



# WELCOME



# APAC Talk Talks LIVE - Mandarin

Topic	Date
Evolution of Bluetooth 5, 5.1, & 5.2	10a.m., Tuesday, May 26
Bluetooth Mesh Solutions & Tools	10a.m., Thursday, May 28
15.4 Mesh Networking Technologies	10a.m., Tuesday, June 2
<b>Bluetooth AoX Solutions</b>	<b>10a.m., Thursday, June 4</b>
Connected Home Over IP (CHIP) for Beginners	10a.m., Tuesday, June 9
Device & Network Security for the IoT	9a.m., Thursday, June 11



Kevin Fang

Sr. FAE, Silicon Labs China

Kevin works as Sr. FAE in Central China team of Silicon Labs, focusing on Bluetooth, BT Mesh and AoX products as well as technical supports to customers.



# Bluetooth AoX Solutions

KEVIN FANG | JUNE 2020



# Asset Management



The larger the building, the more important it is to track critical resources to create efficiencies. Bluetooth can help staff find the closest assets – from luggage carts to wheelchairs to utility vehicles, even if they are parked in the wrong spot or hidden from view.

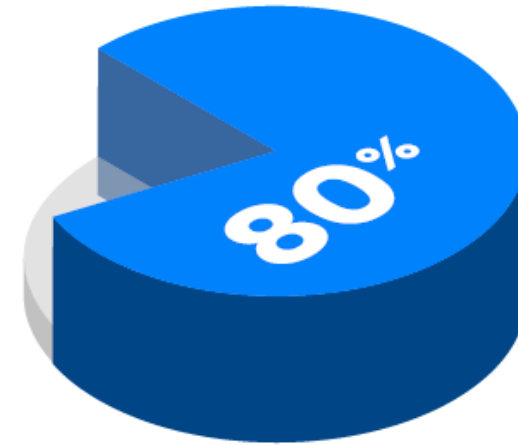
**65% of enterprises will require indoor location asset tracking by 2022**

source: Gartner

# Indoor Navigation



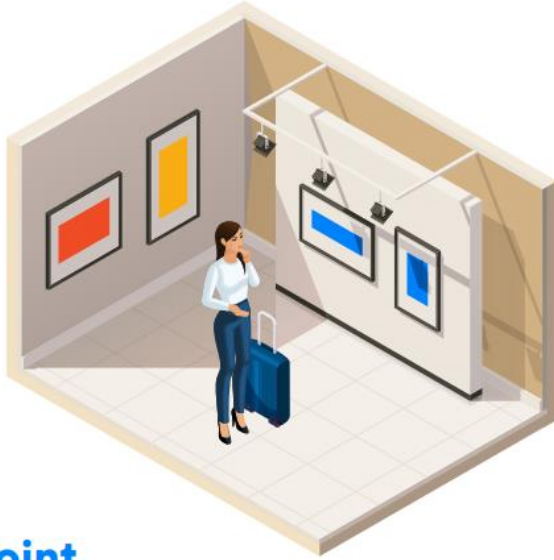
*Visitors can easily navigate a facility while seeing if a favorite restaurant is nearby or locating the closest restroom. Giving travelers the fastest route to their destination helps improve traffic flow and eliminates congestion in the terminal.*



