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BT-201

Features and Benefits of The New *Bluetooth*® Mesh Standard

Mikko Savolainen | August 22nd, 2023

Agenda

Features and Benefits of The New *Bluetooth*® Mesh Standard

01 Bluetooth mesh Market & Drivers

02 Upcoming Bluetooth Mesh Feature Enhancements

03 Silicon Labs Portfolio for Bluetooth mesh

04 Bluetooth mesh DFU demo

05 Summary and Q&A

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Bluetooth® mesh
Markets & Drivers

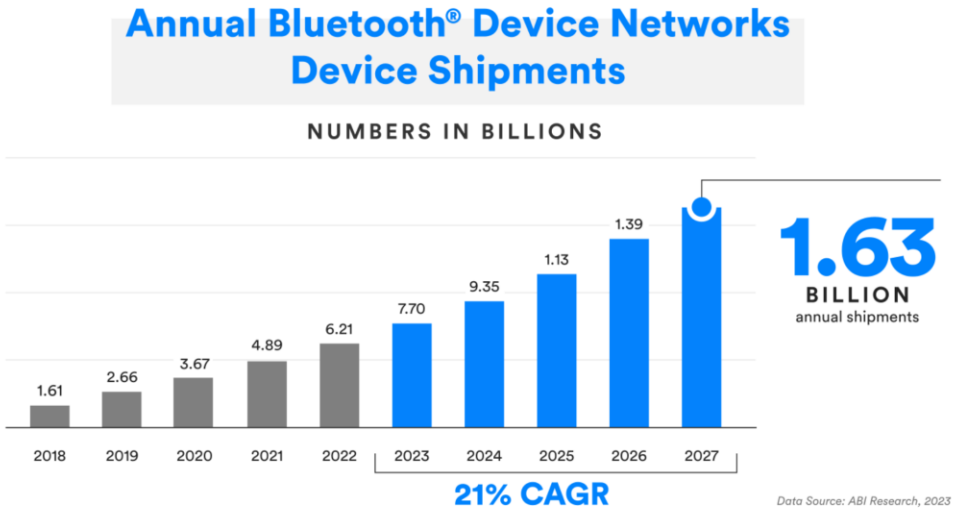
Bluetooth® mesh – Target Markets & Use Cases

WIRELESS LIGHTING CONTROL

- Commercial
- Residential
- Street lighting

SMART HOME & BUILDING AUTOMATION

- HVAC
- Sensors



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The Drivers for Smart Networked Lighting Control

BEING SMART

Energy Savings

40% of a building's energy budget is lighting; save 30%+ in costs using sensor-driven control.

Boost Productivity and Wellness

Color temperature and brightness tuning to create more comfortable space

Regulation

Must use occupancy and daylighting sensors in states like California, US (Title 24)

NO WIRES REQUIRED

Simplified Installation

Avoids cabling for switches & sensors, app/app-less provisioning speeds up deployment and reconfiguration

Value Added Services

Deploy location services for convenience, asset tracking; collect data for preventive maintenance; sensor data for better space utilization and lighting plans

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Bluetooth® Mesh – The Advantages

Smart Phone Connectivity

Easy commissioning & maintenance with apps

Optional Gateway

Scenes and schedules built-in into nodes

Gateways are difficult to build and maintain

Scalability and Security

From few to thousands of nodes

Built-in two-layer security and privacy

Extendibility and Flexibility

Easy to add nodes, partition based on space, reconfigure based on user preference

