

Q&A for Tech Talk Topic: Bluetooth Mesh

Q: Can all of the recording links just be posted in one place for everyone?

A: All of the previous Tech Talk presentations and videos are available at <https://www.silabs.com/support/training>

Q: Just a suggestion: all our employers are cutting back, including on dev kits. On the other hand, we engineers have much greater discretion in how we use our time. It would be helpful to have no-cost dev kits available.

A: We have an upcoming webinar where attendees will receive a free BG22 Thunderboard to work through the virtual labs. If interested, you can register here: <https://www.silabs.com/about-us/events/virtual-bluetooth-workshop>

Q: What is a proven BT mesh network size which works reliably?

A: There has been some performance modeling with networks up to 1000 nodes, but these are only simulations. We have real-world testing and performance results with a network of up to 240 nodes. See our AN1137: <https://www.silabs.com/documents/public/application-notes/an1137-bluetooth-mesh-network-performance.pdf>

Q: What products are available that support IPSP (IPv6 over BLE) in a mesh? Where can I find application notes for integrating?

A: This is not supported today.

Q: How is BT mesh different from Zigbee or Thread? In which scenarios I should choose BT Mesh vs. Zigbee or Thread?

A: Bluetooth mesh gives you the convenience of native smartphone connectivity without a gateway, and can also add location services capability using BLE beacons. Otherwise each technology has its own advantages. It can be a complicated topic, but you might be interested in the short overview provided here: <https://www.silabs.com/whitepapers/selecting-the-appropriate-wireless-mesh-network-technology> and here:

<https://www.silabs.com/products/wireless/learning-center/bluetooth/bluetooth-mesh>

Q: Does SiLabs provide a BT Mesh commissioning app? Is it available in source code?

A: Yes we have a commissioning app for both Android and iOS and the source code is available in our GitHub page: <https://github.com/SiliconLabs>

Q: The application for Bluetooth Mesh that keeps being discussed is for lighting. How does it perform vs. other mesh technologies like Zigbee or OpenThread?

A: Fundamentally, BT mesh uses managed flooding instead of the routing techniques used in Zigbee and OpenThread. In some ways this makes BT mesh more flexible, but also potentially less efficient. Both protocols have a good application layer for lighting. A comparison of the performance of these three protocols is explained in our AN1142:

<https://www.silabs.com/documents/public/application-notes/an1142-mesh-network-performance-comparison.pdf>.

You might also enjoy reading this whitepaper: <https://www.silabs.com/whitepapers/selecting-the-appropriate-wireless-mesh-network-technology>

Q: Will BT mesh routers be able to work from batteries for a long time?

A: Any mesh network requires the routing/relay nodes to be in "always-on" receive mode in order to efficiently receive and repeat messages. While it's possible to operate a router node on batteries, the battery life would be short if using a small battery. In the end it depends on your goal for battery life and the size of the battery.

Q: What technology is recommended for lighting apps, 15.4 based or BLE Mesh based?

A: We support both and don't advocate for one over the other, since each has their advantages. But BT mesh is clearly built for lighting with its many lighting mesh models (application layer specifications). Ultimately, the best answer probably depends more on the ecosystem that you need your network to work with.

Q: How do you turn on all the lights at the same time with Bluetooth mesh in order to eliminate them starting at random times with a managed flood?

A: Bluetooth mesh uses a delay parameter when sending OnOff control messages, which allows lighting nodes to be synchronized to the on/off state, avoiding the "popcorn" effect.

Q: What determines the topology; which node is connected to which node?

A: BT mesh doesn't use connections, so the network topology depends on which nodes are within listening range of which other nodes. All nodes within listening range will receive a broadcasted message. Whether or not they are repeated depends on the packet management data and whether the receiver node is another relay or an end node.

Q: Are there any statistics on how good the low power node functions in a relatively large mesh when its a relay node, because in relay mode the unit is relatively always on?

A: Just to clarify, a Low Power Node (LPN) is an end node which can go to sleep (drop off the network periodically), and therefore it can't be a Relay node which needs to be always on.

Q: Can a friend node support multiple low power end nodes? If so, what is the limit?