**80% of airport  
CIOs see indoor  
navigation as a  
major technology  
program by 2021**

source: SITA, 2018

# Access Control and Personnel Tracking



## Point of Interest Information

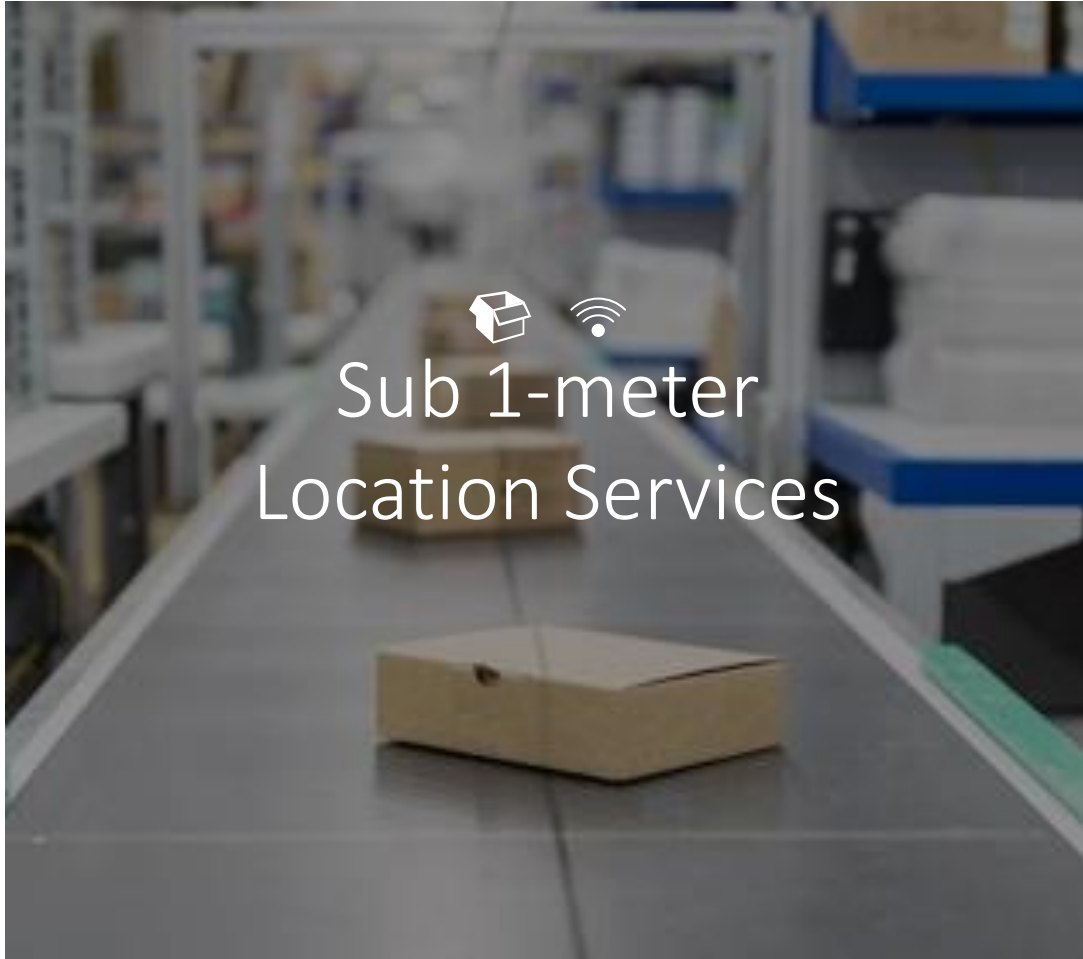
Creating interactive points of entertainment enhances the visitor experience. Visitors in venues like airports, museums, and tourist attractions can use apps on their smartphones to learn about pieces of art, historical monuments, and other points of interest.



## Access Control

With Bluetooth enabled access control, a smartphone can provide employees with secure access to controlled areas of a building. Adding access control to a device that is less likely to be lost or misplaced, such as a smartphone, enhances overall security for the facility.