Value Added Service

Bluetooth enabled luminaires can be used for location services

People counting and occupancy mapping

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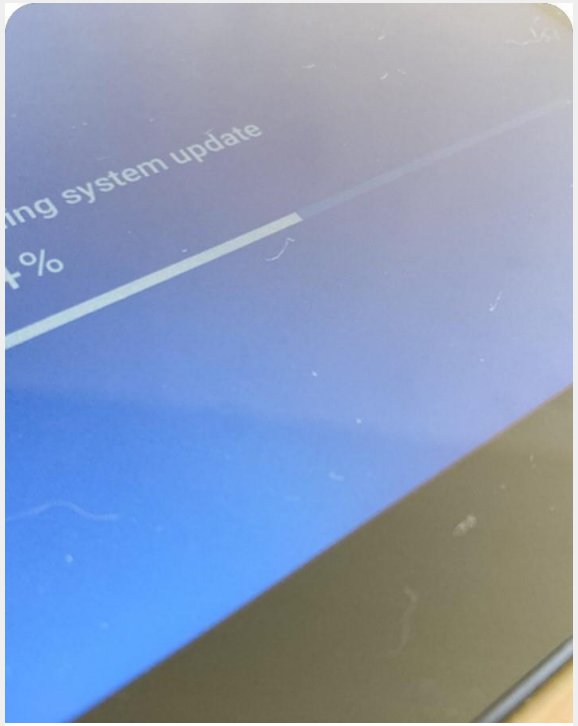
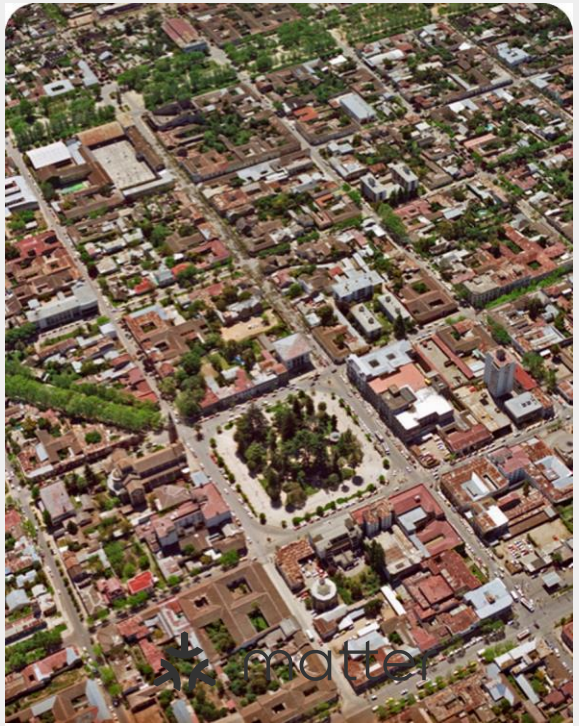
Benefits of New Bluetooth® Mesh Features

Benefits of New Bluetooth® Mesh Features



SIMPLIFIED NETWORK UPGRADE

- Automatic check for new firmware, and installing it
- Standardize Over-the-Air firmware updates for any vendor
- Simultaneous update for homogenous devices
- Reduces time, cost, and complexity

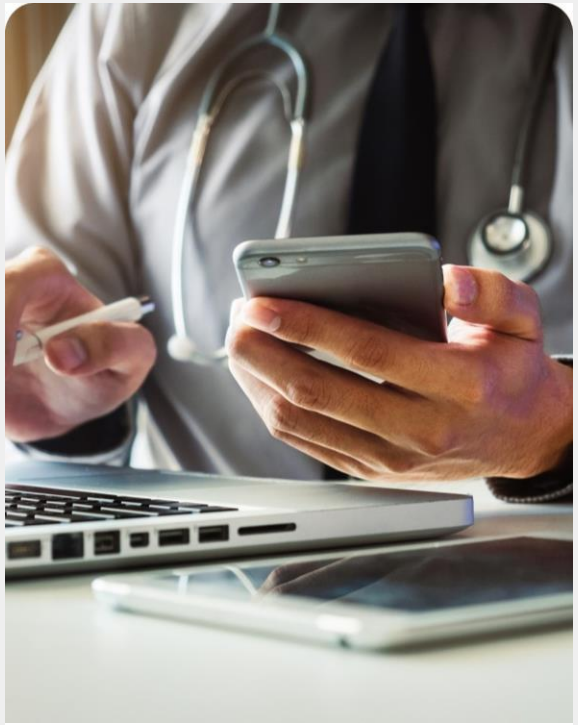


SCALABILITY MADE EASY

- Scalable commissioning in large deployments
- Provisioner NO LONGER needs to be within radio range of device getting provisioned
- Enables faster and simpler network setup

PLUG AND PLAY

- Automatic detection of change in device ownership
- Reset nodes for security and identity purposes in case of change in device ownership
- Eliminates the need to reset, reprovision, and reconfigure



INCREASE NETWORK SECURITY & PRIVACY

- Onboarding authenticated devices
- Certificates to authenticate devices before provisioning
- Prevent tracking of devices within Network

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Upcoming Bluetooth® Mesh Feature Enhancements

Device Firmware Update (DFU)

Initiator

The initiator identifies available firmware updates for a given list of nodes.

The initiator typically runs on a device which supports both Bluetooth mesh and TCP/IP such as a **smartphone** or **gateway** and periodically checks manufacturers' websites for new firmware releases.

Having identified relevant updates, it acquires them and sends the new firmware images to a distributor node.

Distributor

The distributor receives new firmware images from an initiator and is responsible for sending them to appropriate nodes in the network.

The distributor is typically a physically separate device to the initiator so that the initiator does not need to be in range of the network during the entire process.

