



Bluetooth Direction Finding

Kai Ren, Senior Developer Relations Manager, Bluetooth SIG

audio streaming



wireless headsets
wireless speakers
in-car infotainment

data transfer



sports & fitness devices
health & wellness devices
peripherals & accessories

location services



point of interest
navigation & wayfinding
item & asset tracking

device networks



control systems
monitoring systems
automation systems

The community is
continually enhancing
Bluetooth technology



Higher Speed
(LE 2M PHY)
Longer Range
(LE Coded PHY)



Bigger Broadcasts
(Advertising Extensions)
Direction Finding

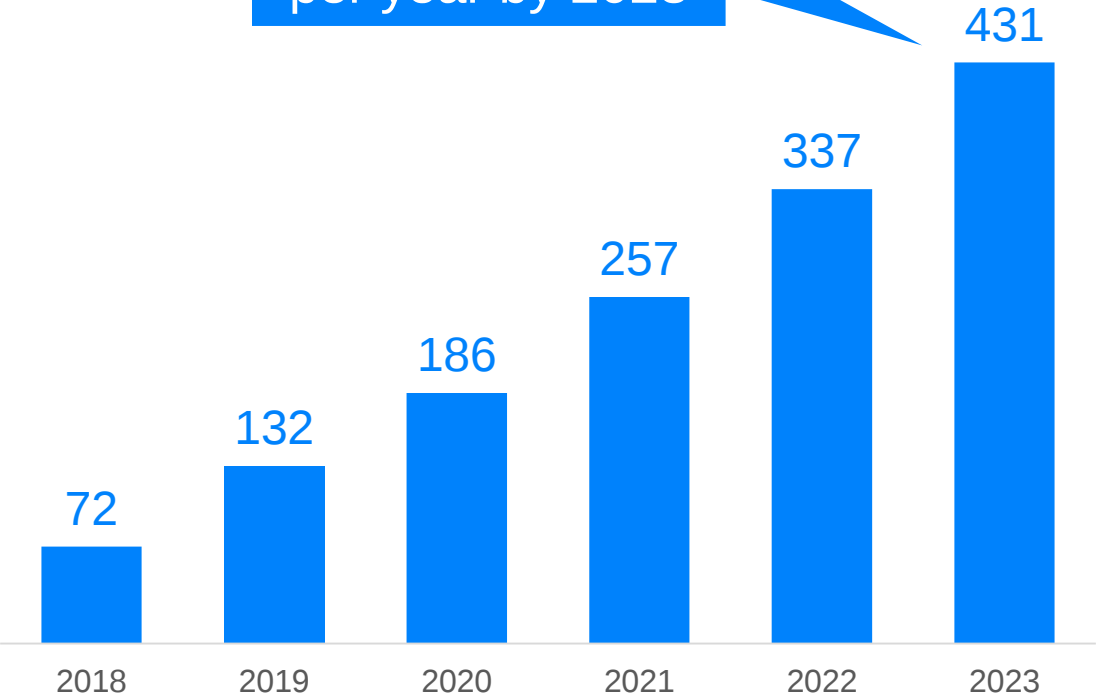


Mesh Networking



Bluetooth Location Services

Over 430 million product shipments per year by 2023





Bluetooth Location Services



item finding solutions

(e.g. personal property tags)



point of interest information solutions

(e.g. proximity marketing)

proximity solutions

Proximity solutions leverage Bluetooth to determine the location of two devices relative to each other.

Today, they can determine if two devices are near each other and approximately how close.

Bluetooth Location Services



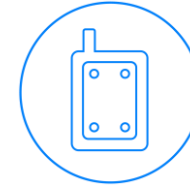
item finding solutions

(e.g. personal property tags)



point of interest information solutions

(e.g. proximity marketing)



real time locating systems (RTLS)

(e.g. asset tracking)



indoor positioning systems (IPS)

(e.g. wayfinding)

proximity solutions

Proximity solutions leverage Bluetooth to determine the location of two devices relative to each other.