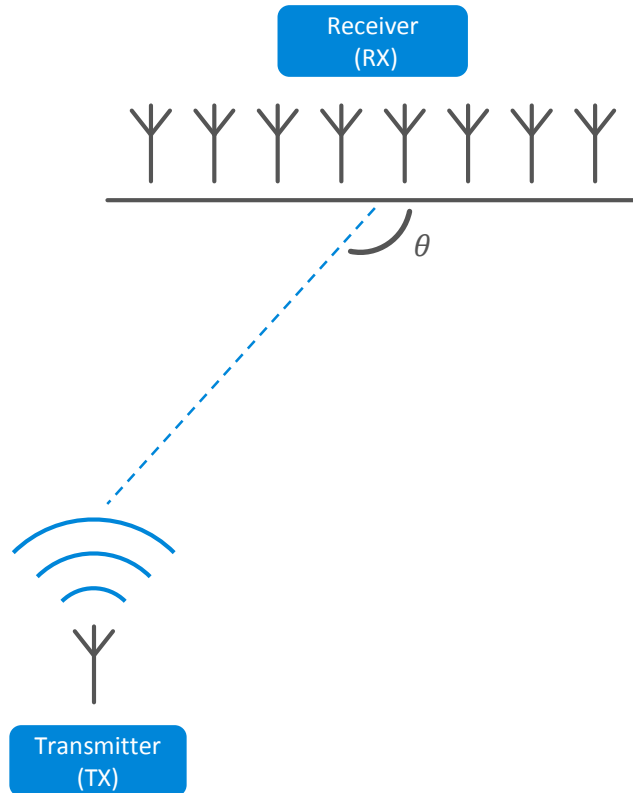
# Why Bluetooth Direction Finding for Indoor Location Services?



- Bluetooth Direction Finding can deliver sub 1-meter accuracy for Indoor Location Services at reasonable infrastructure cost and complexity
- Bluetooth tags can operate 5-10 years on coin cell batteries
- The BoM of a Bluetooth tags can be reach <\$1 in high volume
- Bluetooth also enables one or two-way data transfer
- Bluetooth tag functionality can be integrated as part of regular Bluetooth products like power tools, medical products, wearables etc. at no additional hardware cost



# How Angle-of-Arrival (AoA) Works?



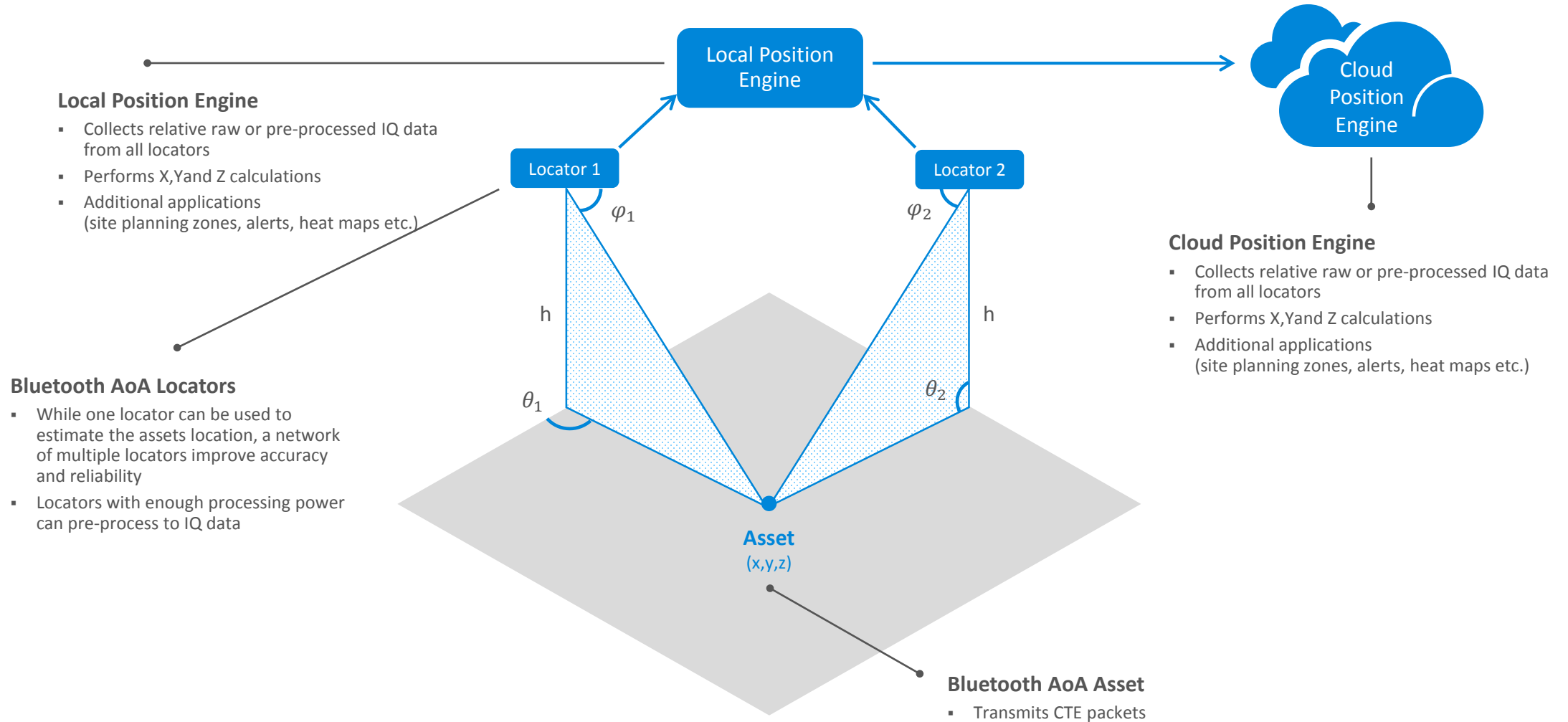
## An asset wants to broadcast its location

