Turning Sensors into Edge Devices: Enabling Advanced Distributed Data and Control in Resource Constrained Devices.

Jim Katsandres

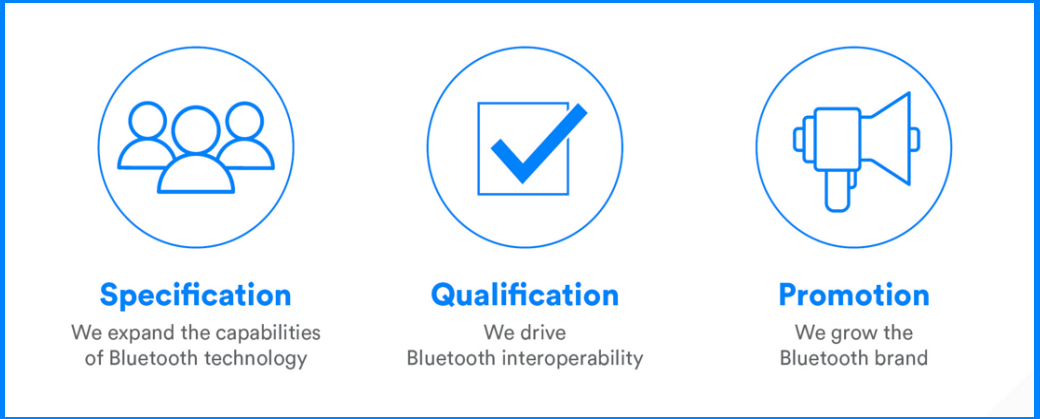
Director, Developer Relations | Bluetooth SIG

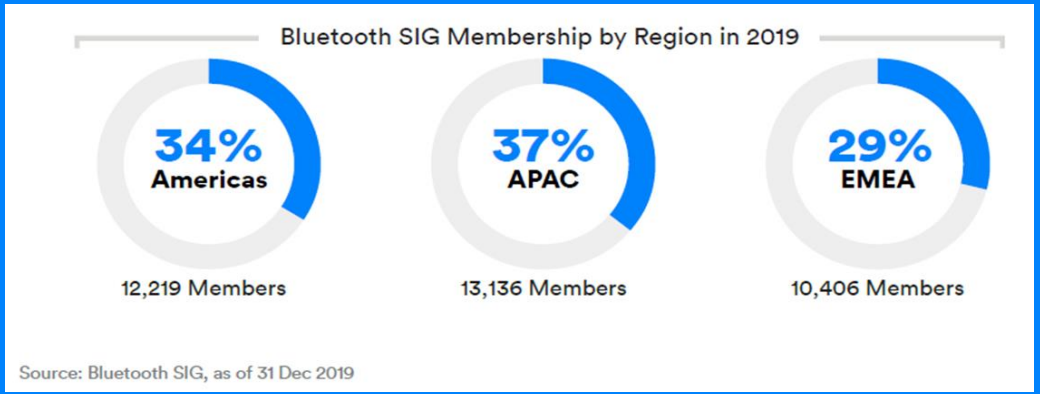
Bluetooth SIG

Standards organization for Bluetooth® technology

Today **11+ million** Bluetooth® devices ship each day

17 million a day by 2024





Bluetooth® is a Solution Oriented Technology

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 Evolving Wireless Sensor

For same low power, you can now get:

- 4x Range to over a Kilometer

  www.bluetooth.com/Range
- 2 x Speed up to 2 Mbps
- 8x Advertising Payload Capacity (beacons)
  - Utilize data channel
- More performance → current battery or
  Same performance → smaller battery

Bluetooth® Equipped Drones

- Example: Pierce Aerospace
  - Continuous Bluetooth connection = **2.1 km**.
  - Broadcast ID using Bluetooth technology = **3 km**
- Collision Avoidance
- Remote Data Reading from Assets
- **www.bluetooth.com/range for more information on range of Bluetooth® technology**

ABB Ability - condition monitoring & predictive maintenance

Equipped or retrofit external smart sensors and variable speed drive (VSD)

Predictive health and maintenance for low voltage motors

Remote inspection, monitoring and optimization

Optimize performance and load

Scheduled versus un-scheduled downtime

Unplanned downtime reduced by up to 70%, motor lifetime extended up to 30%, energy efficiency improved by up to 10%.

