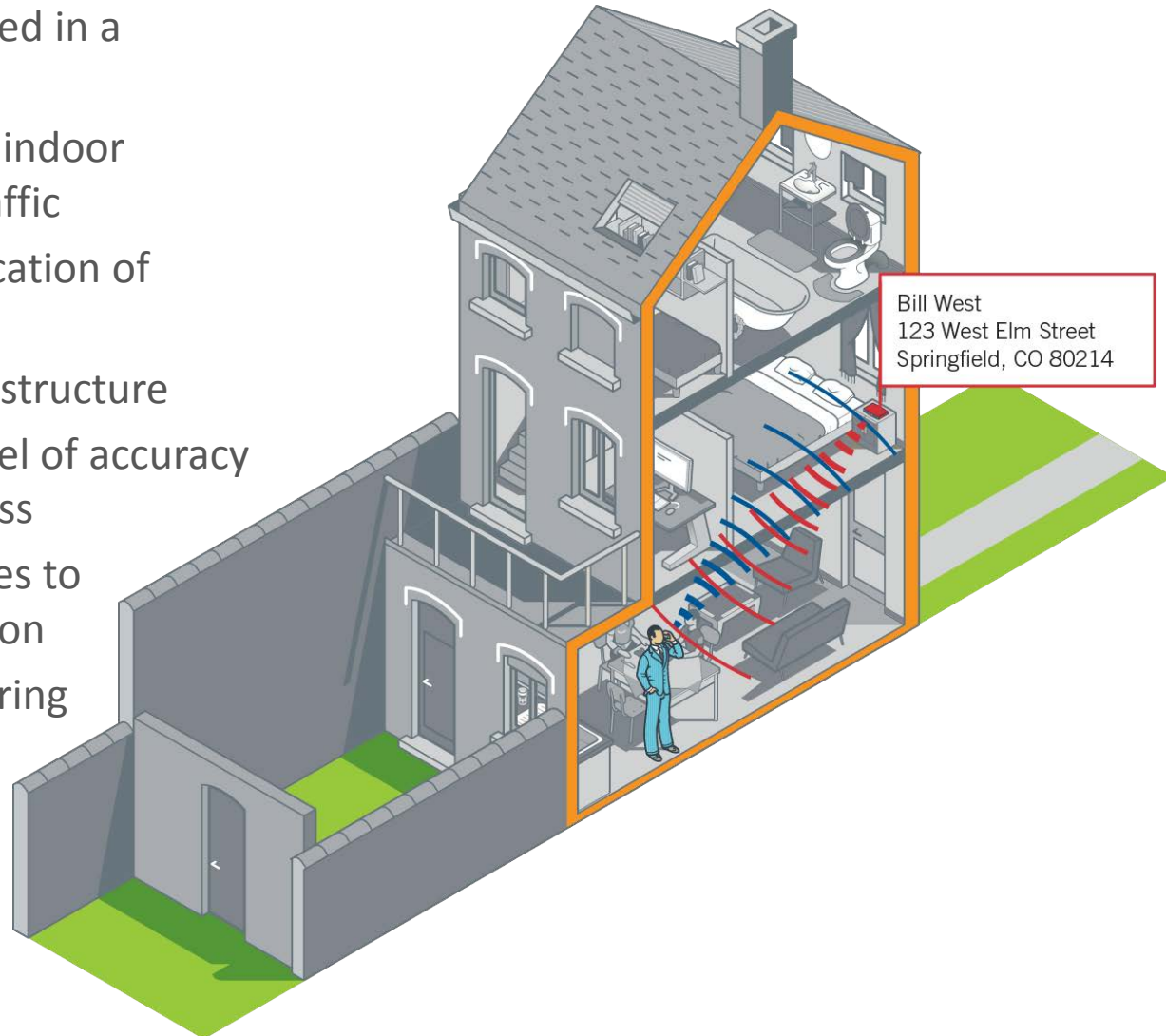
- Residential Femto Cell
- Enterprise Femto Cell
- Geo-Relevant Wireless ALI
- Metro Beacons
- Observed WiFi access point (beacons)
- Observed BLE beacons
- Enterprise WiFi
- Handset Determined Commercial Location
- Handset Determined Beacon Location