Updating node

Updating node is the name given to a node which can receive a firmware image from a distributor and install it.

Stand-alone updater

A stand-alone updater fulfils the role of a combined initiator and distributor, acquiring firmware updates and sending them directly to updating nodes without the need for an intermediate distributor.

- The DFU feature of Bluetooth mesh adds a standard way to update the firmware on the network's nodes
- Its functionality includes:
  - Checking the availability of firmware updates
  - Acquiring the binary images
  - Distribution of the firmware
  - Updating selected nodes
  - Coordinated firmware update
- The DFU feature uses a multicast firmware distribution (BLOB transfer) capability enabling single firmware image to be distributed to multiple devices in one go
- DFU substantially reduces the manual effort required to keep the network up-to-date

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Remote Provisioning (RPR)

- With first release of Bluetooth mesh, each node to be provisioned needed to be in the range of provisioner
- Bluetooth mesh will soon introduce Remote Provisioning that provisions and configure the network through a proxy node, eliminating the requirement to be within radio range of provisioner
- RPR features:
  - Multi-hop Device Provisioning
    - Enables provisioning of nodes through mesh network
    - Reduces installation time and cost for large networks
  - Plug and Play
    - Detect changes to physical composition, and subsequent mesh composition state
    - RPR procedures will update the active composition data state to reflect changes
    - Avoids reset, reprovisioning, and reconfiguring the device
- RPR enables faster and simpler network setup