Bosch - supply chain, quality management

BOSCH
Invented for life

Bosch IoT Cloud and Transport Data Logger solution

Bosch environmental sensors on each transport package

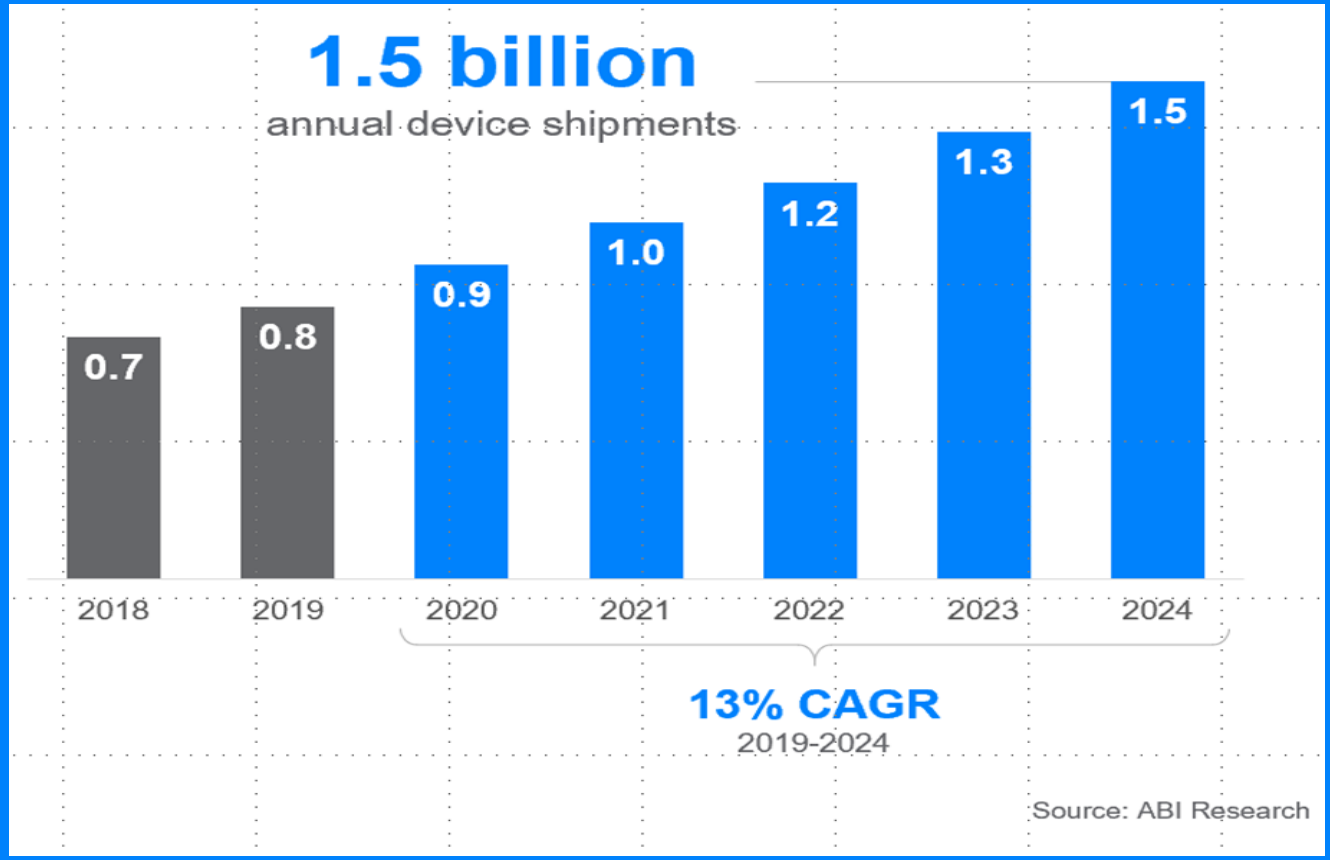
Continuous transport documentation for regulatory compliance