Indoor Position Determination Technologies

- **Femtocell (Enterprise and Residential)**
 - Provides dispatchable locations
 - No changes to handset or network
 - Dispatchable location implemented today with some carriers
- Real-time Wireless ALI
 - Provides dispatchable locations
 - No changes to handset
 - Minimal effort to standardize
 - Minimal effort to implement
- BLE and WiFi Beacons
 - Provides dispatchable locations
 - Requires changes to handset and network
- BLE and Commercial Location for 9-1-1
 - Provides dispatchable location and more precise X/Y/Z location
 - Downloadable/preinstalled/integrated application
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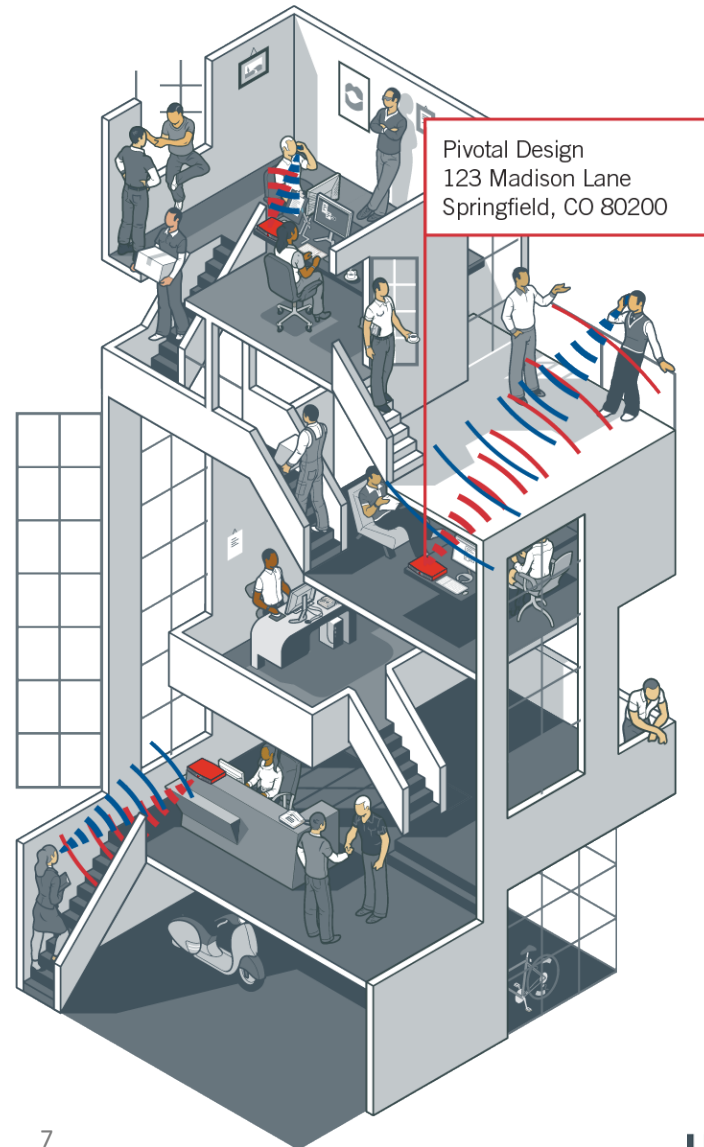
Femto cell – Residential

- Personal cell sites installed in a subscribers house
- Carrier offer to increase indoor coverage and offload traffic
- Contain GPS to verify location of device
- Typically cover inside of structure
- Can provide wireline level of accuracy with dispatchable address
- Requires delivery changes to utilize address information
- Some carriers are delivering address today