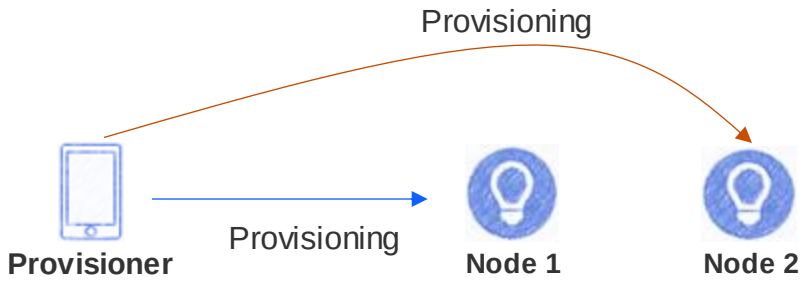

Fig 1: Without Remote Provisioning

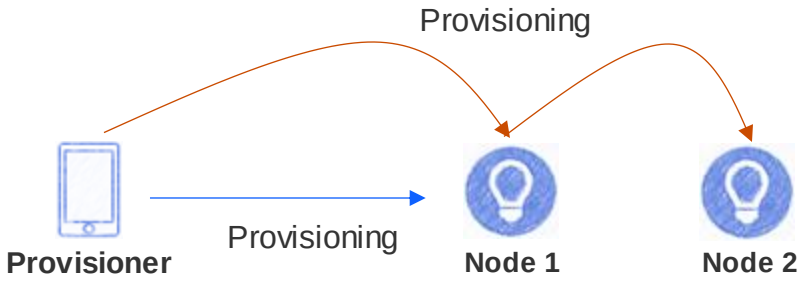

Fig 2: With Remote Provisioning

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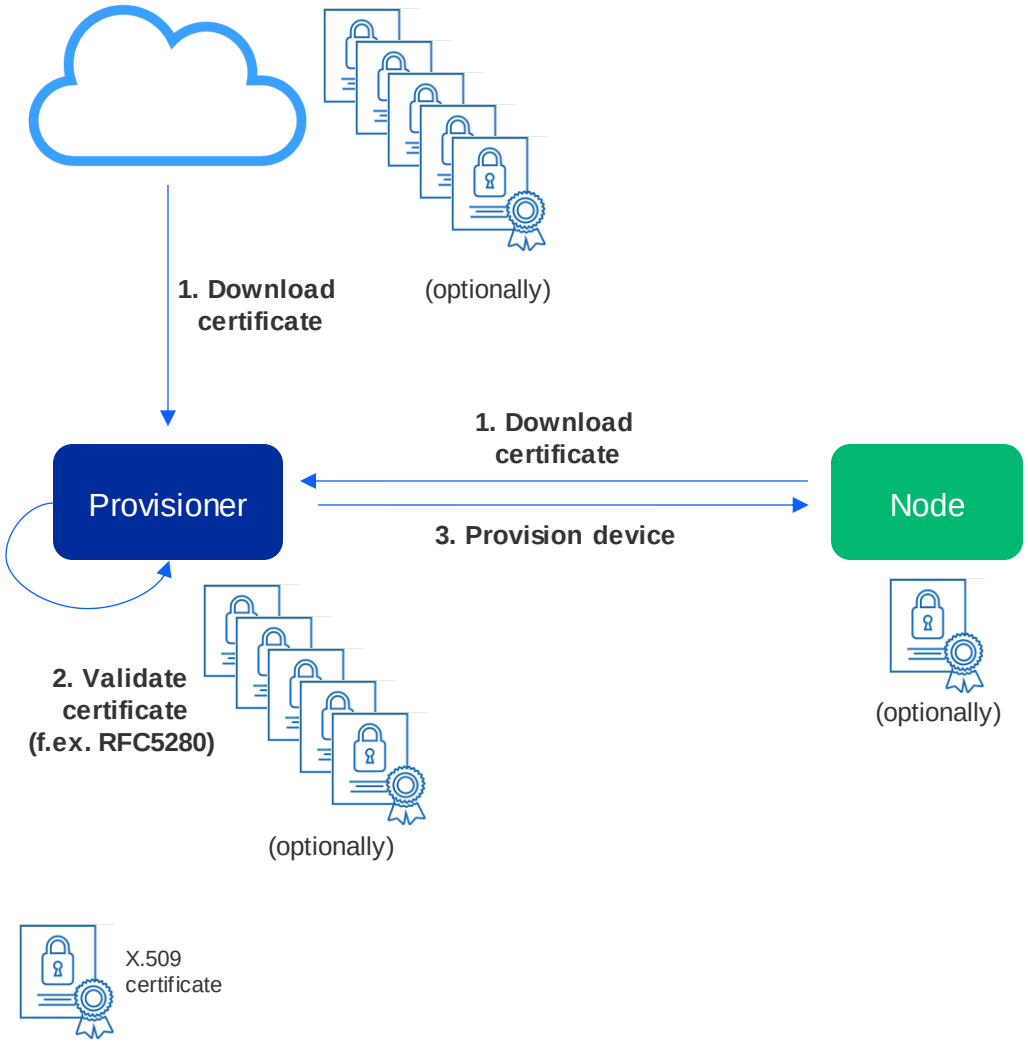
Certificate Based Provisioning (CBP)

- Provisioning enables a device to be part of a network by providing it network and application security keys
- The new Certificate Based Provisioning feature introduces a new method that uses certificates during provisioning to authenticate devices being added to the network
- X.509 certificates:
  - Contains node's public key and UUID
  - Signed by CA or device vendor
  - Stored in a cloud, provisioner or mesh network nodes
- Nodes
  - Have a unique private key matching to the public key in the x.509 certificate
    - Should be stored in a secure storage – not on flash
- Certificate based provisioning provides:
  - Superior authentication scheme
  - Enables bulk commissioning especially when combined with RPR



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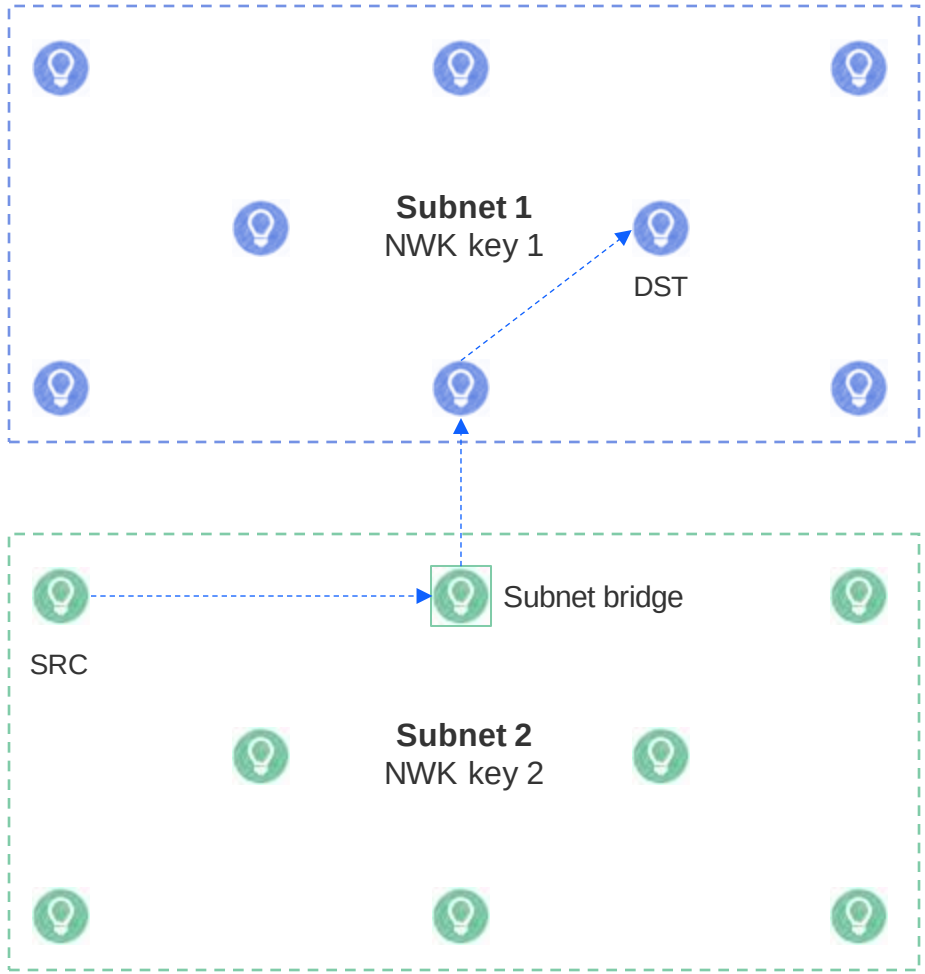
Subnet Bridging