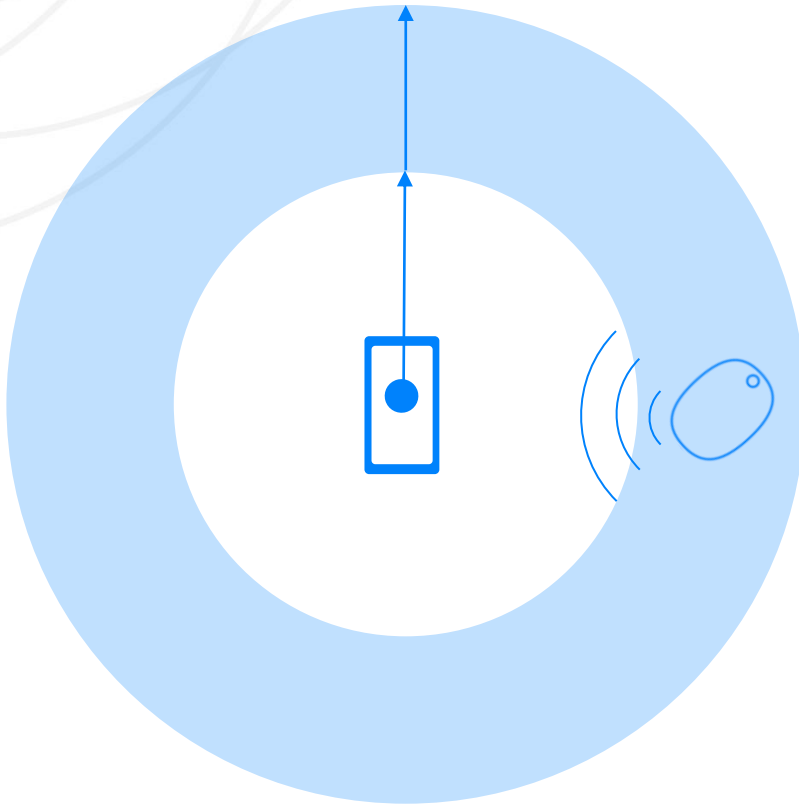
Today, they can determine if two devices are near each other and approximately how close.

positioning systems

Positioning systems leverage Bluetooth to determine the physical location of devices.

Today, they can determine the location of a device with “meter-level” accuracy

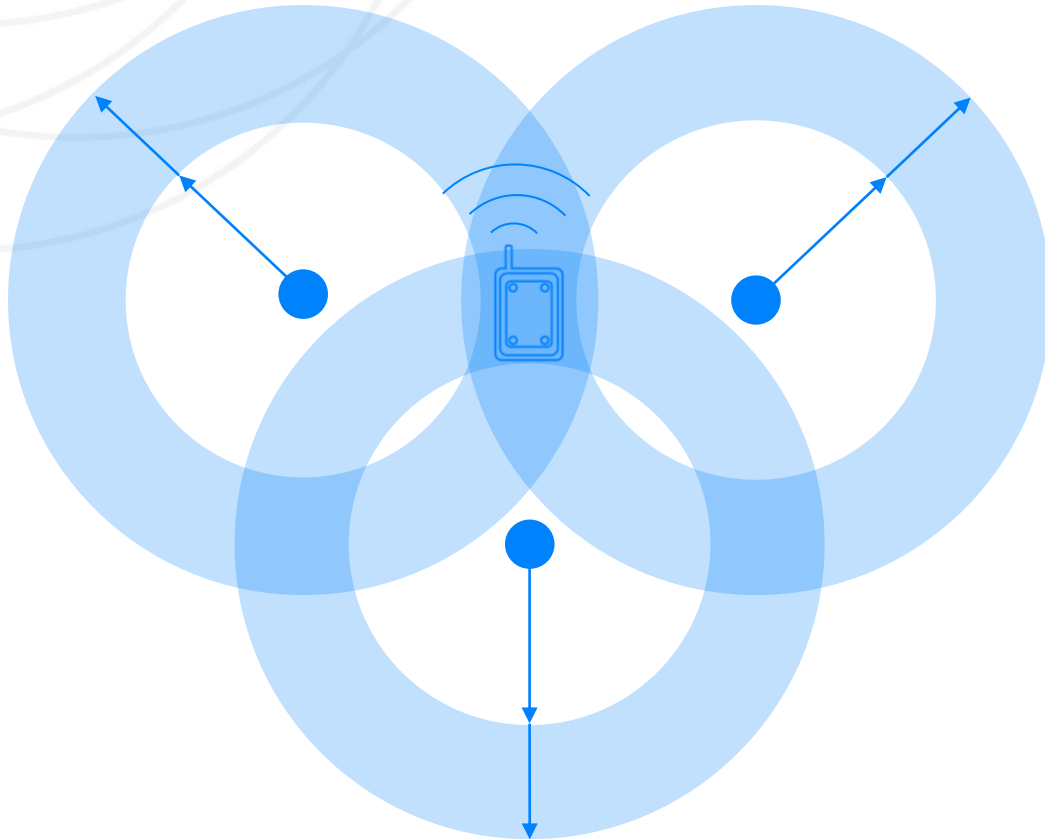
Bluetooth Location Services are Based on RSSI