Systematic inspection of incoming goods

Improved complaints management

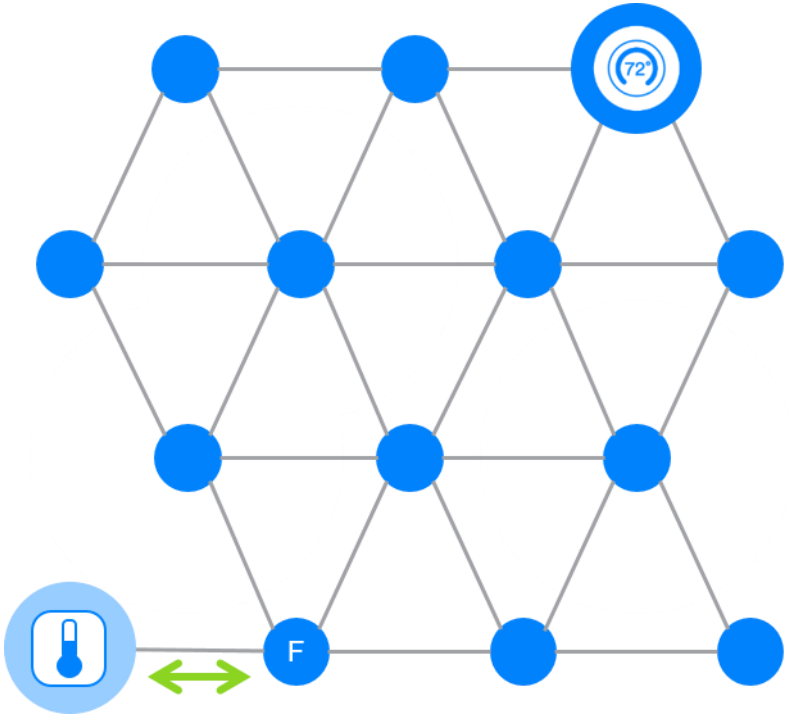
Real-time transparency of the supply chain for transport and risk management

Data Transfer - Latest Advancements and Trends



Device and Sensor Networks

Bluetooth® mesh: industrial grade solution



- Nodes communicate directly
- No hubs or routers
- No single points of failure
- Node failures does not impact delivery
- Low power nodes find friends

Bluetooth® Device Mesh Networks

Most Advanced mesh Network

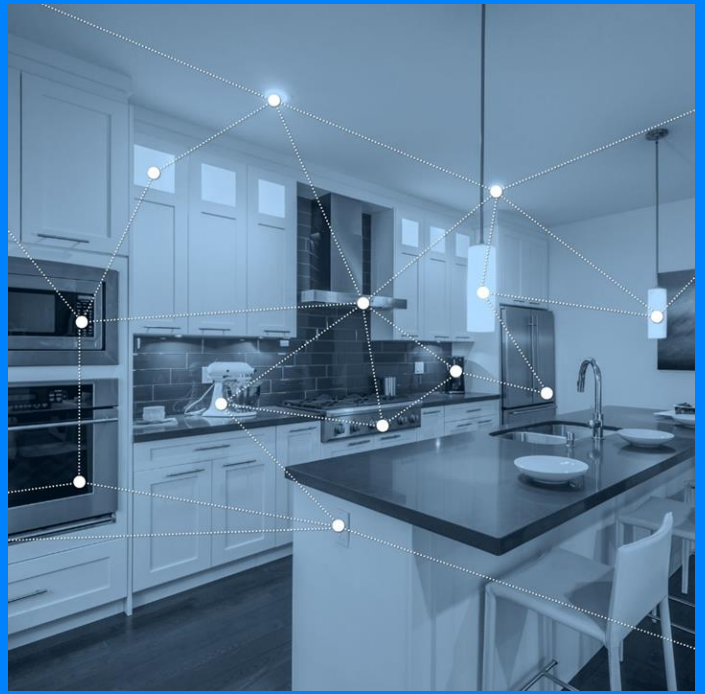
Features, interoperability, security and no single point of failure