- In Bluetooth mesh 1.0, subnets were completely isolated from each other
- Bluetooth mesh 1.1 standard addresses this challenge with subnet bridging
  - Allows communication between devices in different subnets
  - Subnet bridges relay traffic between different subnets
  - Bridge nodes must be selected by the network planner
- Subnet bridges have bridging tables
  - Contain both NWK keys
  - Contain device addresses in both networks
  - Contain information to which direction the traffic can flow



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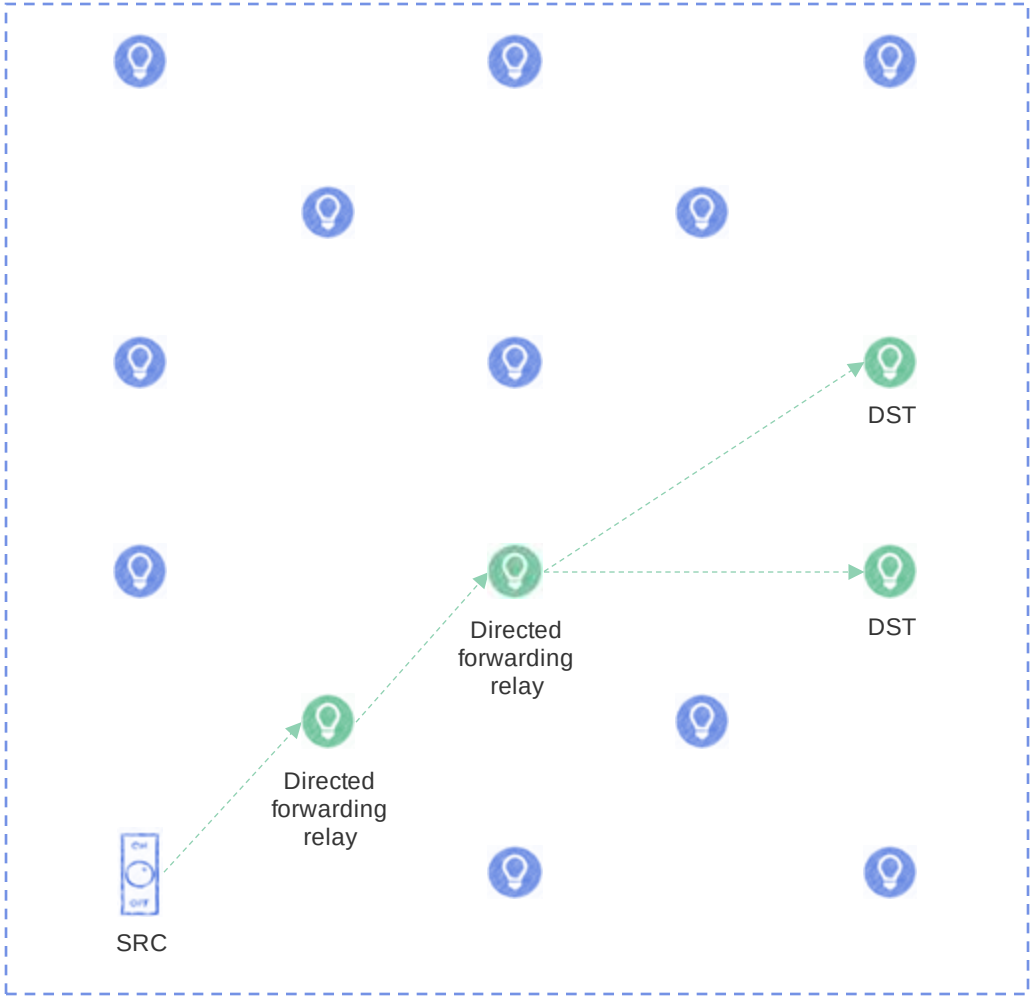
Directed Forwarding