Proximity solutions (e.g. item finding)

- Bluetooth tag (e.g. a personal property tag) periodically advertises its presence
- Locator device (e.g. a smartphone with an app) identifies when a known tag is within range
- Locator estimates distance to tag based on received signal strength (RSSI)

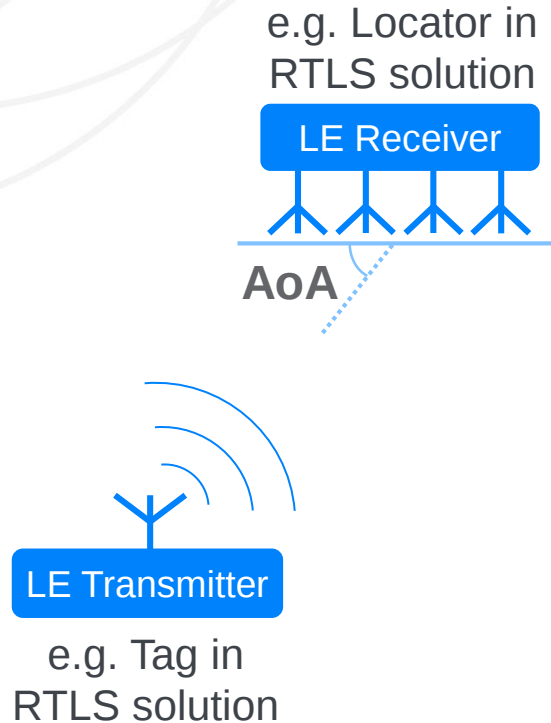
Bluetooth Location Services are Based on RSSI



Positioning systems (e.g. RTLS)

- Fixed locators deployed throughout a facility
- Bluetooth tags, attached to mobile assets, periodically advertise their presence
- Locators estimate their distance to tags they hear based on RSSI
- If three or more locators hear the same tag, trilateration is used to estimate tags position
- Can currently achieve 'meter-level' accuracy

Bluetooth Direction Finding

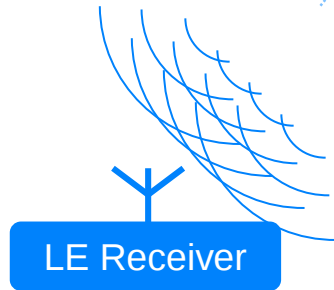
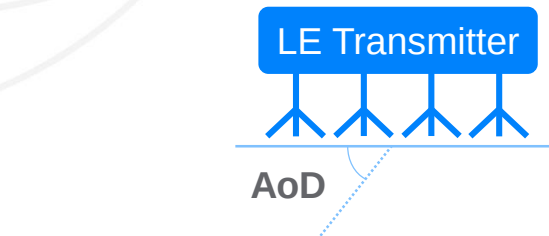