A: Yes a Friend node can support multiple Low Power Nodes. The limitation is only dependent on the RAM allocated for buffering.

Q: What is the BLE mesh 1-hop range?

A: Range of course depends on link budget, which is a combination of factors including TX power, RX sensitivity, and antenna gains. The BG22 has excellent RX sensitivity, but on the other hand the BG21 has a built-in +20dBm PA. So the answer will depend on which devices are in the network. It's probably a reasonable assumption that you can have single-hop range anywhere from 30 to 200 meters.

Q: Is it similar to MQTT on messaging? Does it require a broker?

A: It uses a similar publish/subscribe model, but does not require a broker.

Q: Somewhere Kris mentioned that you have tested your mesh with 240 Devices. Is that correct?

A: Yes, correct. We have measured BT mesh performance with various packet sizes in a real-world 240 node network. You can see the results in AN1137: <https://www.silabs.com/documents/public/application-notes/an1137-bluetooth-mesh-network-performance.pdf>

Q: Is Bluetooth mesh good for a group of portable devices?

A: It's exceptional for this application because the flooding mesh does not need overhead to manage routing tables. Moving nodes can receive messages from anywhere in the mesh as long as there is a relay node in range. By contrast, a routed network with too many moving nodes can become bogged down with overhead messages as it tries to re-optimize the routing tables.

Q: Does the Amazon Echo support Bluetooth mesh?

A: No, the Echo uses Zigbee for local home area networking.

Q: Do you think that future Bluetooth mesh implementations will be "guaranteed" to run on all deployed nodes, vis-a-vis comparable RAM/flash/cycles requirements?

A: The Bluetooth SIG generally does a good job trying to maintain backward compatibility between versions, but there can certainly be no guarantees. Future-proofing with the largest flash/RAM chips can remove some risk but of course is a trade-off with cost.

Q: Can a lighting system implemented using Bluetooth mesh work with Philips lighting systems? What about with DALI or Zigbee?

A: Not without a gateway. The Philips Hue system uses Zigbee, which uses different RF channels and thus they are unable to talk to each other.

Q: Can Bluetooth Mesh relay messages from traditional beacons (not-meshed) to a proxy?

A: Yes, absolutely. A mesh node is capable of receiving BLE beacons, and these can be wrapped in mesh packets to relay across the network.

Q: Comment: 240 nodes is a small setup compared to what others are doing. Some claim up to 1000 nodes or more.

A: BT mesh has the addressing capacity for tens of thousands of nodes, but there is a practical limit to how many nodes can work in a single network due to latency, congestion, etc. It's also highly dependent on the network configuration - for example if there are fewer relay nodes and more endpoints, there is probably less RF traffic. 240 nodes is not a limit, it's just the largest network we have tested so far. Others have modeled larger networks with simulations, but our 240-node testing was done with real hardware.

Q: Can we do an indoor navigation project with BT mesh including augmented reality guidance?

A: Bluetooth 5.1 Angle-of-Arrival technology is more suitable for this type of application.

Q: What is the BT mesh stack flash/RAM size for the BG21?

A: About 340kB of flash and 32kB of RAM for a full-featured node (proxy, relay and friend functionality with most of the lighting mesh models), but some of the features can be turned on/off to impact those figures.

Q: What is the security mechanism for GAP ADV method of mesh?

A: Bluetooth mesh uses multiple layers of security that rely on AES-128 encryption for authentication and privacy, and ECDH for secure provisioning.

Q: Is there is a legacy system working on DALI and Zigbee etc., that can bridge between BT mesh and old technologies?

A: A gateway could do this, but we are not sure if such a product exists in the market yet.

Q: How many nodes and what type of range does BT mesh support?

A: BT mesh allows up to 32k nodes, but the practical limit is likely far less. Range depends on too many factors to give one answer, but could be anywhere from 30-50 meters indoors and 100-200 meters outdoors.

Q: Are there emulation tools available for simulating large node networks without needing all hardware?

A: Silabs does not currently offer this.

Q: How easy/difficult it is to implement a sample Bluetooth mesh model for lighting which Kris mentioned using Silicon Labs chip, firmware and application development kit?