- Continuous tone extension (CTE) is added to the end of a Bluetooth advertisement or connection packet
- Asset can support other Bluetooth functions while being tracked as CTE does not use the payload

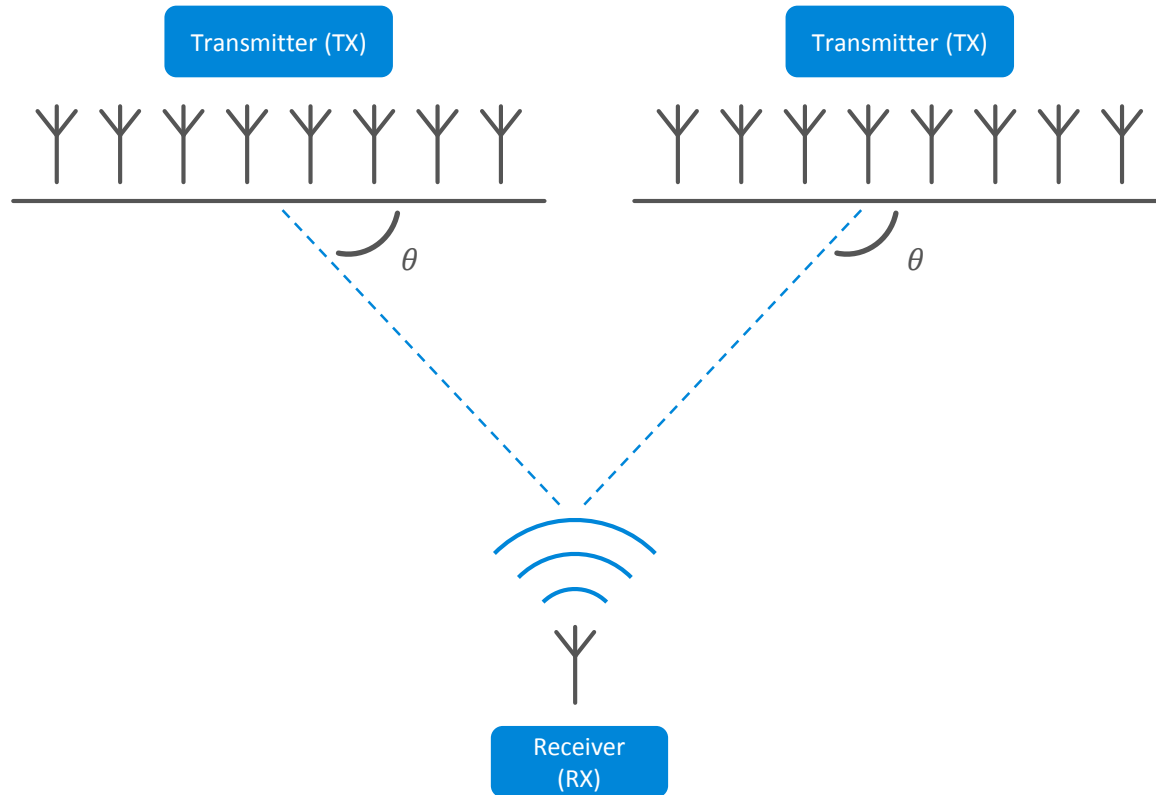
## A locator wants to find the asset

- A locator needs to have multiple antennas, as antenna is switched during the CTE reception
- A locator listens for CTE packets and measures IQ data from the CTE payload
- Can perform spherical azimuth and elevation calculation, or pass the IQ data forward to back-end processing

# How AoA Works at a System Level?



# How Angle-of-Departure (AoD) Works?





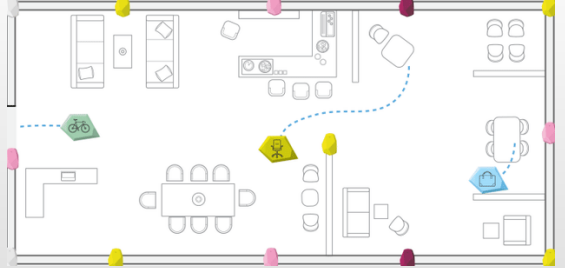
## Transmitters broadcast indoor position

- The transmitters switch antennas while transmitting CTE
- Therefore the transmitters need an antenna array, switches and Bluetooth 5.1 AoD capable radio
- Transmitters can also transmit other data, such as their own coordinates

## The receivers listen for the AoD packets

- The receiver does the IQ sampling while receiving CTE
- Azimuth and elevation is calculated from the CTE
- The receiver can compute its own positioning for example if AoD transmitters share their own location or alternatively the IQ or azimuth and elevation information can be sent to position engine

