CMX Indoor Location

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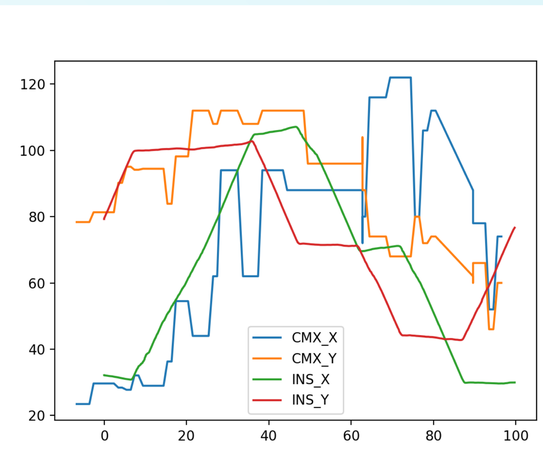
Introduction

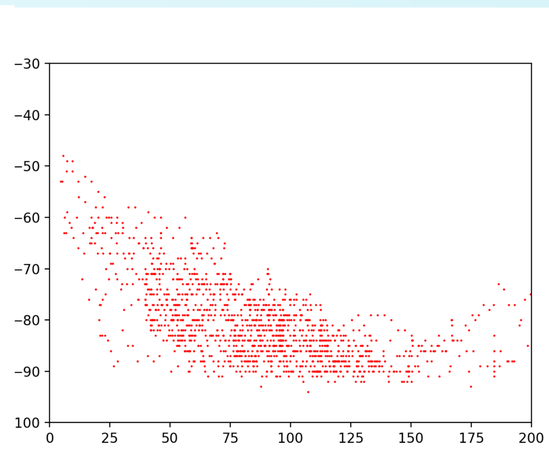
Mainstream positioning techniques based on GPS and Bluetooth cannot well fit into indoor scenarios, because GPS signals are not accessible indoors while the accuracy of Bluetooth positioning is around 5~10 meters. Thus, indoor location systems are based on Wi-Fi signals. Traditional solutions includes Angle of Arrival(AoA) and Received Signal Strength Indicator (RSSI), but fingerprinting on these features needs human human labor to construct sufficient training set.

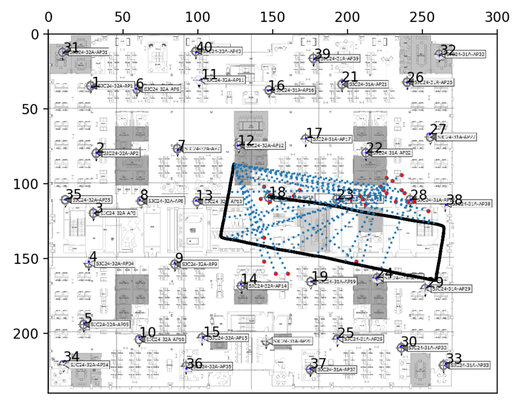
In 2016, a protocol specified in 802.11REVmc-FTM (IEEE 802.11mc-2016 technical Specification) define the Fine Timing Measurement(FTM) procedure between the Mobile device (STA) and Network infrastructure device (AP). This feature allows measuring distance based on time of flight (exchange of frames with timestamps, basically). This of course can be used to compute relative location.

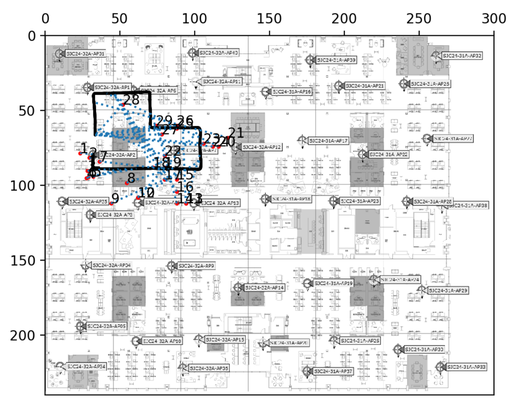
However, according to the implementation of engineering team, the CMX location dots got from FTM are pretty jumpy. Thus, we hope to fuse the complementary data from device sensors and BLE beacons together with CMX locations to help improve the accuracy. The long term core location roadmap is to move from signal strength or phase array based location to time based solutions for the majority of client locations by 2020.