Using Angle of Arrival (AoA) method

- Targeted for RTLS, item finding, and PoI information
- Transmitter sends special packets using a single antenna
- Receiver...
 - Has multiple antenna arranged in an array
 - Antennas see received signal phase difference because of different distances to the transmitter
 - Takes IQ samples from received signal while switching between active antenna
 - Relative signal direction calculated using data

Bluetooth Direction Finding

e.g. Locator beacon in
IPS solution



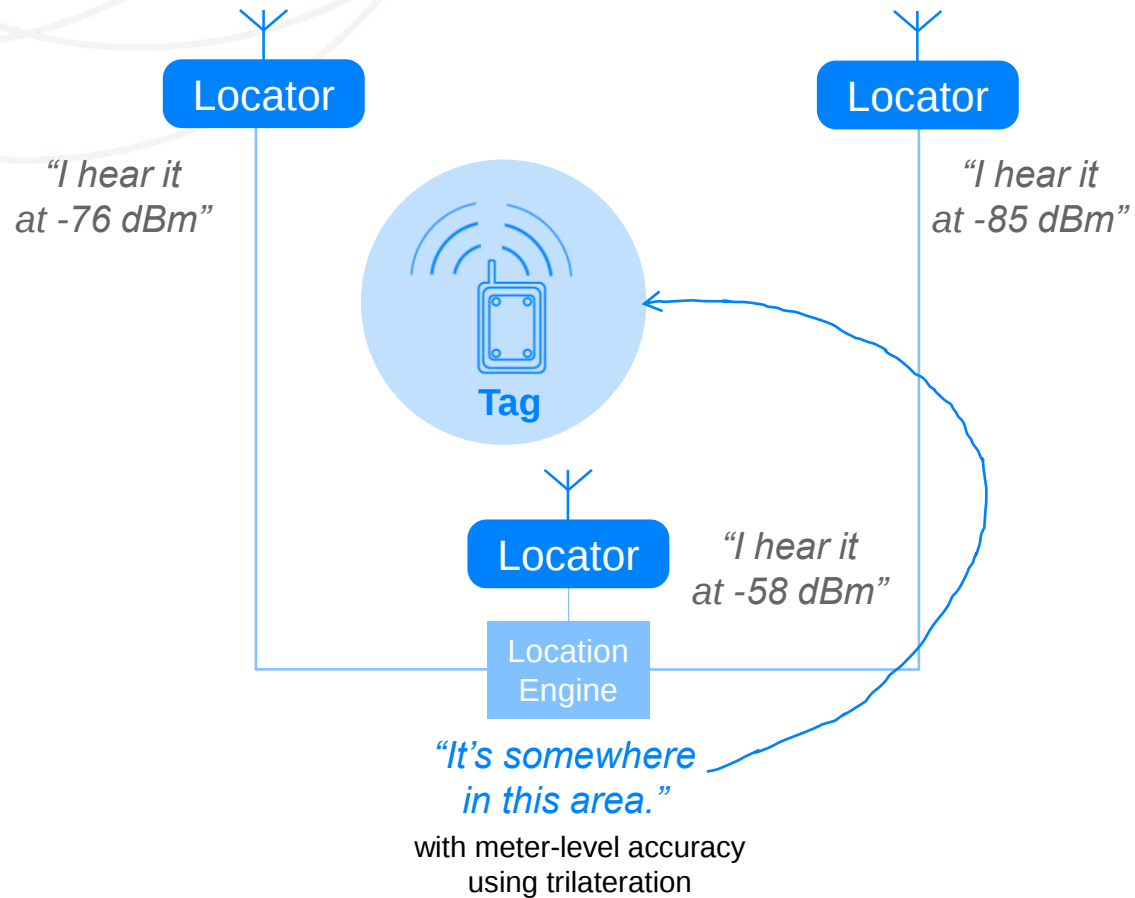
e.g. Smartphone in
IPS solution

Using Angle of Departure (AoD) method

- Targeted for indoor positioning systems (IPS)
- Transmitter sends special packets while switching between active antenna arranged in an array
- Receiver...
 - Receives signals using single antenna
 - Takes IQ samples from received signals
 - Has knowledge of antenna layout within transmitter
 - Relative signal direction calculated using data