# Silicon Labs' Solutions for Implementing Direction Finding

ASSET TAGS		LOCATORS AND BEACONS		POSITIONING ENGINE & TOOLS	
					
<b>Generic tags (RSSI)</b>	Any Bluetooth capable EFR32BG22 (BG22) is most optimized	<b>Generic gateways (RSSI)</b>	EFR32BG21 (BG21) has best performance and is most optimized	<b>Position engine &amp; installation tools</b>	Not supplied by Silicon Labs
<b>AoA/D tags</b>	BG22 supports AoA/D BG22 hardware available <u>now</u> AoA/D software available <u>Q2-Q3</u>	<b>Bluetooth 5.1 AoA locators</b>	BG22 supports AoA/D BG22 hardware available <u>now</u> AoA/D software available <u>Q2-Q3</u>	<b>Position engine &amp; installation tools</b>	Not supplied by Silicon Labs
<b>Quuppa compatible tags</b>	BG22 is Quuppa compatible BG22 hardware available <u>now</u> Quuppa software available <u>now</u>	<b>Quuppa locators</b>	Available now from Quuppa <a href="http://www.quuppa.com">www.quuppa.com</a>	<b>Quuppa Positioning Engine (QPE) and tools</b>	Available <u>now</u> <a href="http://www.quuppa.com">www.quuppa.com</a>

# BG22: Optimized for Asset Tags

# Optimized



## Secure Bluetooth 5.2 SoCs for High-Volume Products

### Radio

Bluetooth 5.2  
+6 dBm TX  
AoA & AoD

### Ultra-Low Power

3.6mA Radio TX  
2.6mA Radio RX  
1.4uA EM2 with 32kB RAM  
0.54uA in EM4  
RTC in EM4