“Models” = interoperability

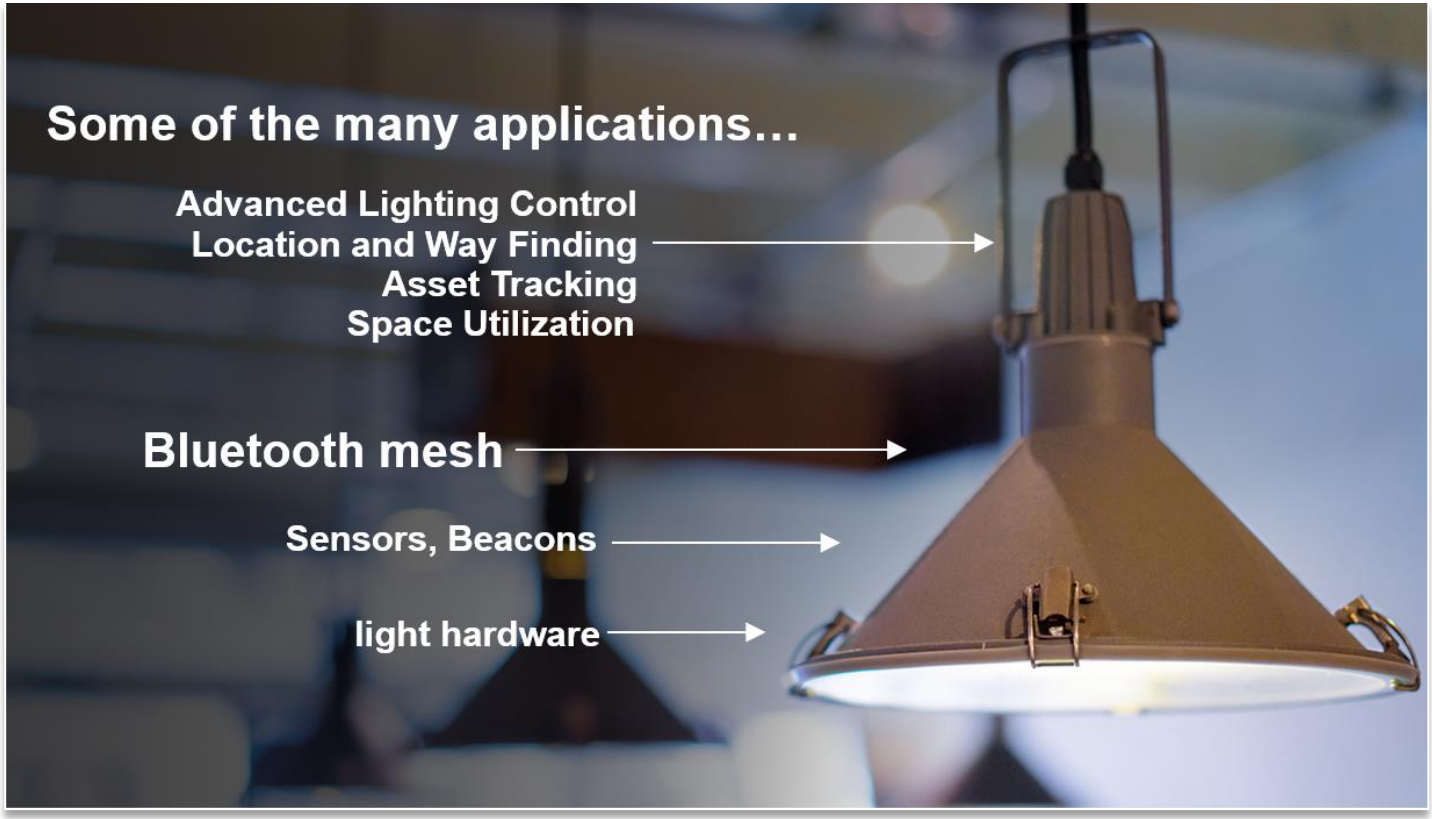
Advanced Lighting control, Sensor networks, Generic and more coming