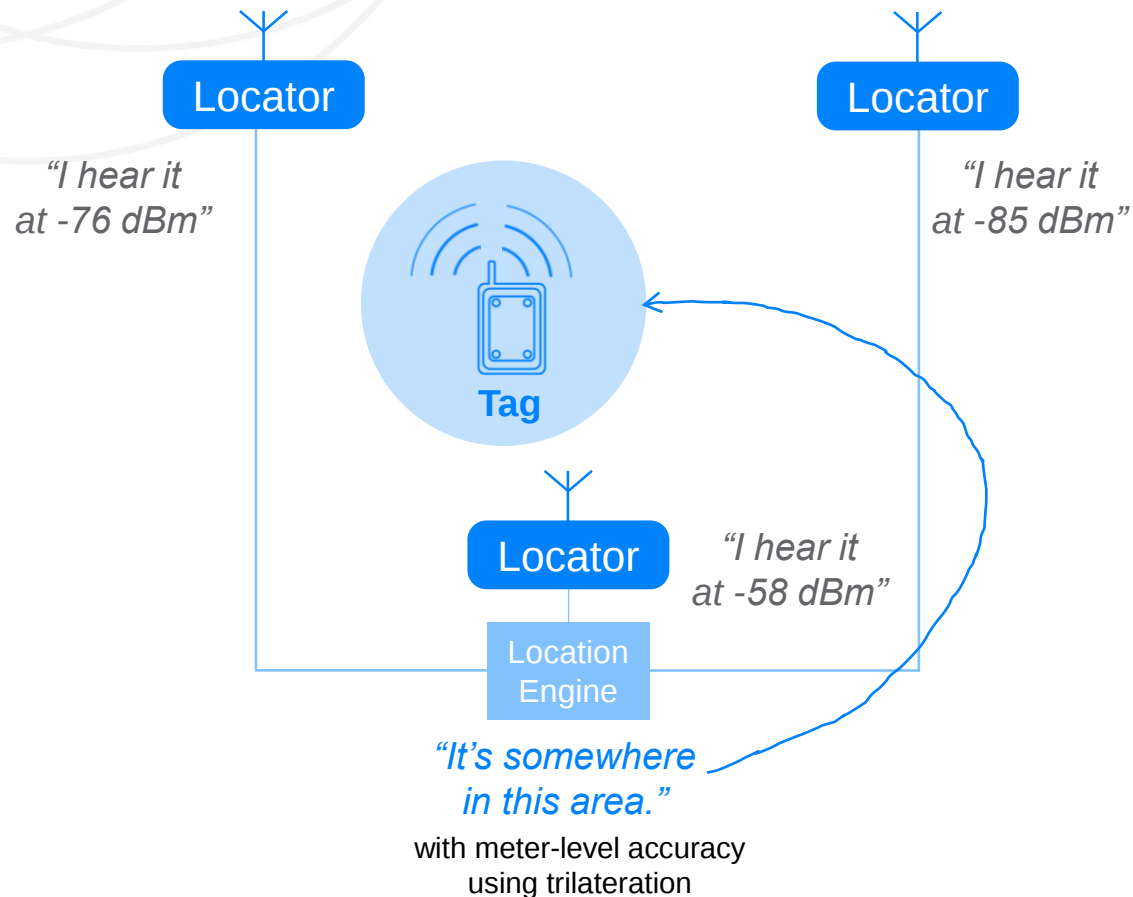
Real Time Locating Systems (e.g. asset tracking)

