



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



Specification

We expand the capabilities
of Bluetooth technology



Qualification

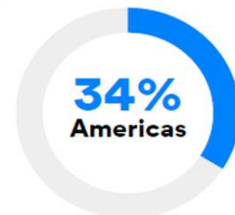
We drive
Bluetooth interoperability



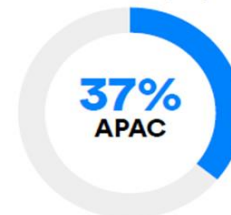
Promotion

We grow the
Bluetooth brand

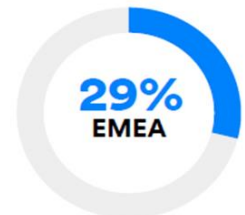
Bluetooth SIG Membership by Region in 2019



12,219 Members



13,136 Members



10,406 Members

Source: Bluetooth SIG, as of 31 Dec 2019

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

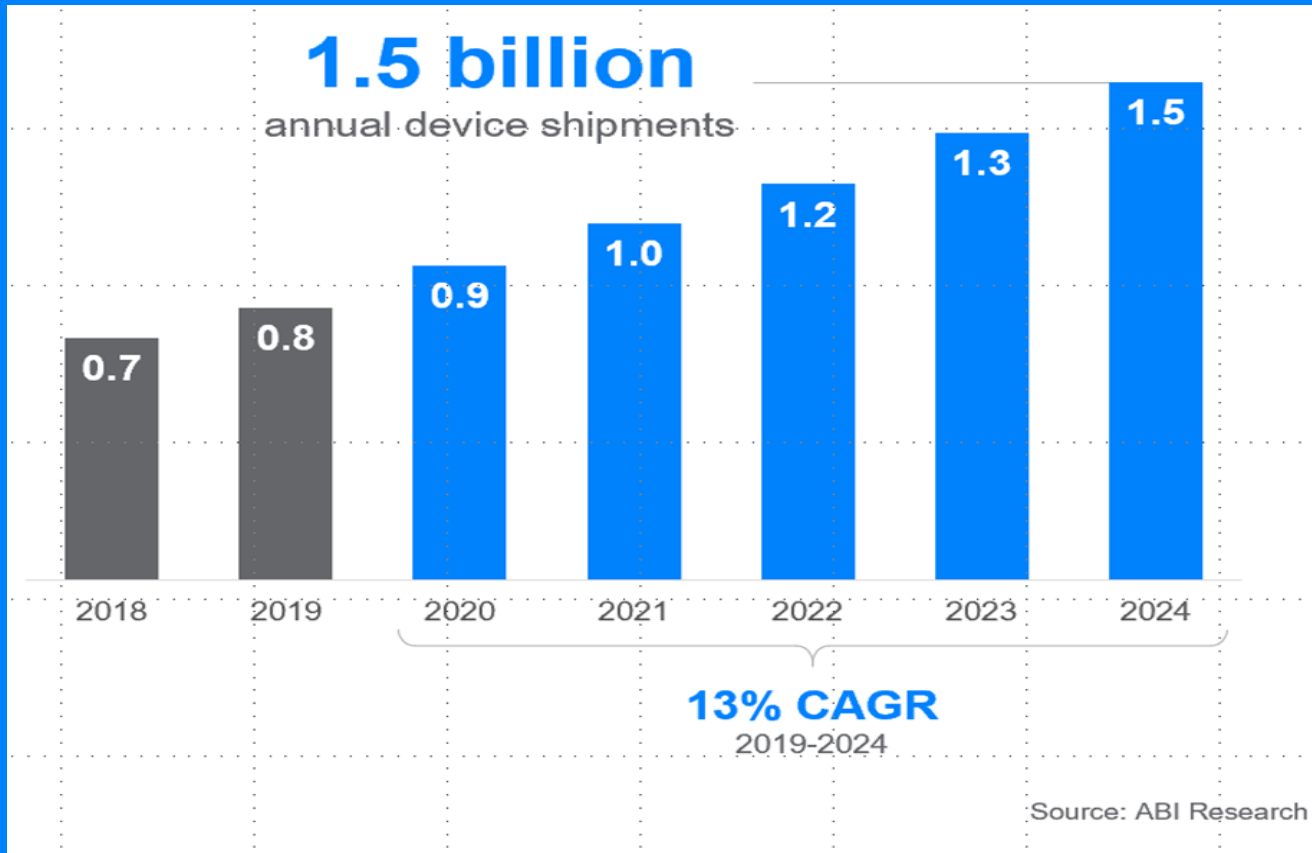
Continuous transport documentation for regulatory compliance

