

AN1317: Using Network Analyzer with *Bluetooth*® Low Energy and Mesh



It can be used and read jointly with the *AN958: Debugging and Programming Interfaces for Customer Designs* for more information on PTI usage with custom hardware.

This document assumes familiarity with the basic Network Analyzer information in the <u>Simplicity Studio 5 User's Guide</u>.

KEY POINTS

- Packet Trace Interface
- Wireless Network Analysis
- ISD capture files
- Bluetooth mesh networks
- · Bluetooth mesh security keys
- Bluetooth Low Energy

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1 Introduction

Network Analyzer is a tool for analyzing wireless network traffic. It supports a wide variety of short-range wireless protocols like Bluetooth Low Energy, Zigbee, proprietary protocols and others. It is provided as part of the Simplicity Studio tool set.

1.1 Debugging a Wireless Network

Silicon Labs' tool set provides the user with a comprehensive way to analyze wireless traffic. With it, the user can tap into the data buffers of the radio transceiver via a dedicated serial hardware interface called the Packet Trace Interface (PTI). PTI data can be then transferred via USB or Ethernet to a computer running Simplicity Studio. Finally, the time-stamped data can be interpreted and displayed in Network Analyzer.

Most Silicon Labs' development kits, such as the Wireless Starter Kit (WSTK), have the PTI embedded and ready to use. Note that it is also possible to use the network analysis features when working on custom hardware if the PTI pins are exposed via a debug interface.

2 Hardware and Packet Trace Interface (PTI)

On the EFR32 series 1 and 2, a mechanism is provided for the user to be able to tap into the data buffers at the radio transmitter/receiver level. From the embedded software perspective, this is available through the **RAIL Utility**, **PTI** component in Simplicity Studio. That component is effectively a simple packet trace interface driver.

2.1 Packet Trace Interface

The Packet Trace Interface (PTI) is an interface giving serial data access directly to the radio transmitter/receiver frame controller. The following figure describes at a high level the architecture of the radio transceiver.



A clock and data signal are connected to the frame controller to monitor all packets received/transmitted by the chip. At the chip level, a signal is dedicated to trigger the timestamping of each PTI frame by the WSTK board controller. The PTI is a non-intrusive sniffer of data, radio state and time stamp information.

A single-pin UART signal is used for PTI data transfer. This can be configured in the **RAIL Utility**, **PTI** component. The baud rate is selectable. The default baud rate is 1.6 Mbps. The maximum baud rate is 3.2 Mbps.

When using 2M PHY with Bluetooth Low Energy, the default PTI-over-UART speed (1.6 Mbps) must be increased to a higher baud rate. The following shows an example:

RAIL Utility, PTI

Configuration	
[] mode	DTI Raud Pate (Hertz)
mode	PTI Baud Rate (Hertz)

Additionally, the speed at which the PTI frames are forwarded from the EFR32 back to USB/UART must also be increased. This is done by setting the PTI config corresponding to your adapter at the correct baud rate through the Admin Console interface.

In the Debug Adapters view, right-click the device. In the context menu, select Launch Console...



Select the Admin tab, and execute the command:

pti config 0 efruart 3200000



2.2 Hardware Kit and PTI

As described previously, the WSTK can be used to monitor the wireless traffic. The WSTK can be connected to the PC via USB or Ethernet:

- USB The simplest solution. This is used throughout this document.
- Ethernet Recommended for best performance and scalability.



Figure 2.1. WSTK Board

Alternatively, it is possible to use the PTI on custom hardware if the corresponding pins are exposed (via the 20-pin Simplicity Connector on the WSTK or the Simplicity Mini connector on the debug adapter for example):



Figure 2.2. Simplicity Debug Adapter Exposing PTI Signals on the Mini and Simplicity Connectors



Figure 2.3. 20-Pin Simplicity Connector and the Mini Connector

For more detail, refer to AN958: Debugging and Programming Interfaces.

3 Network Analyzer Features

This section describes the main features of the Network Analyzer user interface.

3.1 Tool Access and Preference Page

Network Analyzer is provided with Simplicity Studio. For easy access, on the toolbar click Tools, and select Network Analyzer.