- Bluetooth mesh 1.0 introduced *managed flooding* that made multiple paths available for a message to reach destinations
  - Managed flooding is an effective, reliable and a low maintenance method to deliver messages
  - Under certain configurations, managed flooding resulted in an inefficient path of travel for messages
- A new Bluetooth mesh feature introduces directed forwarding feature to improve the scalability of the network
  - Adds Directed Forwarding Node types
  - Directed forwarding configuration models
  - Paths and lanes for optimized message delivery
  - Methods to create, maintain and validate paths and lanes
- Complex feature best covered in a separate presentation



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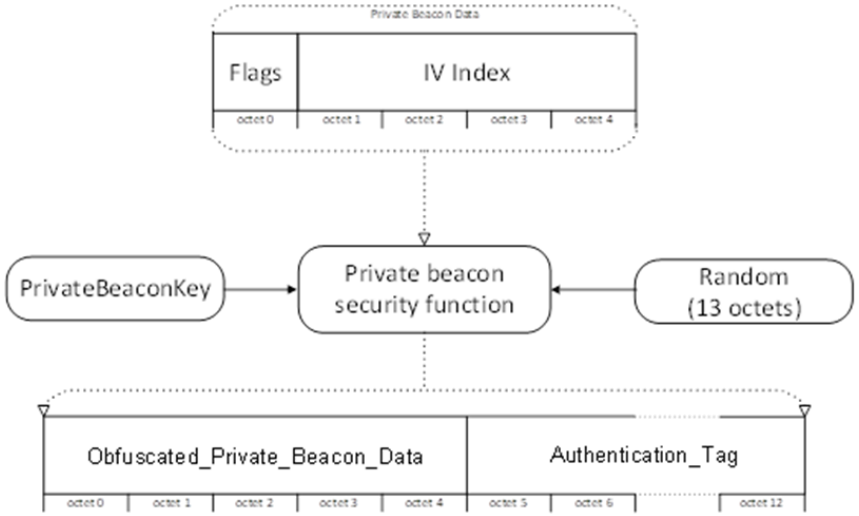
Private Beacons



- Nodes in a Bluetooth mesh network can act as beacons, and transmit static information about device data, location or point of interest information
- Unencrypted static information poses privacy risks by allowing tracking of:
  - Network itself
  - Devices in a network
  - Users of those devices
- The Private Beacons feature encrypts static information to prevent privacy risks during beaconing
  - Data is encrypted using *PrivateBeaconKey*, derived from main network key, and a random 13 octet number
  - Random number, and Bluetooth device address changes periodically to ensure obfuscated data changes
  - Information can only be decrypted by nodes that are part of the network
- Private beaconing ensures devices, or users of those devices in a network cannot be tracked using static information contained in a beacon message

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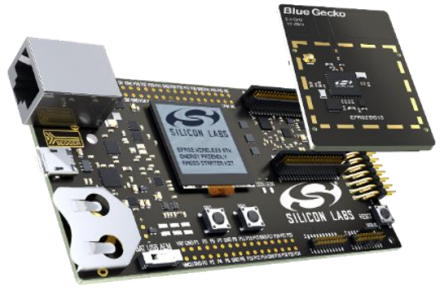
Silicon Labs Portfolio for Bluetooth® Mesh