### World Class Software

Bluetooth 5.2  
Bluetooth mesh LPN  
Direction Finding

### Compact Size

5x5 QFN40 (26 GPIO)  
4x4 QFN32 (18 GPIO)  
4x4 TQFN32 (18 GPIO)

### ARM Cortex-M33 with TrustZone

76.8 MHz with FPU and DSP  
352/512kB of flash  
32kB RAM

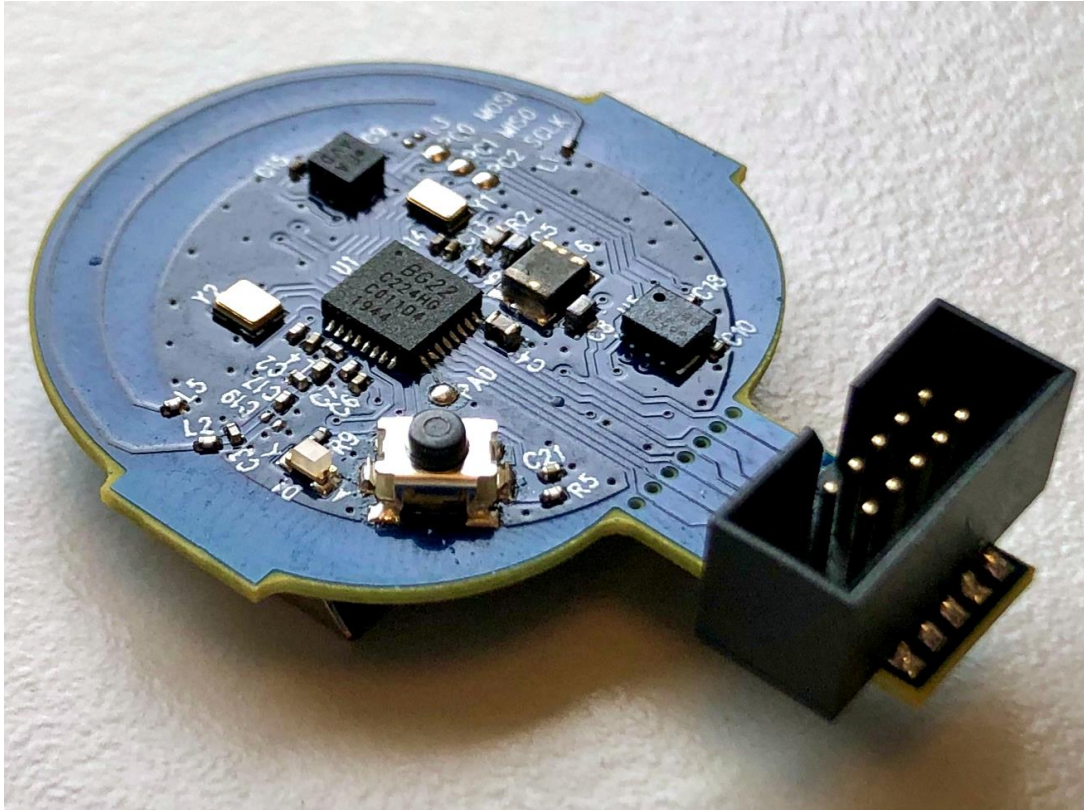
### Peripherals Fit for Purpose

2x USART, 2x I2C, 2x PDM and GPIO  
12-bit ADC (16 channels)  
Built-in temperature sensor with +/- 1.5 °C  
32kHz, 500ppm PLFRCO

### Security

AES128/256,SHA-1, SHA-2 (256-bit)  
ECC (up to 256-bit), ECDSA and ECDH  
True Random Number Generator (TRNG)  
Secure boot with RTSL  
Secure debug with lock/unlock