A: We provide out-of-the box examples to implement a lighting demo, so it's very straightforward using the SLWSTK6006A mesh dev kit and following this guide:

<https://www.silabs.com/documents/public/quick-start-guides/qsg148-bluetooth-mesh-demo-quick-start-guide.pdf>

Q: Does the BT mesh support self-healing?

A: The self-healing concept doesn't apply to Bluetooth mesh because it is based on a managed flood network and doesn't need to maintain routing tables.

Q: If I build new BLE Mesh light, should I certify it somehow as a BLE Mesh device?

A: The short answer is yes; all Bluetooth products must be certified with the Bluetooth SIG. Since Silicon Labs does the certifications for our chips and stacks, this simplifies the process for you.

Q: Can the mesh stack on the phone make it a full participant in the mesh, or is it just for control-plane operations? For example, could the phone act as a mesh router?

A: The phone can work as a full participant in the network, sending commands and working as a client or server to send/receive data, but it does not have any relaying ability.

Q: How can I set up the network (using network retransmission, relays with retransmission) to achieve 100% delivery success? If it is not possible, then how would you work around it. Currently I'm using 4 transmissions on network level and relays also with 4 retransmission, but still I have 99.98% packet reliability. Acknowledgements could be used, but if it is sent to a group, it is not always known how many acknowledgements to expect.

A: This could be installation specific. I would recommend using the Network Analyzer tool in Simplicity Studio to help you understand the lost packets. You might also be able to use the Heartbeat messages to identify nodes which are not responding.

Q: Could you please help me to find some basics about Bluetooth mesh? I am new to this subject.

A: Sure. A good starting point with some short videos is here: <https://www.silabs.com/products/wireless/learning-center/bluetooth/bluetooth-mesh>. For more in-depth understanding, see the whitepaper here: <https://www.silabs.com/whitepapers/enabling-ubiquitous-iot-connectivity-with-bluetooth-mesh-networking>

Q: What about a Linux hosted ADK?

A: You can easily connect our Bluetooth IC to a Linux system via UART and we provide the host API as source code. We also have provisioner sample code available for Linux.

Q: Joined little late, did he cover how many nodes we can provision max?

A: We support up to 4k nodes today with our software.

Q: What is recommended to expose the BT mesh network to the IP world (i.e. control home from the Internet)?

A: You would need a gateway to provide the bridge between the IP world and BT mesh.

Q: Which wireless mesh protocol provides the longest range (the same market, the same regulations) between 2 relays?

A: The range is a function of RF capability and the environment rather than the protocol, although there are some small differences due to the PHYs that are used. Z-Wave might have the longest range with all other things equal because sub-GHz propagates further than 2.4GHz.

Q: Where does the BLE Mesh stack reside in the NCP example?

A: See this KBA for a nice explanation with diagrams: https://www.silabs.com/community/wireless/bluetooth/knowledge-base.entry.html/2018/01/18/ncp_host_implementat-PEsT

Q: Can Bluetooth mesh determine location of devices based on hop count and RSSI?

A: Not really. The RSSI and number of hops are available, but neither one gives you information about the direction to a node.

Q: How is BT mesh different from Zigbee mesh ? I think is it just the range?

A: There are too many differences to explain in one short answer, but fundamentally, Zigbee is a routing mesh based on IEEE 802.15.4 while BT Mesh is a flooding mesh based on BT v4.0. They also use different application layers, the Zigbee Cluster Library for Zigbee and Mesh Models for BT mesh. These define how devices communicate with one another.

Q: Kris can you elaborate on managed vs. intelligent?

A: In a routed mesh, a coordinator maintains a table of the optimum routing paths to each node in the network in order to manage latency and message reliability. In a flooding mesh, the packet is broadcast, then broadcast again by Relay nodes if the address doesn't match. There are mechanisms in the flooding mesh to ensure packets don't travel around the network forever, thus BT mesh is called a managed flooding mesh.

Q: Is there a compatibility table showing which phones/versions work with which Silabs devices/SoCs?

A: Yes we have such a report. You can request it from your local Silicon Labs salesperson.

Q: Can you talk about any upcoming Profile Spec v1.1 Features, specifically MDF?

A: Unfortunately no. The Bluetooth SIG roadmap is confidential information and something we cannot publicly share.