Results

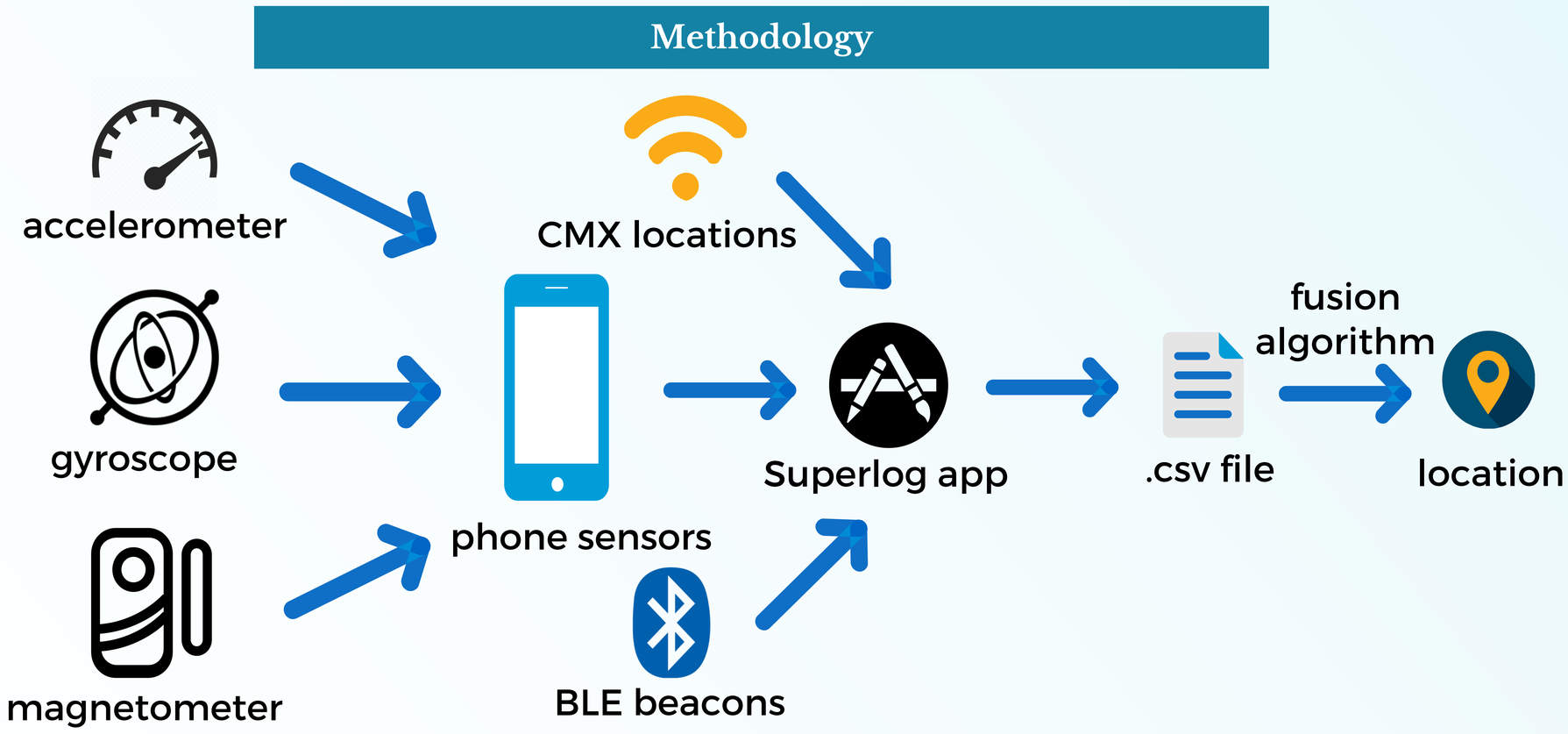








Methodology



Algorithm	Purpose
CMX + BLE → location	Snap to beacon
high dimensional fingerprinting → location	Alternative location estimation technique
accelerometer + gyroscope → inertial path	Real time blue dot updates, requires holding phone straight ahead, relative path only
accelerometer → relative heading	Reduces requirement to hold phone straight ahead
magnetometer → absolute heading	Reduce “warm up time”, more robust heading
location + inertial path + heading → absolute path	Translate and rotate inertial path to world coordinates, limited by CMX moving accuracy
Moving accuracy measurement	
Outlier removal	
Average CMX while stationary	
Adaptive step size lambda (scale inertial path to match CMX path)	
Weighting inertial/CMX matching using confidence factor	
Drag to path (vs. snap to path)	

Final Goal

“Cisco Maps”