Femto cell – Enterprise

- Installed in enterprise by carrier or enterprise
- Often cover definable indoor spaces
 - Offices
 - Public Spaces
- Can provide wireline level of accuracy with dispatchable address
- Addresses must be managed
- May have GPS

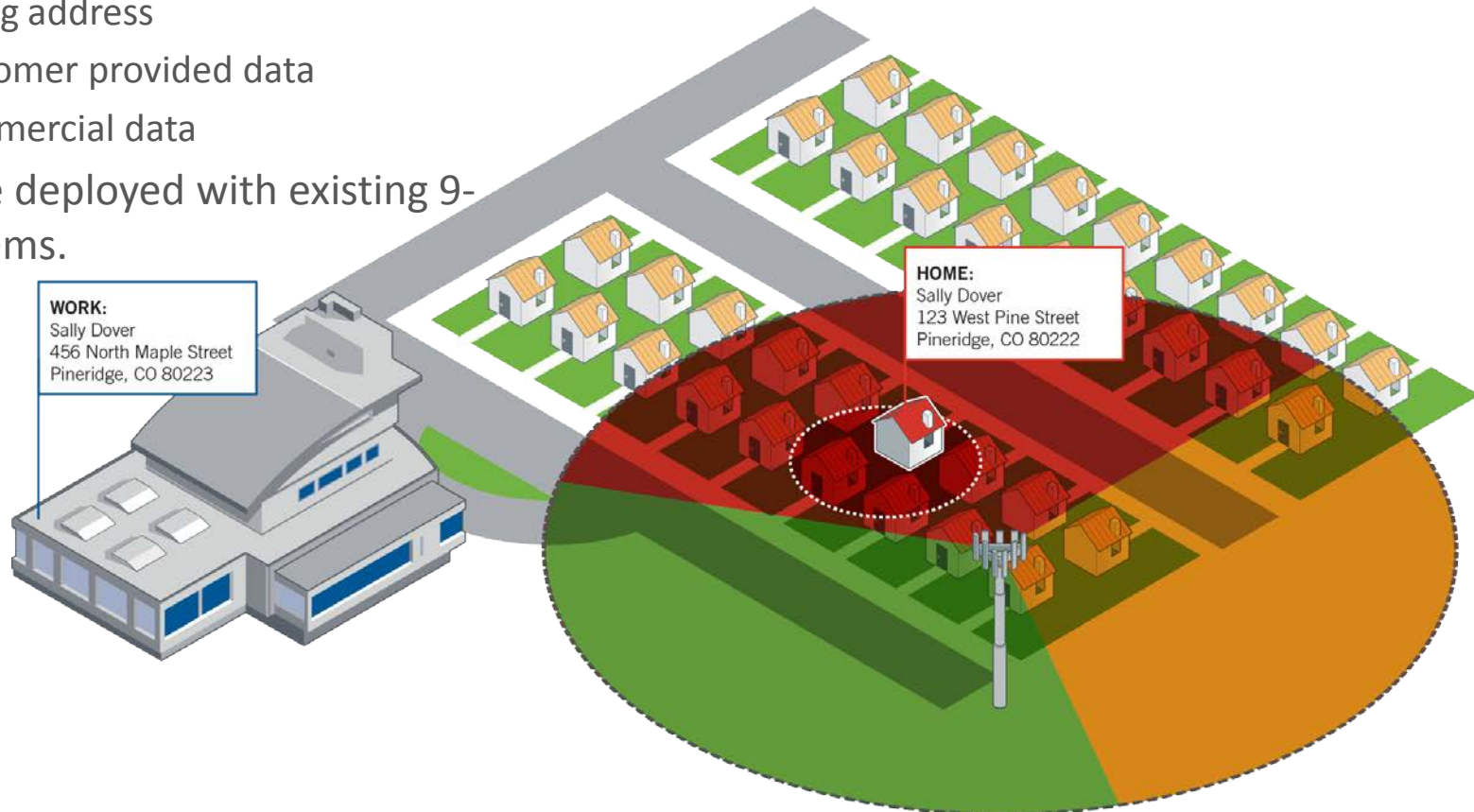


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Providing Dispatchable Locations Through Real-time Wireless ALI

- Only provide addresses associated with emergency caller
- Associated user addresses are cross referenced with 9-1-1 location.
- Multiple possible data sources
 - Billing address
 - Customer provided data
 - Commercial data
- Could be deployed with existing 9-1-1 systems.