Q: Is there a USB dongle that can be used as a tap for the Network Analyzer software running on a Windows PC?

A: No, but you could use our development kit, and it has a USB interface to a PC, but it's not as small as a plug-in dongle.

Q: So in a portable Bluetooth network, I cannot use all nodes as low-power node? There must be some nodes as friends nodes?

A: That is correct. Low power nodes are not able to listen to messages that propagate through the network when they are sleeping, so they rely on a Friend node to buffer those messages. The Friend node is always on and monitoring mesh traffic.

Q: What are the hardware requirements for using AEM on own device?

A: We have a KBA that explains how to modify your WSTK to enable using AEM on your own device:

https://www.silabs.com/community/mcu/32-bit/knowledge-base.entry.html/2014/05/21/using_aem_to_measure-BdWI

Q: Are your modules EMI/EMC certified? Like the FCC or RED or any similar certifications that can help us for a quick time to market?

A: Yes. All of our modules are certified with the FCC and latest CE RED standards. This information is in the datasheets, and compliance test reports are available on the specific product web pages.

Q: What is each node's approx. range?

A: It depends on the environment and line of sight conditions, but 30-50 meters indoors and up to 200 meters outdoors is a reasonable expectation.

Q: Why use 5.2 over 5.1, 5.0, 4.x?

A: Along with the more significant new features, each new release of the Bluetooth specification also includes minor updates, errata fixes, etc. Typically you will want to use the latest version but as long as the feature you need is supported then any currently active version is fine. However Bluetooth mesh is built on v4.0, so you don't yet have the option to use a newer version.

Q: Are those security features hardware or software based or both?

A: Both. The crypto accelerators, DPA countermeasures, and Secure Vault are in hardware. The Secure boot with RTSL is done with software. For details on each security feature, see www.silabs.com/security

Q: Without handling the hardware at a very nascent stage, can I simulate the whole firmware development through a Silicon Labs software wherein I can emulate the WSTK and all the other software packages Kris mentioned?

A: Yes, you can use Simplicity Studio to create and develop software projects targeting a specific device without having that device connected. Simplicity Studio is a free download.

Q: Do you have OTP so we can put our own keys persistently? RSA 2048 or?

A: The Secure Vault in the BG21 provides you with secure key storage, but is implemented using PUF technology and an isolated security processor rather than OTP. You can see more details at <https://www.silabs.com/security/secure-key-management>

Q: BGM220P modules will be pin-to-pin compatible with existing BGM13P module?

A: They have the same footprint but are not pin-to-pin drop-in compatible.

Q: For a gateway to the IP world is there any software to be used or a device with IP functionality connected to a BT mesh chip via NCP with custom software to achieve it?

A: This type of translation software is typically done by the gateway developer.

Q: What is the lowest current EM2 mode in BG13 or BG21 module?

A: 1.3uA for BG13 and 4.5uA for BG21 (targeted at mains powered devices)

Q: Is there a USB based module using the CP2102 with a EFR32MG21?

A: Nothing like this with the CP2102 built in, but it's a good solution if USB is needed.

Q: Are your software APIs compatible with Qt?

A: Our host library is provided in ANSI C.

Q: Do you have an example for a proxy node for a light switch with a dimmer slider?

A: Yes, this example is included in our SDK.

Q: I did not catch the promo code for your Works With conference. Can you repeat it?

A: The early bird promotional code is WWSH.

Q: Can BLE Mesh be used for latency-sensitive applications? For example, real-time control with low tail latencies.

A: Possibly, but it depends of course on the amount of latency you can tolerate. This will give you a good idea of the latency vs. other parameters of the BT Mesh network:

<https://www.silabs.com/documents/public/application-notes/an1137-bluetooth-mesh-network-performance.pdf>

Q: What is the battery life when in relay mode?

A: This depends on the battery really. Since the relay node needs to be always listening to mesh traffic, it will never go into sleep mode. That means you are continuously consuming Rx current which can be anywhere from 3.6mA (BG22) to ~10mA (BG12/13/21). It would also depend on the output power you use to transmit.

Q: MGM210P022 (BGM210P022) is upgradable to Secure Vault (with SE firmware upgrade)?