Systematic inspection of incoming goods

Improved complaints management

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

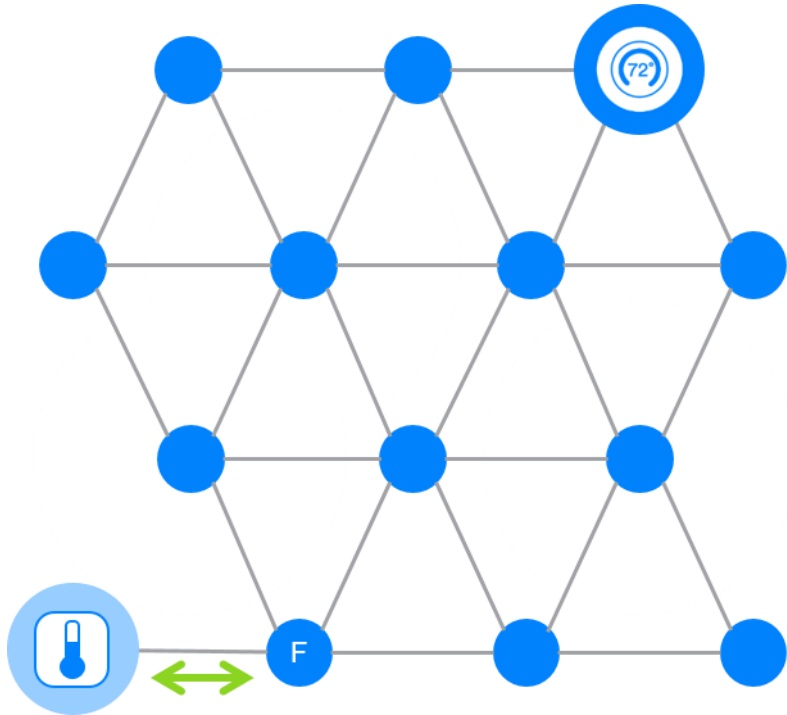
Data Transfer - Latest Advancements and Trends



The background is a solid blue color with several geometric shapes. A large, light blue triangle is positioned on the left side, pointing towards the center. On the right side, there are two smaller, darker blue triangles pointing towards the center, one above the other. The text is centered in the middle of the slide.

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

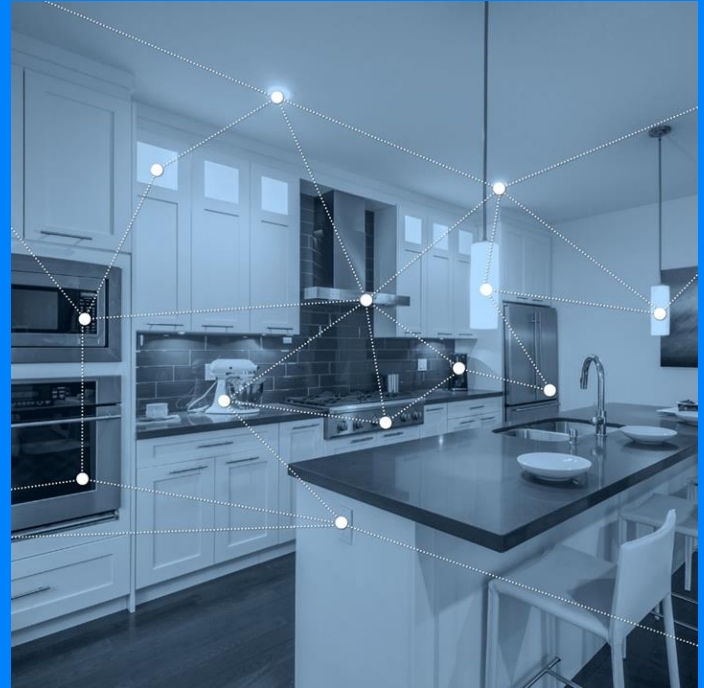
Features, interoperability, security and no single point of failure