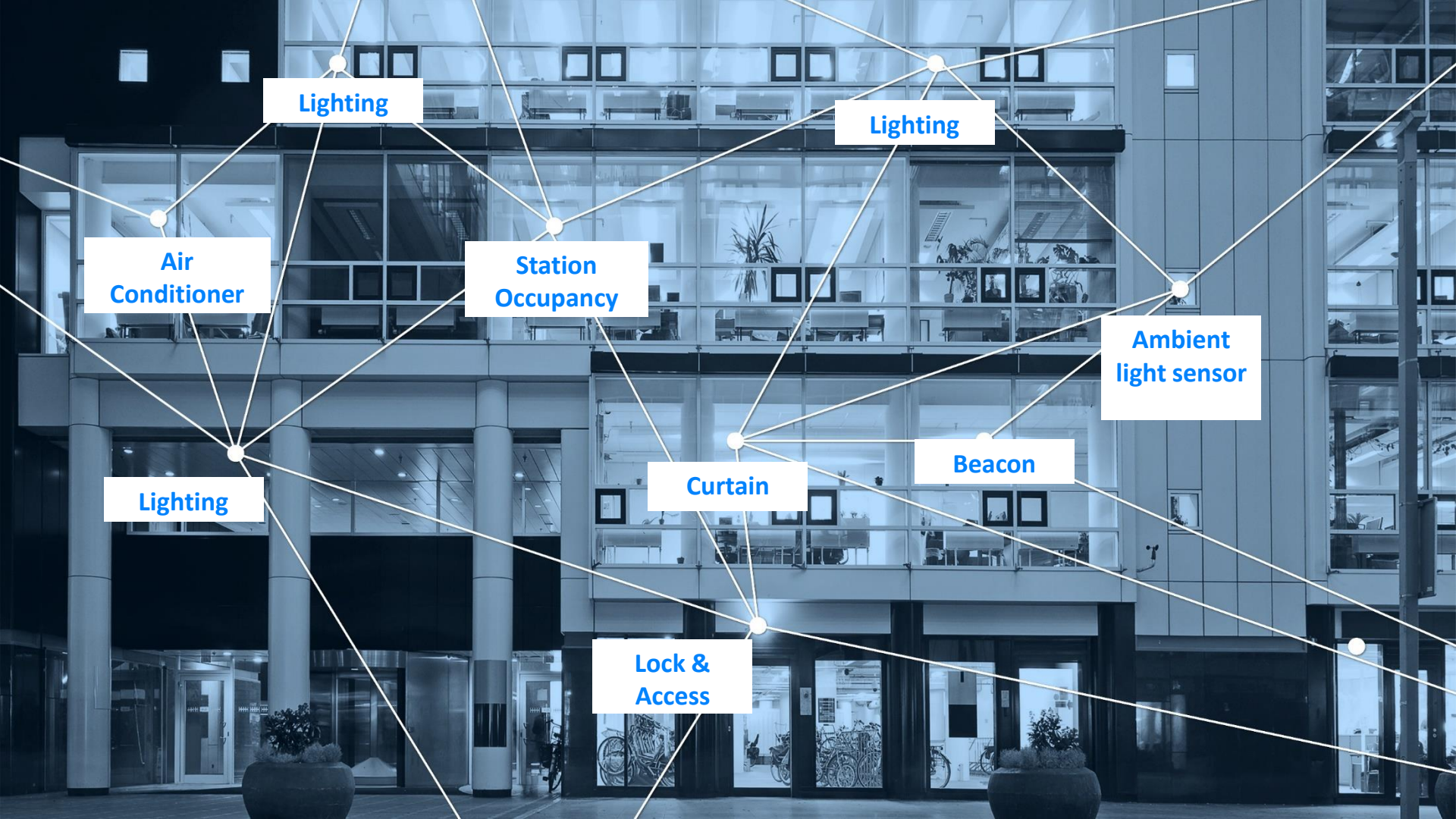
Platform for Additional Value

Platform as a Service, asset tracking, way finding, monitoring and control, many others