A: No, the internal chip is different for Secure Vault, so you would need to use a different module OPN. They are pin-for-pin drop-in compatible.

Q: What is Silicon Labs' Bluetooth app source code license?

A: You can download the app source code via Simplicity Studio (called ADK) and you'll be presented the license agreement before download.

Q: During the slides, I believe Kris mentioned ADV as being more efficient and quicker than GATT... can you elaborate on that and why that is?

A: GATT is used for BLE point-to-point connections (to exchange data) and requires additional overhead packets. The ADV packet is a simple broadcast message. So using ADV for BT mesh reduces overhead, minimizes over-the-air traffic, and allows for broadcast to support the flood mesh.

Q: Which one is more suitable for a water meter network, Zigbee or BLE mesh? What is the packet size? Can I use a +20 dBm version?

A: Zigbee supports larger packet sizes today, but both protocols can use +20dBm in North America. And both support sleepy end devices. In general, Zigbee has a longer legacy in metering applications and BT mesh is initially focused on lighting. But it would take a longer discussion to help understand your needs, so I would recommend reaching out to your local Silicon Labs salesperson to arrange a meeting. You might also find this whitepaper useful:
<https://www.silabs.com/whitepapers/selecting-the-appropriate-wireless-mesh-network-technology>

Q: How are you catering to Asia/Pacific market, particularly India? Any FAE in India?

A: Yes we have local Silicon Labs FAEs in India. If you post a support ticket at www.silabs.com/support, it will be routed to the local FAE (among others).

Q: What is the bandwidth for the BT mesh networks?

A: In small setups, you can achieve 100 messages per second, but as the network grows larger, you may need to reduce the message rate. You can get a lot more detail here: <https://www.silabs.com/products/wireless/learning-center/mesh-performance>

Q: What is the average power consumption in a BT mesh application for data transmission once per day?

A: If you only broadcast once per day, the average power will be dominated by the EM2 sleep current, which for the BG22 is 1.2 μ A. You could also potentially keep the part in EM4, which would reduce the current draw to 0.17 μ A but you would have a longer turn-on time.

Q: Is connection-based mesh more power efficient than connectionless?

A: BT mesh is a connectionless protocol (there is no connection-oriented version). In general, a connection-oriented mesh is typically more power efficient as the time slots are very organized, but the challenge is that mesh networks can become very large and connection management can become a large burden on the network (especially with moving nodes).

Q: Are RX/TX currents scalable at runtime, or is the power-level one-size-fits-all ?

A: Rx current is fixed and dependent on the modulation type. Tx current can be modified by changing output power in software which can be done on-the-fly.

Q: How do you prevent async communication between xG21 and xG22? (different link budget).

A: Excellent question. The smaller link budget of the BG22 (with lower Tx output) means that it will need to be closer to its Friend node when used as a LPN.

Q: Does BT mesh support A2DP? Could I created a wireless home theater system out of BT mesh?

A: No, A2DP is a BT Classic profile, using the BR/EDR PHY. BT mesh is based off Bluetooth Low Energy.

Q: Are you planning to support lower bitrates on the BG22 radio?

A: The BG22 has a configurable radio if you wanted to use a 2.4GHz proprietary modulation. It also supports all of the BT 5 modulations (1Mbps, 2Mbps and two LE Coded PHYs).

Q: Does SL support SOC keys in manufacturing?

A: Yes. Please contact your local Silabs sales office.

Q: For pulse counting, xG22 seems better with 2 processors? Can it be implemented with xG13 with single processor?

A: If you need pulse counting, the xG13 is probably a better option. It has a dedicated pulse counter hardware block which works in low power modes (with the CPU asleep).

Q: Is the BGM220P pin compatible with the BGM210P?

A: No, these are not pin-compatible modules.

Q: Can LoRa and BT mesh work together in a system?

A: If your question is about interference, it should not be an issue because they operate on different frequency bands. It's also possible to operate the LoRa stack and BT mesh in one SoC.

Q: Why would I choose a BG13 over a BG21 or a BG22?

A: The BG21 has the best link budget and most flash/RAM, but the BG22 has the lowest power. If you need something more middle ground with +20dBm and low power, the BG13 is a good option.