“Models” = interoperability

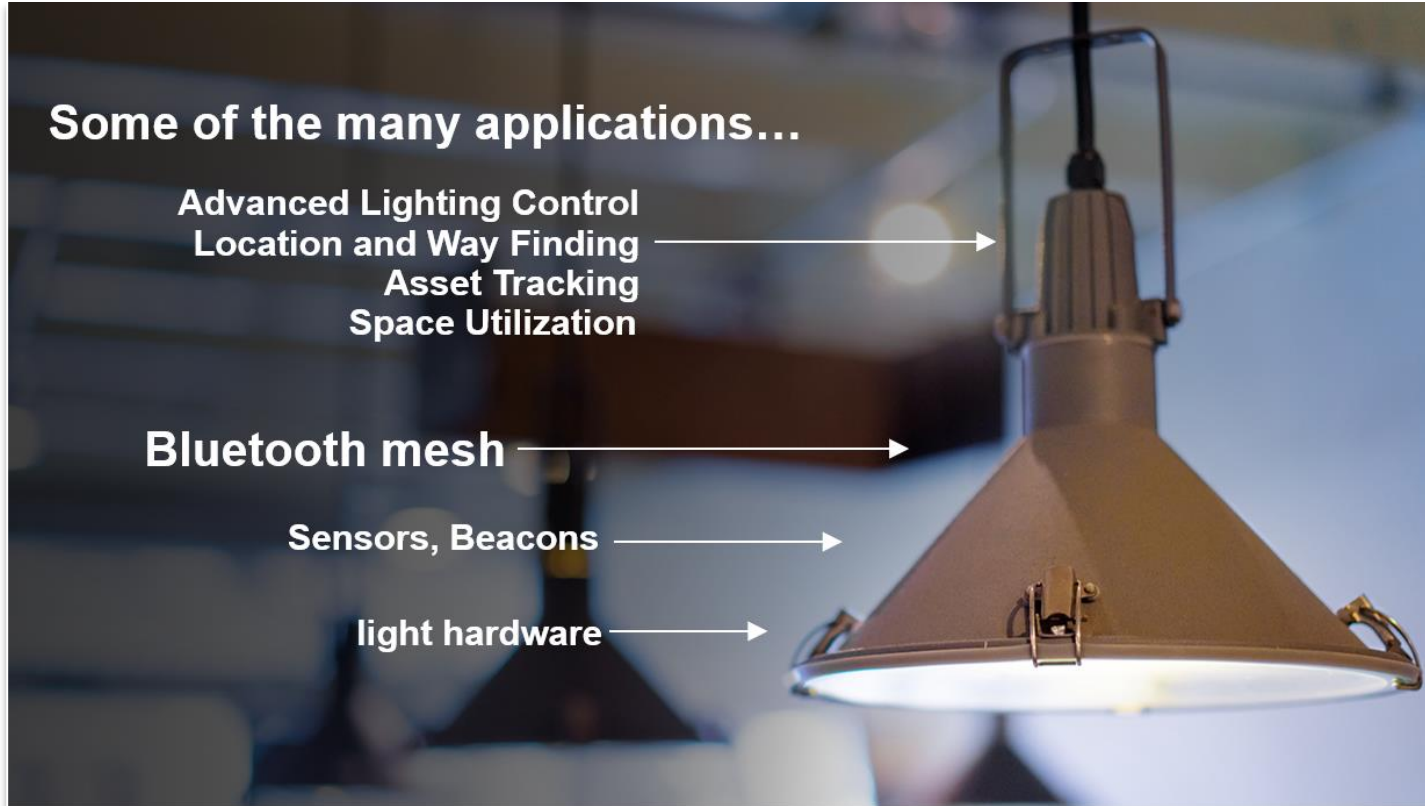
Advanced Lighting control, Sensor networks, Generic and more coming