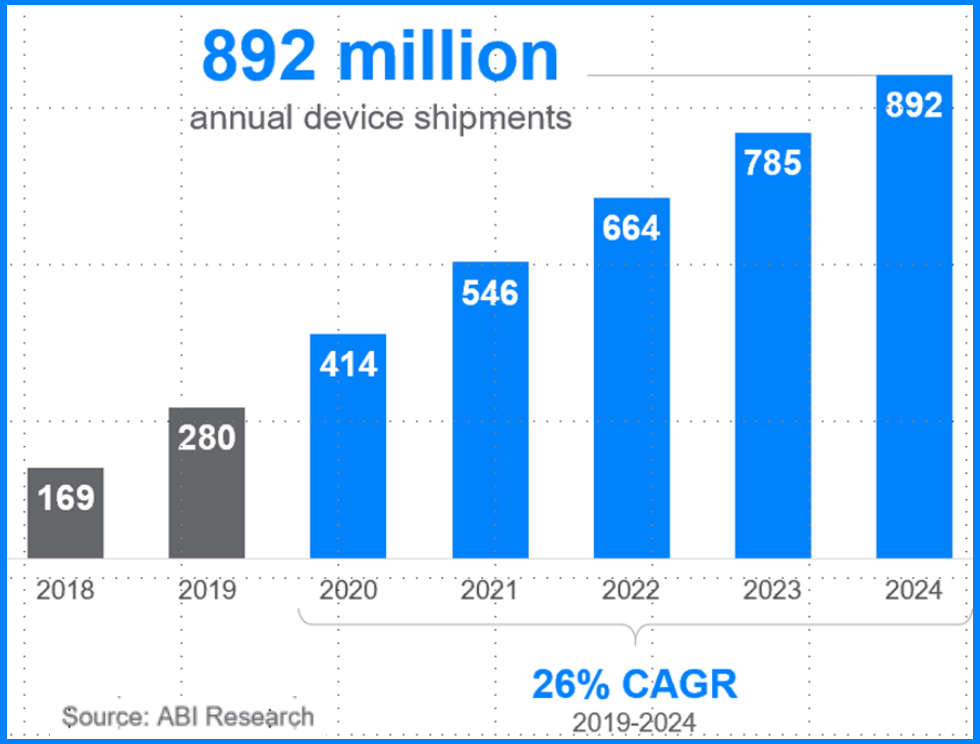


Bluetooth® Enabled Devices as a Platform




Lighting
Lighting
Air Conditioner
Station Occupancy
Ambient light sensor
Beacon
Lighting
Curtain
Lock & Access