Today
using signal strength

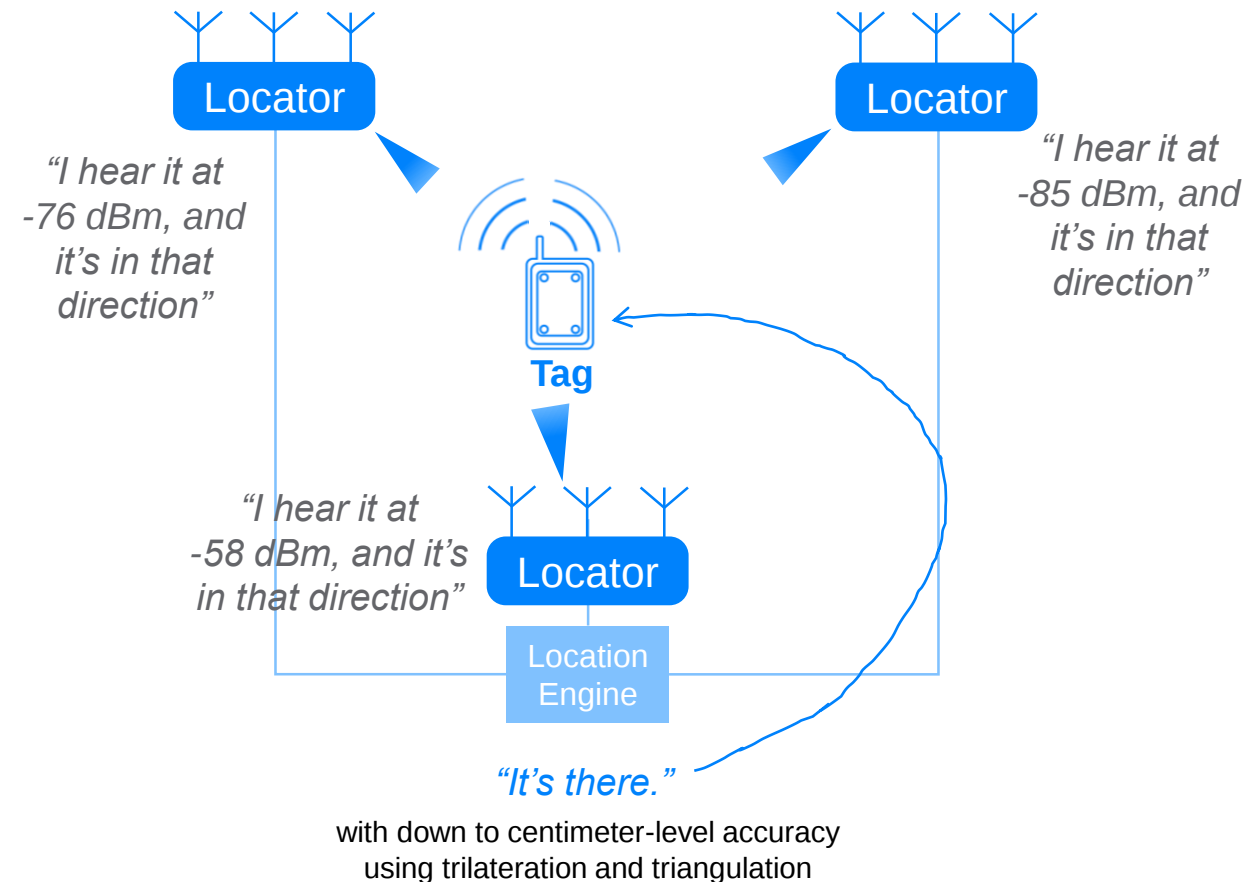


Real Time Locating Systems (e.g. asset tracking)