File Edit Navigate Search Project Run Window Help 👝 Network Analyzer			
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	OVERVIEW EXAMPLE PROJECTS & DEMOS DOCUMEN	TATION COMPATIBLE TOOLS	
			Create New Project
	General Information	Recommended Quick Start Guides	
	Preferred SDK: Gecko SDK Suite v3.1.2 Manage SDKs	QSG169: Bluetooth® SDK v3.x Quick-Start Guide QSG176: Bluetooth® Mesh SDK v2.x Quick-Start Guide QSG176: Bluetooth® Mesh SDK v2.x Quick-Start Guide QSG176: Slicon Labs Direction-Finding Solution Quick-S plicity Commander	tart Guide
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 B BGM2205 WITCHESS GECKO MODULIE Radio Board (BRD4310A) B BGM2205C12WGA 	Decord.	Torona David	

With Network Analyzer Preferences, accessed by **Windows > Preferences** or the **Preferences** control on the toolbar, you can tune the tool, add security keys, and modify displays and icons.

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You can also modify the Bluetooth protocol decoder in great detail (under the Decoding menu), define the integration with other tools (Energy profiler, Wireshark), and add Security keys (see section 4.2.2 Keys for more information).

3.2 Interface

3.2.1 Large File Editor

Because radio traffic contained in a captured session can be very large, a pane allowing time interval selection is opened first, as shown in the following figure. The interface implementing that feature is called the Large File Editor. It gives a complete overview of the capture session and allows you to select a specific time interval of study.



Interval viewing pane: Displays the traffic data present in the ISD live or recorded session. The data points corresponding to the green curve represent the number of packets per unit of time. Further display options are available through the right-click context menu.

Open Interval button: Once you have selected the area of interest in the interval view, click **Open Interval** to see traffic detail. This opens a subsequent window in which transaction and events are listed, as shown in section 3.2.2 Interval Editor.

List of nodes: In the right pane, the list of nodes present in the selected time interval is shown.

Filtering pane: Some packet filtering can be done on the selected time interval. In practice, this is more useful in the transaction/event pane. Filters are explained in more detail in section 3.6 Filters.

Bookmarks and Event Difference pane: Those functions are explained in detail in sections 3.4 Bookmarks and 4.1 Network Analyzer for Bluetooth LE, respectively

The following figure illustrates a selected interval (using the mouse directly on the waveform). The interval of interest appears in clear, whereas the rest of the interval viewing pane is greyed out.



3.2.2 Interval Editor

The Editor is laid out as follows:



The events displayed in the event pane are directly linked to the transactions displayed in the transaction pane. When a transaction is selected, Network Analyzer jumps to the corresponding events in the event pane.

Press CTRL+SHIFT+Up/Down to toggle between events in a transaction.

In the **Status** field, "Missing packets" indicates that a packet expected in the transaction has not been received within the current timeout window.

Note: A transaction is a group of related packets that together form a higher layer protocol procedure or message exchange. In the case of Bluetooth Low Energy (and Bluetooth mesh), a "transaction" refers to an actual Bluetooth Low Energy transaction as defined in the core specification. This corresponds most of the time to a Bluetooth Low Energy procedure. Equally, the event pane displays the actual Bluetooth Low Energy events corresponding to the transaction or procedure. For more details, refer to the Bluetooth Core specification document.

The filtering capabilities of the tool are explained in detail in section 3.6 Filters.

Event detail pane: The event detail pane exhibits all the data present in the corresponding Bluetooth LE packet. The data are displayed in a decoded format allowing the user to unpack the information at all layer levels, from radio information up to the GATT protocol and

Bluetooth mesh Access layer. Using the Option menu in the top right corner of the Event Detail pane, you can expand the bit fields and toggle between hexadecimal and decimal format.

🕅 Event Detail 🗢
> BLE Advertisement Data [17 bytes]
✓ BLE Advertisement Header [8 bytes]
Advertisement Header: 0x4017
0 = Rx Address: Public (0)
.1 = Tx Address: Random (1)
0 = Ch Sel: LE Channel Selection Algorithm #1 (0)
0000 = PDU Type: Adv Indication (0)
0001 0111 = Length: 0x17
Advertiser Address: 75 D2 69 28 6D 6A
0111 0101 1101 0010 0110 1001
0010 1000 0110 1101 0110 1010 = Company Assigned
✓ Radio Info EFR32 [12 bytes]
Crc3: 5B CE 9A
HW End: Rx Success (0xF9)
RSSI: -81 dBm (0xAF)
Sync Word: 8E 89 BE D6
Radio info: 0x00
0 = Antenna Select: 0x00
.0 = Sync Word Select: 0x00
00 0000 = Channel Number: RF channel 0, 2402 MHz (0)
< >>
Hex Dump [38 bytes]
C 00 10 0.5

Note that when a bit field is selected, the corresponding data is automatically highlighted in the hex dump view of the packet.

Various layers of decoding exist, which can be viewed in the Hex Dump Pane (for Bluetooth mesh, result of Network decryption, Application decryption, Defragmentation of various levels and so on).