Bluetooth® Device Mesh Networks Growth

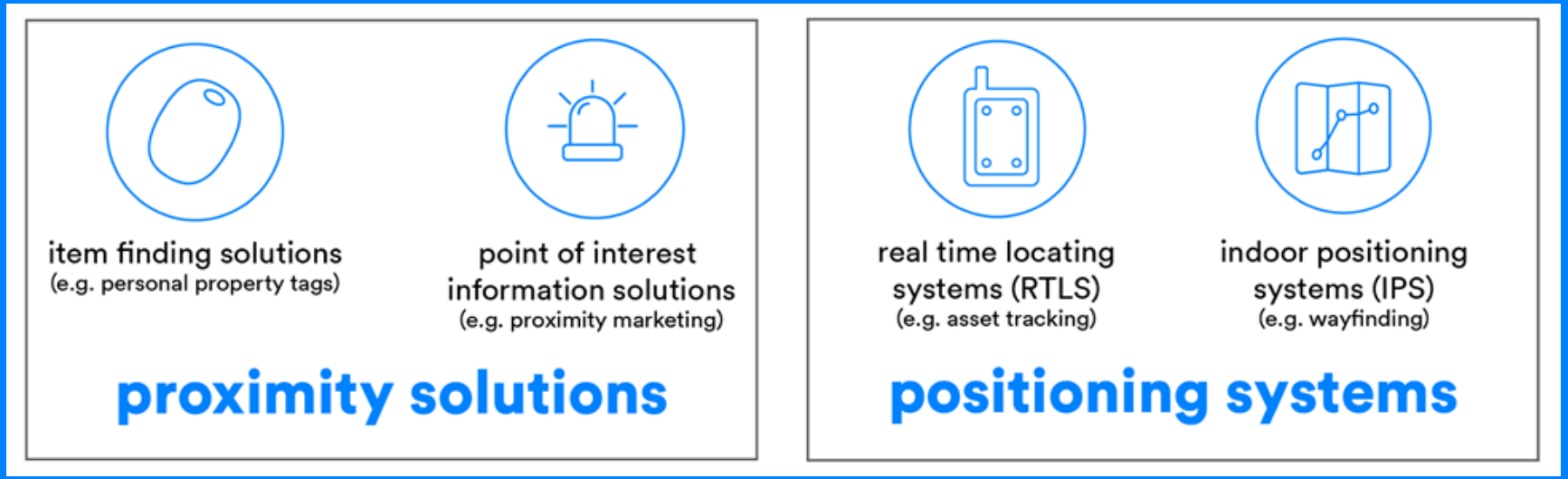


Large growth driven by strong adoption in **China**

Thousands of Nodes can participate in a Bluetooth mesh network

Location Services

Location Services



Bluetooth® Technology Advancements

First Generation

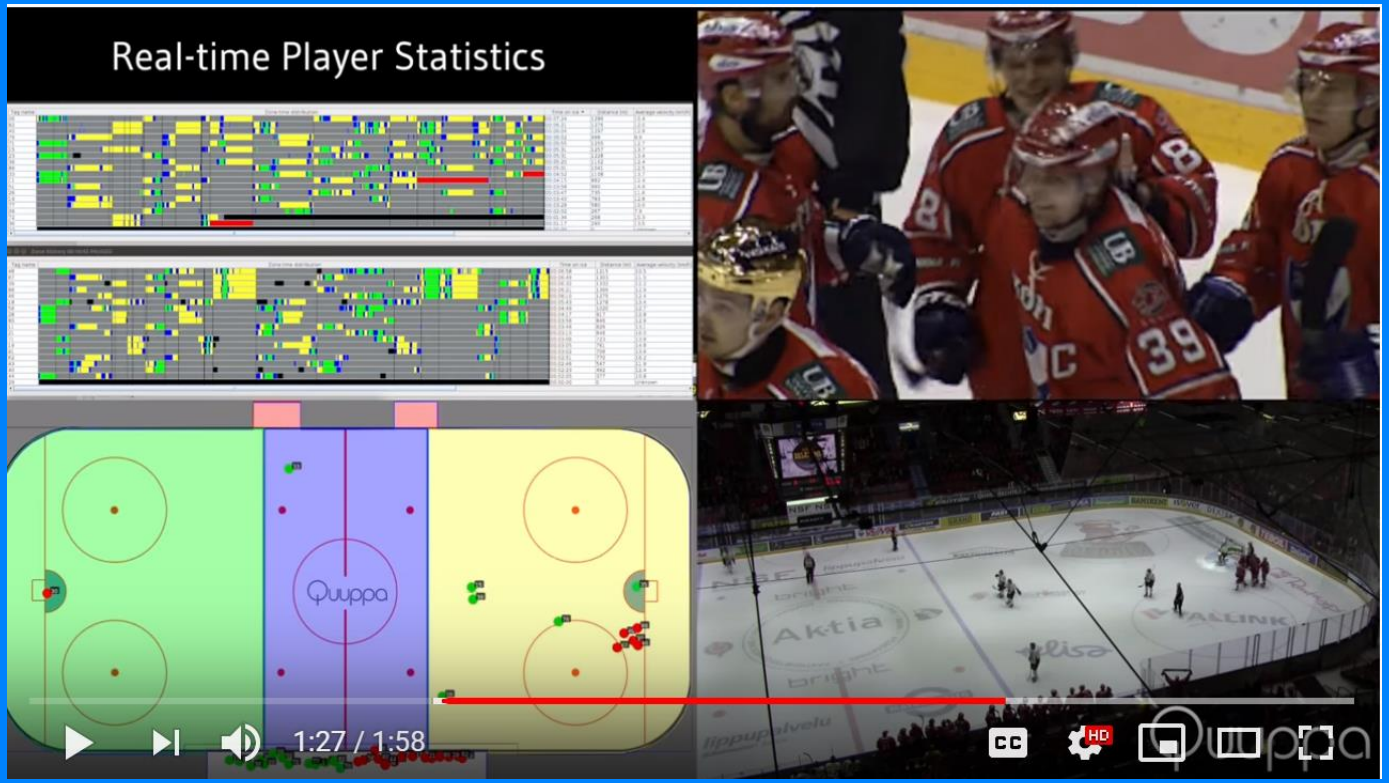
METER level accuracy

Based on Bluetooth® RSSI and trilateration

Latest Generation

CENTIMETER level accuracy

Using Direction Finding Angle of Arrival (AoA) and Departure (AoD)