A Complete Solution for Mesh Network Development

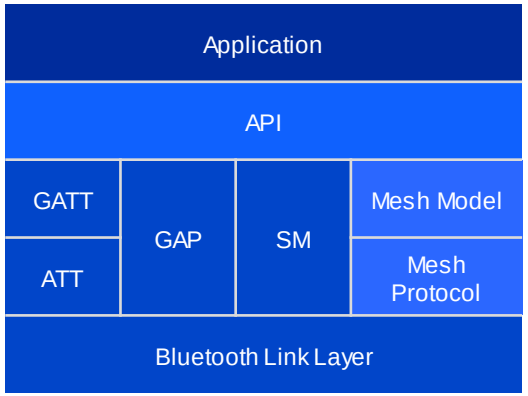


SOC, MODULES, DEV KITS

Multiple physical interfaces to support advanced development and debugging

UART, Ethernet, USB

LCD, LED, buttons



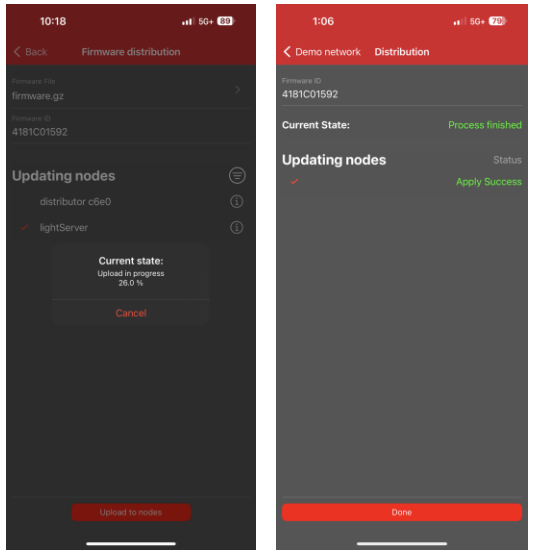
STACK SOFTWARE

In-house developed & maintained stack

Bluetooth mesh v1.1 ready

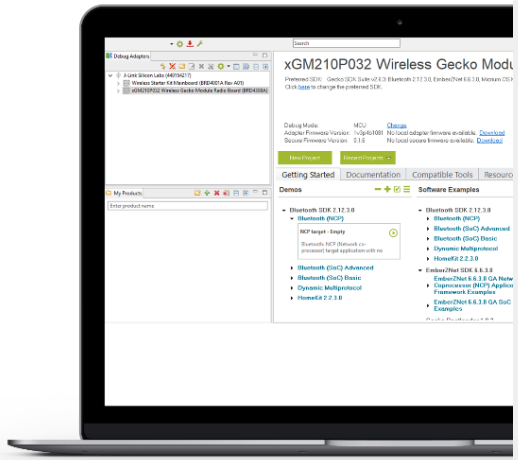
Comprehensive support for features and bearers

All security features supported



MOBILE APPLICATIONS

Bluetooth mesh ADK and reference applications and source code for iOS and Android



DEVELOPMENT TOOLS

Simplicity Studio with sample apps

Mesh configurator

Network analyzer

Energy Profiler

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The Portfolio of SoCs and Modules

Increasing Features

BG22 SoC

BGM220S SiP & PCB Modules

Industry-leading energy efficient SoC

- SoC, PCB Module and SIP
- Bluetooth mesh LPNs
- Remote provisioning (512 kB parts)
- Certificate based provisioning (512 kB parts)
- DFU - Updating node only (512 kB parts)

BG27 SoC

Optimized for Bluetooth mesh and Bluetooth LE applications for connected health

- Supports button cells
- DCDC Buck and Boost
- Coulomb counting
- Small form factor WLCSP
- Relay, Proxy
- Remote provisioning
- Certificate based provisioning
- DFU – Updating node only

BG21 SoC

BGM210L Module

High performance RF for Gateway applications

- Highest output power in Industry
- Line-powered devices
- Secure Vault High
- Relay, Friend, Proxy, Friend
- Remote provisioning
- Certificate based provisioning
- All DFU features (1024 kB parts)

BG24 SoC

BGM240S SiP & PCB Modules

Feature rich device with Highest integration

- Largest Flash/RAM
- High I/O pin count
- AI/ML hardware accelerator
- Secure Vault High
- Relay, Friend, Proxy
- Remote provisioning
- Certificate based provisioning
- All DFU features

Increasing Flash/RAM

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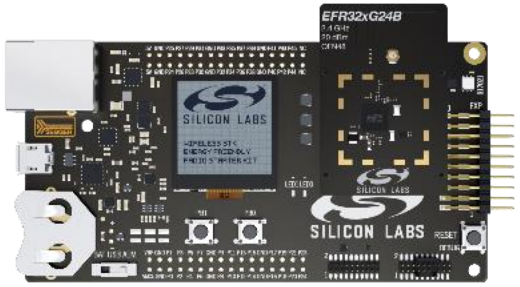
Getting Started with EFR32BG24 and EFR32MG24 SoCs

Part Number	Description
xG24-DK2601B	xG24 2.4 GHz +10 dev board

- **Dev Kit**
  - Most affordable development board
  - On-board debugger
  - Signal breakouts
  - On-board sensors
  - 20-bit ADC
  - AI/ML Accelerator
  - Impressive out-of-box demos
- **Contents**
  - 1 x dev board



Part Number	Description
xG24-PK4186C	xG24 2.4 GHz +10 dBm Pro Kit
xG24-PK4187C	xG24 2.4 GHz +20 dBm Pro Kit