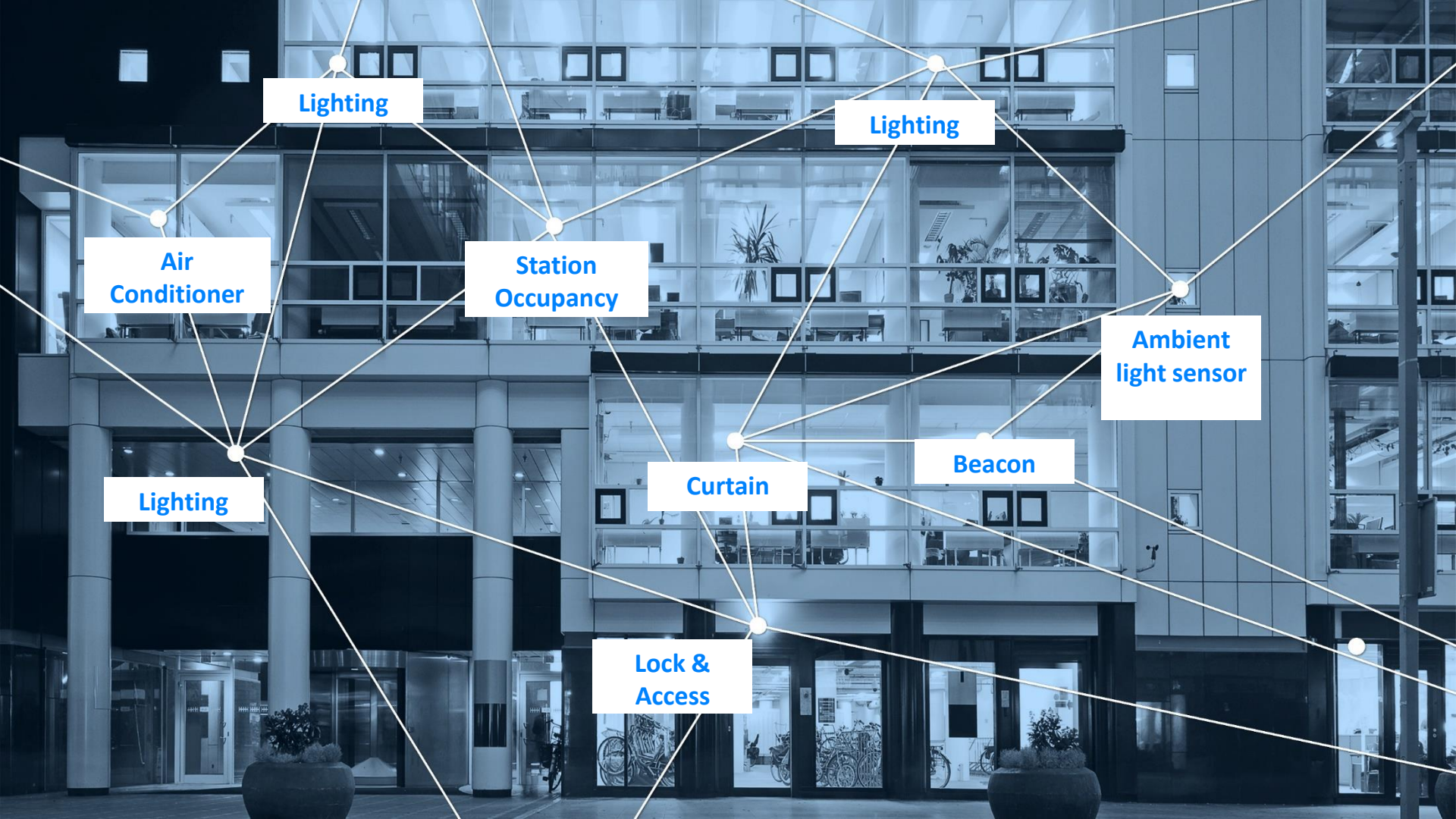
Platform for Additional Value

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**

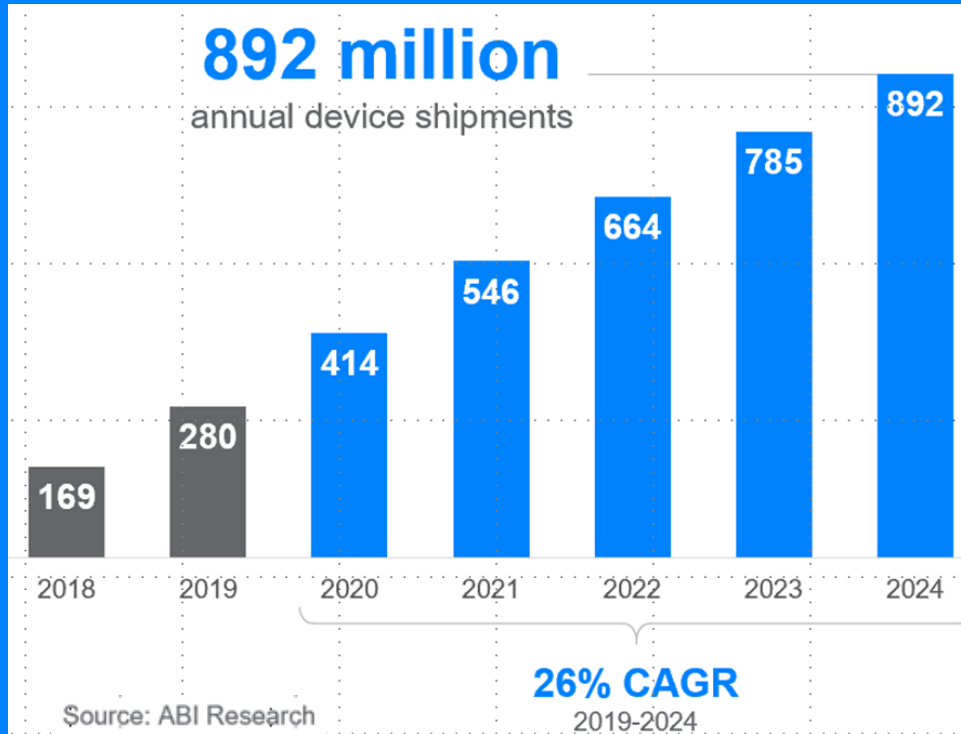
Lighting

Curtain

Beacon

**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

The background is a solid blue color with several geometric shapes. A large, light blue triangle is positioned on the left side, pointing towards the center. A smaller, darker blue triangle is located in the bottom right corner. The text 'Location Services' is centered in the middle of the image in a white, sans-serif font.

Location Services

Location Services



item finding solutions
(e.g. personal property tags)



point of interest
information solutions
(e.g. proximity marketing)

proximity solutions



real time locating
systems (RTLS)
(e.g. asset tracking)



indoor positioning
systems (IPS)
(e.g. wayfinding)

positioning systems

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)



Real-time Player Statistics

The interface displays two tables of real-time player statistics. The top table shows player names, jersey numbers, and various performance metrics. The bottom table provides a similar overview. Below the tables is a color-coded ice rink diagram with player positions marked by colored dots. The rink is divided into three zones: green for the left side, purple for the center, and yellow for the right side. The word 'Quuppa' is visible in the center zone. A video player interface at the bottom shows a progress bar at 1:27 / 1:58 and standard playback controls.

The right side of the interface features two video feeds. The top feed is a close-up of several players in red jerseys, with one player prominently displaying the number 39 and a captain's 'C' on his chest. The bottom feed is a wide-angle view of the ice rink during a game, showing players in action and various advertisements on the boards and ice, including 'Aktia', 'bright', and 'ALLINK'. A video player interface at the bottom shows a progress bar and standard playback controls.

www.quuppa.com

www.wisehockey.com

Battery-Free Bluetooth® Tags – Connect Everything...