# BG22 Example Tag Design



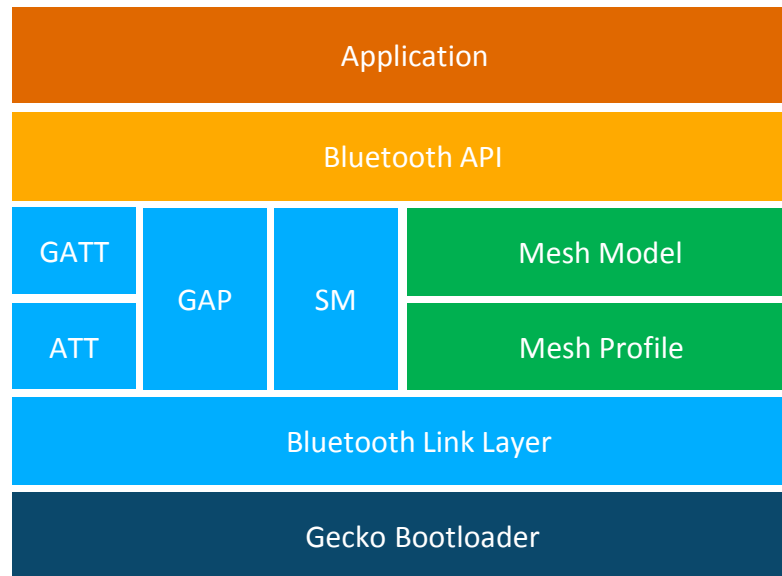
## BG22 Based Tag Reference

- EFR32BG22C112 4x4 QFN32
- Built in PCB antenna
- 1 or 2x XTALs
- Accelerometer for wake-on motion
- RFSense for wake-on radio
- Button for wake-on by user
- Barometer for height detection
- CR2032 battery holder
- Mini Simplicity debug connector
- Slightly larger than CR2032

## BG22 benefits for tags

- Extremely low power
- EM4 wake-ups from via I/O or with RTC
- RFSense wake-on radio for RF wake-ups (commissioning, proximity wake-up etc.)
- Possibility to use 1x HF XTAL
- Built-in temperature sensor
- AoA, AoD and Quuppa compatible

# Bluetooth Direction Finding Software for Tags and Beacons



## Silicon Labs Direction Finding software for tags

- Supports connectionless and connection-oriented AoA TX (CTE transmissions)
- AoD ready
- Also support concurrent Bluetooth advertisement and connections or dynamic multiprotocol