Today
using signal strength

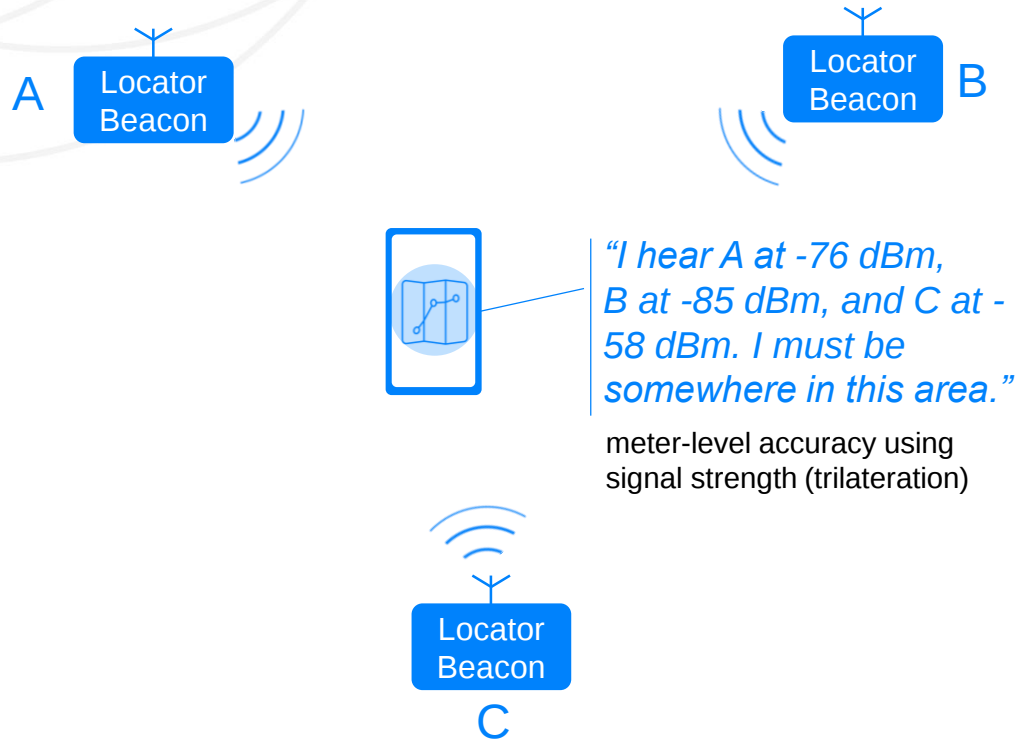


With direction finding using AoA
using signal strength and direction



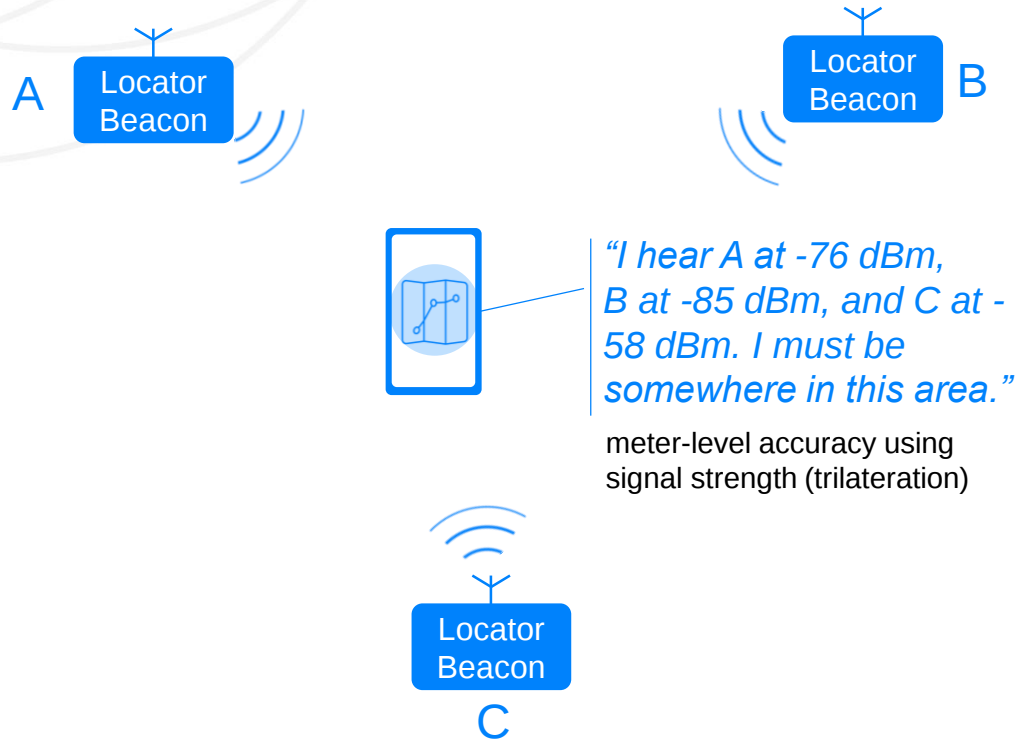
Indoor Positioning Systems (e.g. wayfinding)