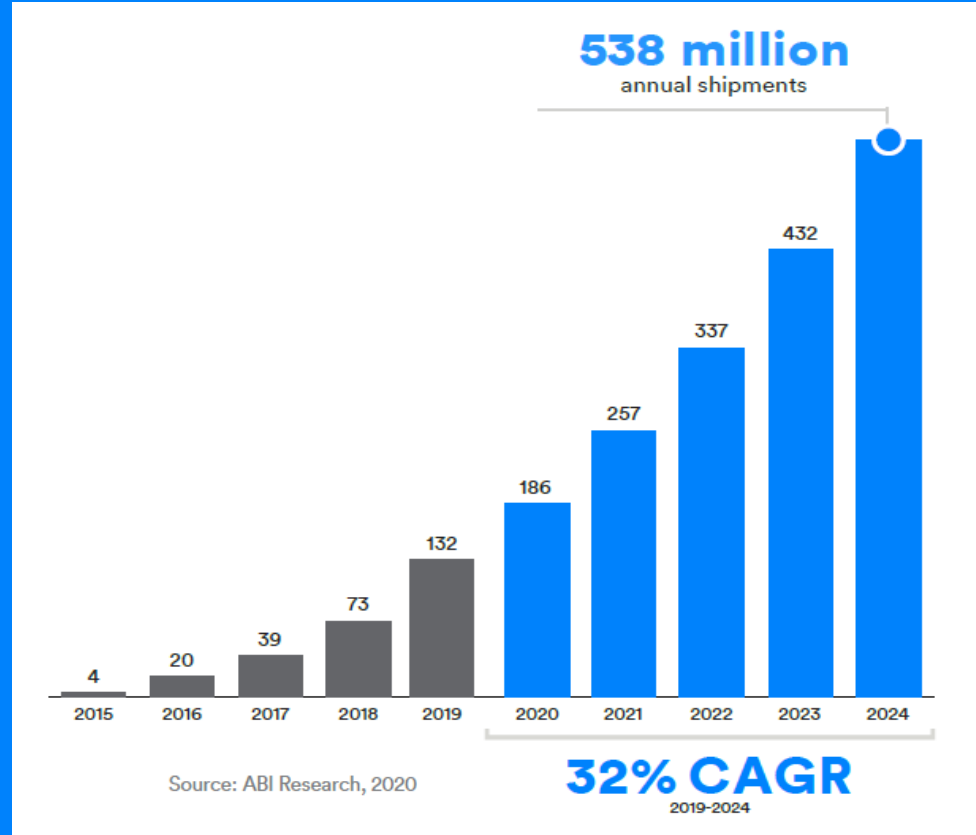
Industry Leading Technology

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

audio streaming



wireless headsets
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sports & fitness devices
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location services



point of interest
navigation &
wayfinding
item & asset tracking

device networks



control systems
monitoring systems
automation systems

Applications Spanning Bluetooth Solution Areas



Thank You!

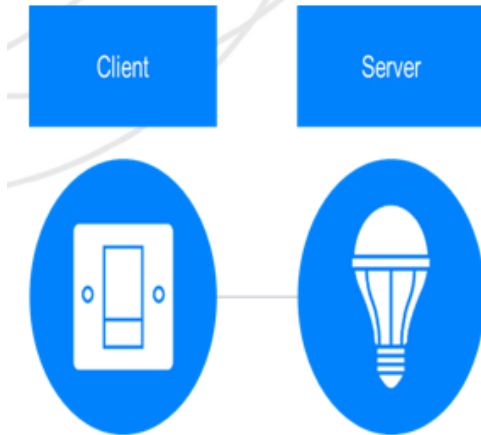


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Key to Application interoperability is Bluetooth® mesh **Models and Profiles**

Key Component to Interoperability



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

Can turn things on / off
send commands
send status

Client / Server / Control types

- servers have “state”
- clients talk with servers

finite state machines

- “Control” models contain both
Client & Server parts

Behavior and Feedback Control Loops

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