- **Pro kits**
  - Packet Trace capabilities
  - Ethernet for large network test
  - RF measurements
  - Energy profiling
  - External device debug
- **Contents**
  - 1 x WSTK main board
  - 1 x radio board
  - (2)AA battery holder
  - Mini-simplicity cable

Part Number	Description
xG24-RB4186C	xG24 2.4 GHz +10 dBm Radio Board
xG24-RB4187C	xG24 2.4 GHz +20 dBm Radio Board
xG24-RB4188A	xG24 +20 dBm Antenna Diversity Board

- **Radio Board kits**
  - Uses existing WSTK boards
  - Uses existing software tools
  - Reference design and design files
- **Contents**
  - 1 x radio board

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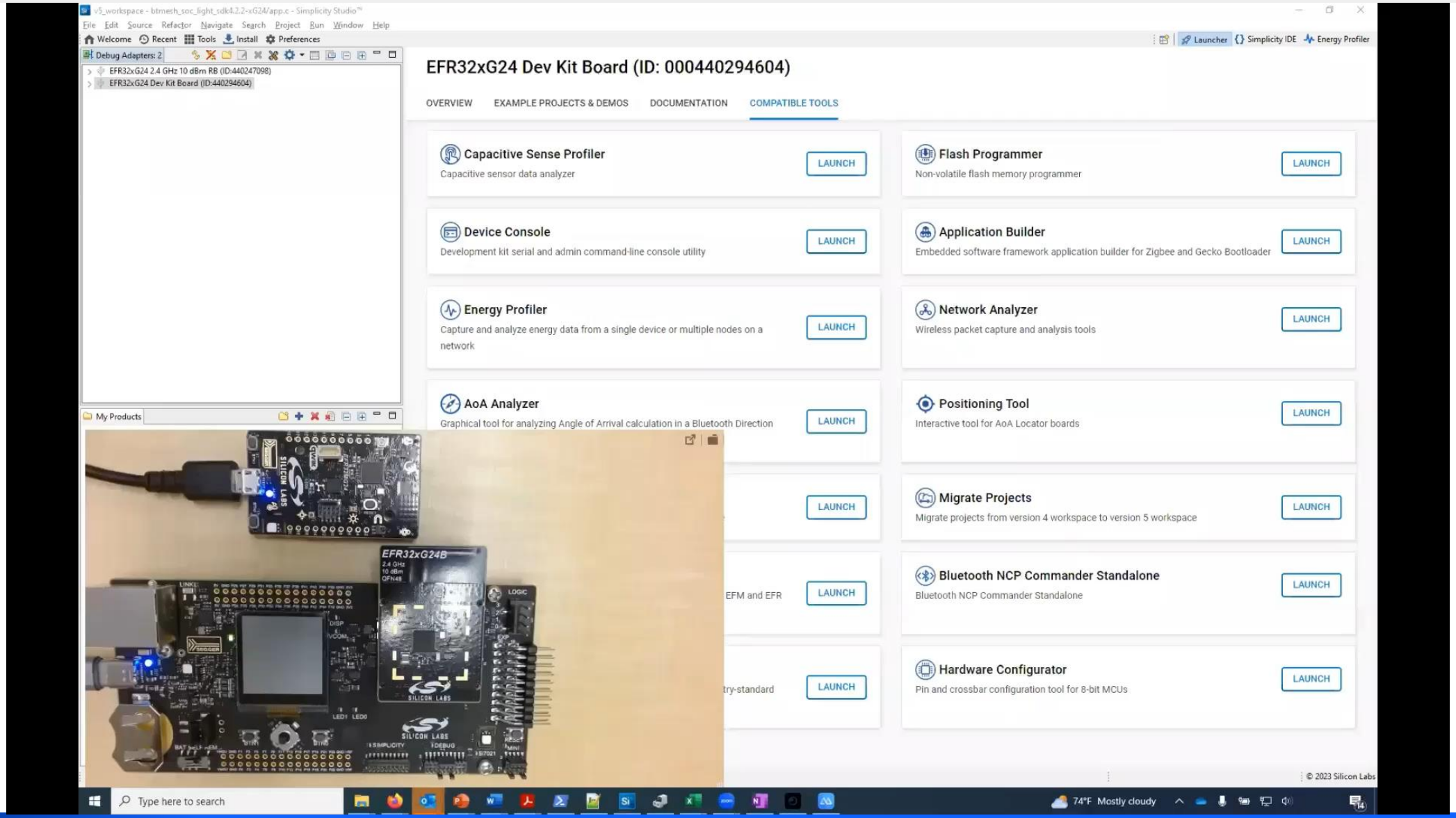
Bluetooth® Mesh DFU Demo

Bluetooth® Mesh DFU Demo



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Summary | Q&A