Today
using signal strength

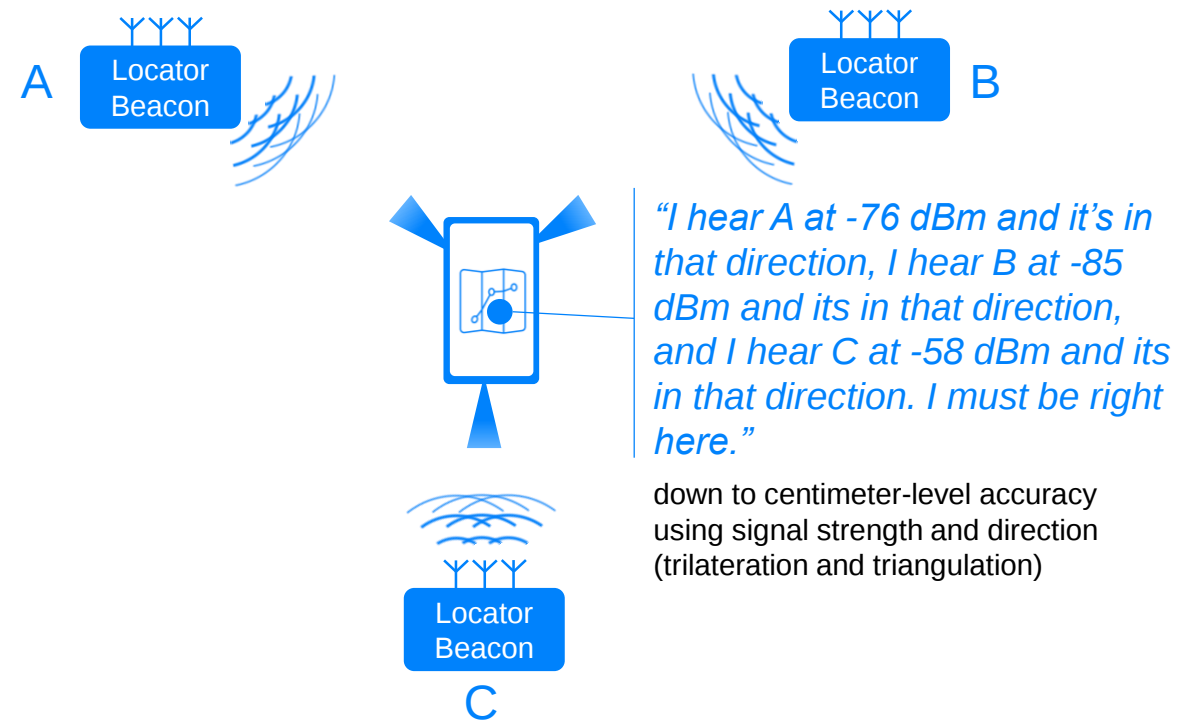


Indoor Positioning Systems (e.g. wayfinding)

Today
using signal strength



With direction finding using AoD
using signal strength and direction





Use Cases

探索、创新、开拓







← 17\18 出口 EXIT
人民公园 People's Park

出站验票 EXIT GATE

南京西路, 黄河路, 九江路 6~12 出口 EXIT
West Nanjing Road, Huanghe Road, Jiujiang Road
南京路步行街, 新世界城, 国际饭店, 人民公园, 上海美术馆
Pedestrian Street of Nanjing Road, New World City, Park Hotel, People's Park, Shanghai Art Museum

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Developer sessions by Bluetooth SIG

Date	Time	Topic
Today	11:45 ~ 13:15	Bluetooth - Longer Range, Higher speed and Increased Capacity
Tomorrow	10:00 ~ 11:30	Bluetooth Direction Finding Feature and the Latest Specification Enhancements
Tomorrow	13:00 ~ 14:30	Bluetooth Mesh Provisioning and Interoperability

#BluetoothAsia2019#



Q&A

探索、创新、开拓



谢谢

Thank you!