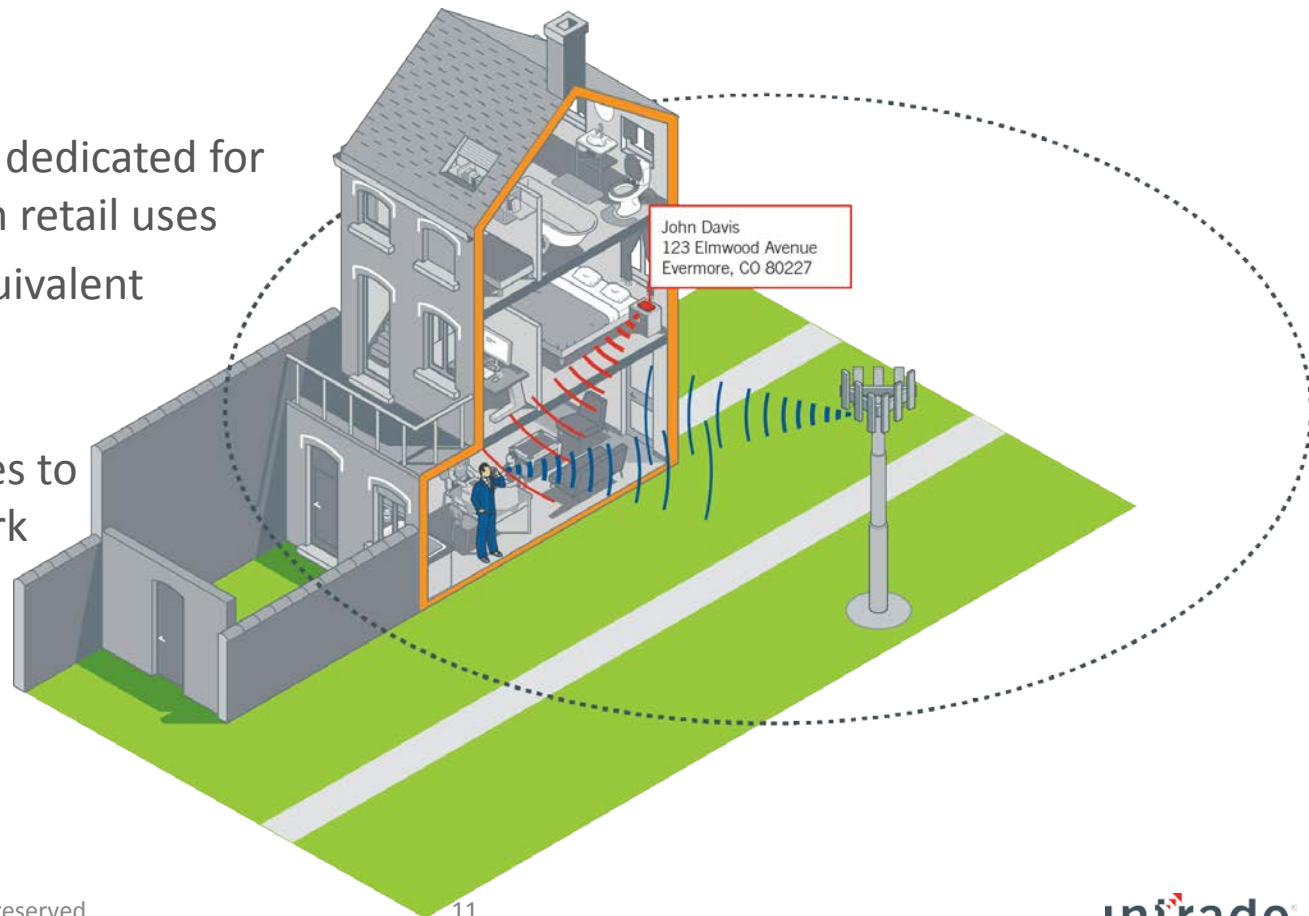


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Providing Dispatchable Location through BLE & WiFi Beacons

- Bluetooth Low Energy (BLE)
- Developed for retail applications
- BLE and WiFi radios existing in most new smartphones.
- Very low cost
- BLE beacons can be dedicated for 9-1-1 or shared with retail uses
- Provide wireline equivalent 1 address location
- Requires standards changes and changes to handset and network