**Early access for BG22 in Q2'20**

**General availability for BG22 in H2'20.**

# Bluetooth Direction Finding for Locators and Gateways



## **BG22 SoC Provides Best AoA Performance**

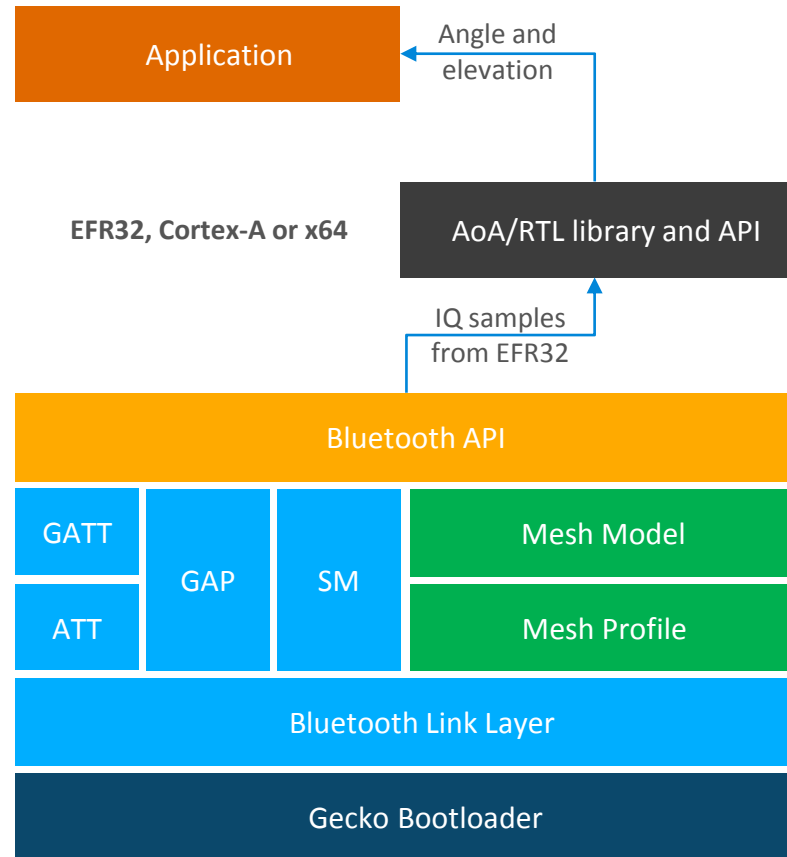
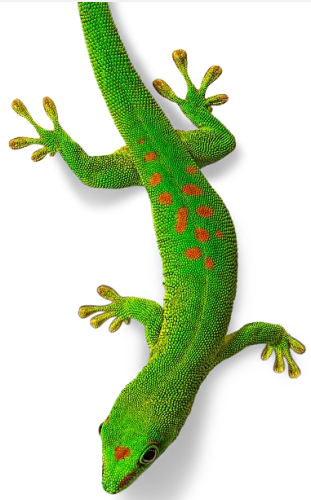
- 1 degree accuracy with the SoC
- Both 1M and 2M PHY support
- Extremely good sensitivity

## **4x4 antenna array for best performance**

- 4x4 for best accuracy and robustness
  - <5 degrees of accuracy
- 5x 1-to-4 Skyworks' RF switches (~\$1)
- PCB patch antennas with circular polarization
- Half dome radiation pattern
- 4-layer PCB



# Bluetooth Direction Finding for Locators and Gateways



## Bluetooth software

- Connection-oriented and connectionsless AoA receive support
- AoD Ready
- RF switch control and IQ sampling with BG22 (Tested with Skyworks, pSemi and CoreHW RF switches)
- Raw IQ data available via API

## AoA/RTL library and API

- Converts raw IQ data to azimuth & elevation
  - Detects and filters out multipath
  - Detects and filters out CTE collisions
  - Angle and elevation filtering algorithms for different use cases (high accuracy, real time etc.)
- Provides a developer API for configuration and data conversion
- Significantly simplifies locator software development

**Early access for BG22 in Q2'20 and general availability in H2'20.**

# Silicon Labs and Quuppa Joint Offering

## Q17 Locator

Q17 is Quuppa's latest addition to the Generation Q product line.

The Q17 boasts a smaller, lighter design with a considerable increase in performance and a variety of other improved hardware components and firmware upgrades. Q17 and Generation Q brings Quuppa, once again to the forefront as the definitive leader in Real-Time Location Services.



## Quuppa Positioning Engine (QPE)

The Quuppa Positioning Engine (QPE) is the heart and soul of the system. It receives data from the Locators, runs it through advanced positioning algorithms and offers a standard JSON / REST - push / pull API that enables seamless integration with other systems. The QPE can be run locally or as a cloud-based platform.



## Who is Quuppa and what they do?

- Spin off from Nokia with 15 years of AoA experience
- Perceived market leader for accurate indoor tracking (can be used outdoor as well)
- Provides ready-to-install AoA infrastructure and position engine and ecosystem partners
- [www.quuppa.com](http://www.quuppa.com)

## Silicon Labs partnership

- Any Bluetooth enabled EFR32 can be tracked by Quuppa locators and position engine



works with  
BY SILICON LABS

SEPTEMBER 9-10, 2020 | Virtual

<https://workswith.silabs.com>

## Thank You | Questions

Any query, please contact us or email to [Kevin.Niu@silabs.com](mailto:Kevin.Niu@silabs.com)

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