www.quuppa.com www.wisehockey.com

Battery-Free Bluetooth® Tags – Connect Everything…

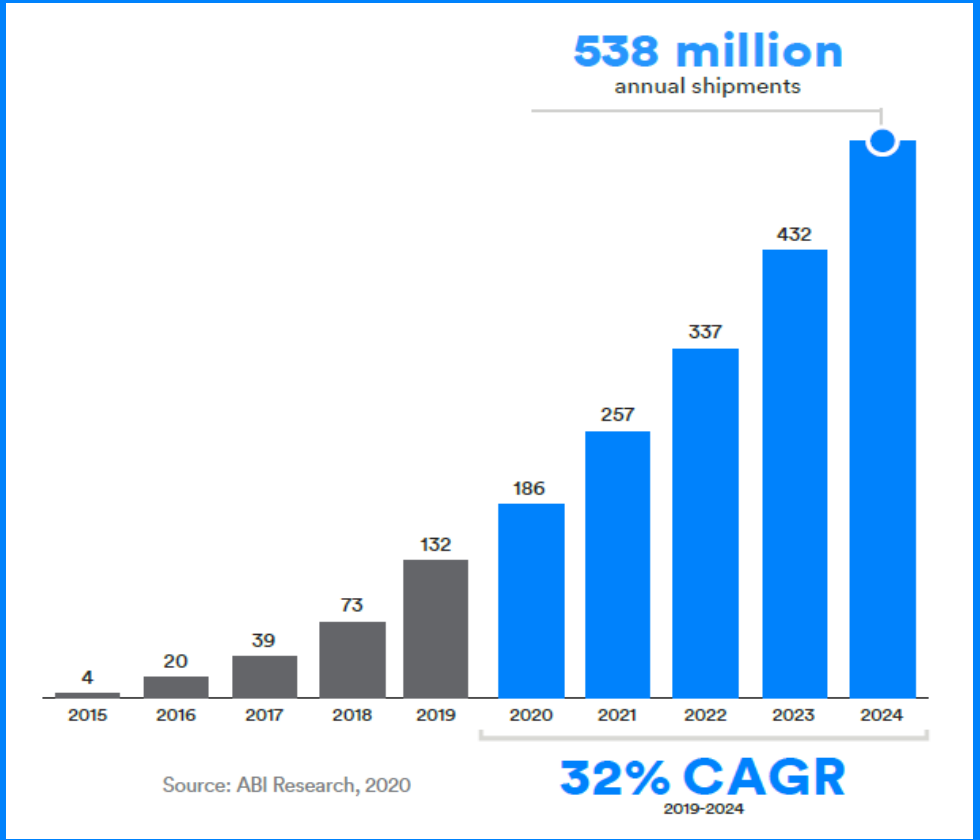
Industry Leading Technology

Bluetooth® based Location Devices

538 Million ship annually by 2024

4x Growth annual shipments by 2024

Demand is now much higher than these numbers due to demand for Bluetooth solutions for combating Covid-19



Audio and Sensors

Location Audio Sharing

Public TVs

Multi-Language

Assistive Listening

Bluetooth® is a ***Worldwide Standard*** Solution Technology

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Applications Spanning Bluetooth Solution Areas

Thank You!

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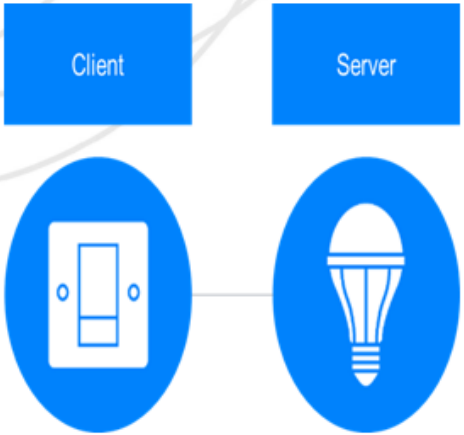
Web: www.bluetooth.com

Key to Application interoperability is Bluetooth® mesh **Models** and **Profiles**



Key Component to Interoperability

Defines node functionality by defining states, messages, state transitions and behaviors

Client / Server / Control types

-servers have “state”
-clients talk with servers finite state machines
-“Control” models contain both Client & Server parts

Can turn things on / off

send commands
send status

Behavior and Feedback Control Loops

- Light dimming
- Temperature control
- Sensor monitoring
- Many use cases