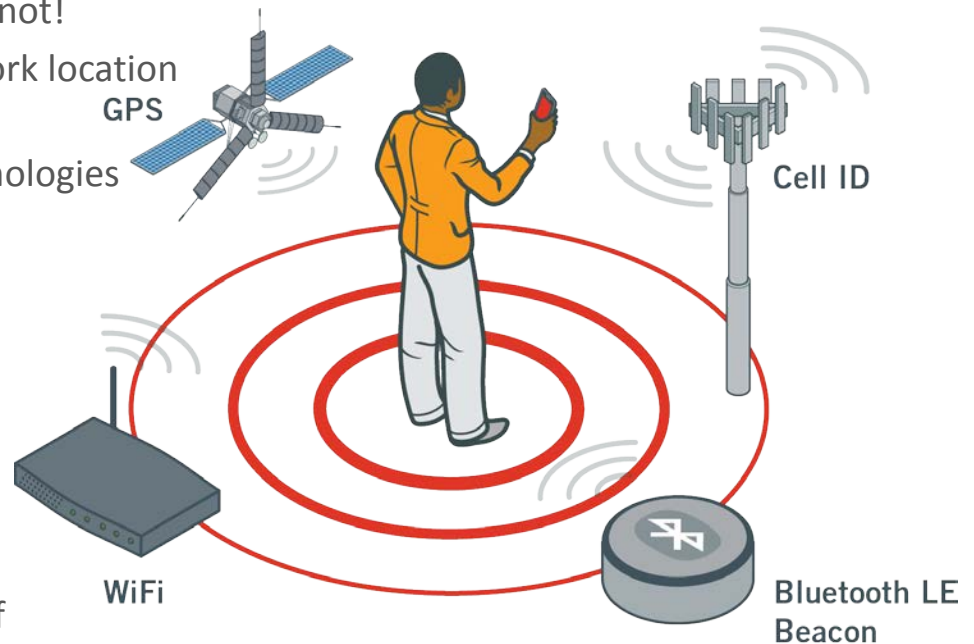


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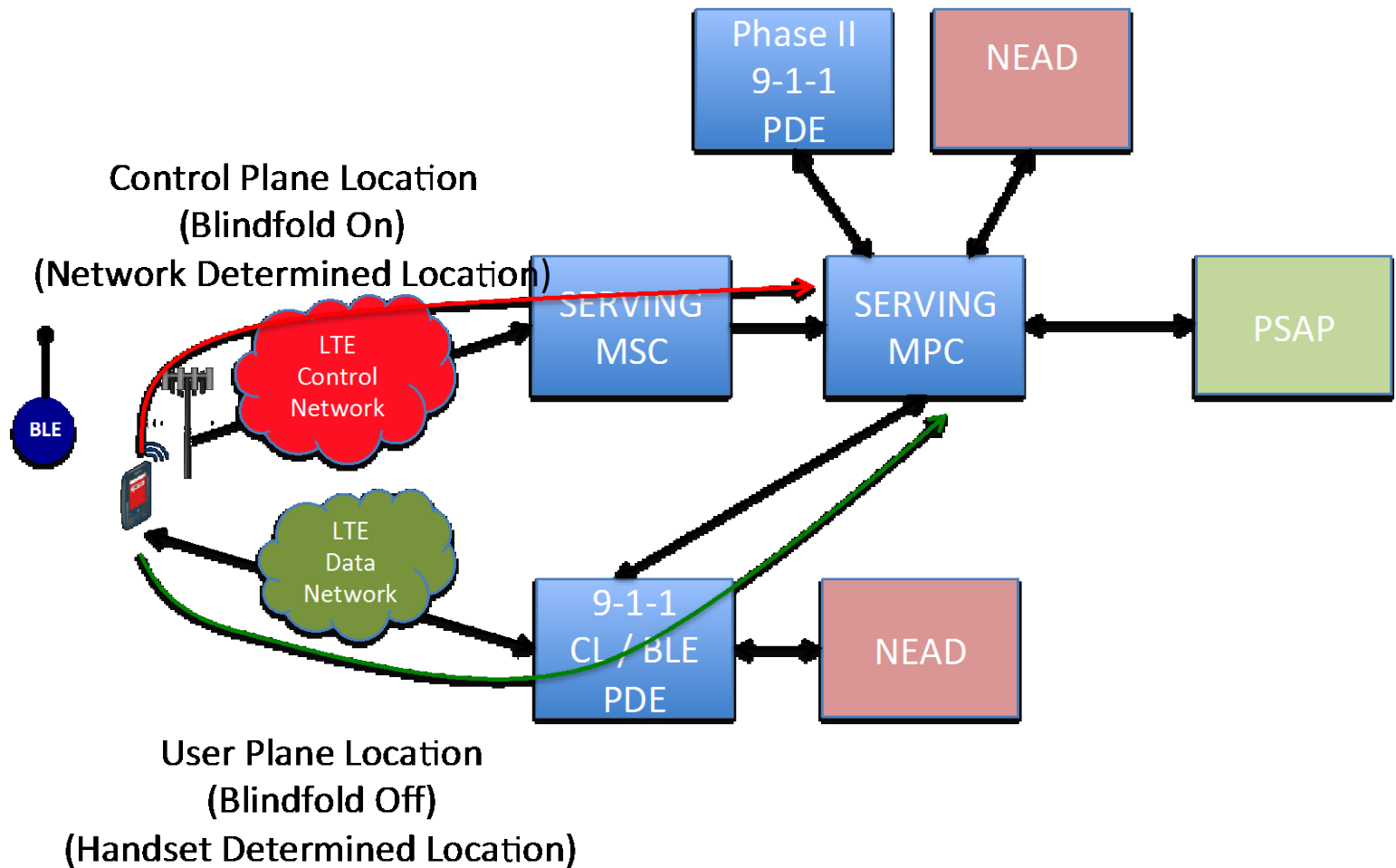
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 - **Carrier Provided / OS provided handset based**
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BLE and Commercial Location for 9-1-1

- Why can Starbucks locate me but 9-1-1 can not!
- Can provide enhanced location over network location alone.
- Commercial location uses additional technologies beyond Cell and GPS
 - WiFi
 - Beacons
 - Barometer
 - Multi sensor
- 9-1-1 can leverage commercial location to improve 9-1-1 X/Y/Z location at a low cost
- Dramatically increase accuracy and speed of implementation of BLE beacons
- Can provide dispatchable location and more accurate X/Y/Z location
- Commercial handset based location technology is the “best of breed” of location technologies today likely will continue to be in the future.
- Could follow commercial privacy model



Control Plane Location and User Plane Location



Challenges for PSAPs

- Understanding uncertainty
- Differentiating between dispatchable location and cell site address
- Understanding that Phase 1 cell locations may be more accurate than Phase 2 X/Y
- Have a way to receive and utilize Z

Questions

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