3.3 ISD File

Network Analyzer can capture data from nodes of any connected adapters, either from one node at a time or from multiple nodes. It can display data from Live sessions as well as Recorded sessions.

Network Analyzer saves session data to an ISD (.isd) file, which is a compressed file that stores session data and the network state. Network state includes display settings such as map modifications, which Network Analyzer restores when you reload the session file.

The following procedure describes how to start a network data capture on a single device:

- 1. In Preferences > Simplicity Studio > SDKs select the desired SDK.
- In Preferences > Network Analyzer > Decoding >Stack Version, Make sure "Bluetooth Low Energy" is added in the decoding preferences.
- 3. If using encryption with known keys, make sure the security keys are added (see section 4.2.2 Keys for more detail).

4. Connect to the adapter.



5. Start capture.



To start capturing on several adapters, press and hold the CTRL key and, in the Debug Adapters view:

- 1. Select more than one adapter.
- 2. Right-click and select Connect.

- 3. Right-click and select Start Capture.
- 4. Release the CTRL key.

A Debug Adapters: 2 🚳		Debug Adapters: 2 🛛	\$ X ≅ Z × X ♀ = □ □ = ⊕ = □
 BGM220P Wireless Gecko Module R8 / BGM220P Wireless Gecko Module Wireless Starter Kit Mainboard (BF EFR32xG21 2.4 GHz 10 dBm R8 (ID:44 EFR32xG21 2.4 GHz 10 dBm R8 (ID:44 BFR32xG21 2.4 GHz 10 dBm R8 (ID:44 Wireless Starter Kit Mainboard (BF 	Interview Interview Rename Interview Connect Interview Start capture Start capture Start capture Redo last upload Upload application Upload adapter firmware Make a sniffer Interview Interview Bluetooth NCP Commander	 BGM220P Wireless Gecko Module RB (B BGM220P Wireless Gecko Module RB (B Wireless Starter Kit Mainboard (BRC FR32xG21 2.4 GHz 10 dBm RB (ID:440) EFR32xG21 2.4 GHz 10 dBm RB (ID:440) EFR32xG21 2.4 GHz 10 dBm RB (ID:460) Wireless Starter Kit Mainboard (BRC Wireless Starter Kit Mainboard (BRC 	ID:44C Rename adio I Connect 04001 Disconnect 04376 Start capture 30ardi Start capture with options 304001 Stop capture Redo last upload Upload application Upload adapter firmware Make a sniffer Image: Launch Console Image: Bluetooth NCP Commander

With Bluetooth mesh, when working in a busy environment, capturing from multiple nodes makes more sense than capturing from only one, because Bluetooth mesh nodes are constantly scanning for incoming packets.

a) Connect to a Group of Adapters. b) Start Capture on a Group of Adapters

For example, some nodes might be emitting Bluetooth mesh messages or beacons at the same time the node being used for capturing is answering a configure request. As a result, the data that were sent will not be received, simply because the link layer of the underlying Bluetooth LE stack was in the advertising state and not scanning. Additionally, there are three primary advertising channels and the radio transceiver can only listen to one channel at a time.

This should not be mistaken for an error or a malfunction in the stack. Rather, this is simply a by-product of the technology reliance on primary advertising channels and advertising PDUs. Apart from the GATT bearer scenario (relying on Bluetooth LE connections), there is no communication collision control.

Note: It is possible to use "Duplicate Detection", i.e. when the same packet is detected on multiple adapters it will only be displayed once. See **Preferences->Network Analyzer->Capture Configuration** for more details.

3.4 Bookmarks

Bookmarks can be used for marking events. As the name indicates, those are actual bookmarks that point to a certain Bluetooth LE or mesh event. Those are useful for pinpointing a certain event in a transaction that can be problematic and then sharing it with somebody else.

The following procedure shows how to set and navigate through bookmarks:

1. Select the event and right-click it.

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2 sav	ved filters AN	ID										
1.64	01.sp/s											
16.3	185	1 a 1 a 1 a 2 a 2 a 2 a 2 a 2 a 2 a 2 a	A Desired lands and lands and a desired at the second se	की किल्लिक किलिए के लिएक		and the local sector of the	Beer and second states of			- 94 No 199 No	NULL IN SUCCESSION OF THE OWNER.	
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			100011						Node 4	7Node 48Node 53Nod	e 54*	~
Tran	sactions tota	il:1,589 shown:1,523										~ 🗆
	Time	Duration	Summary	NWK Src		NWK Dest	P#	M#	E#	Error Status	Warning Stat	tus ^
I	16.399877	2.803	BT Mesh - Looking for Provisioner (Device: 53 69 60	C 6 90 FD 9F C8	F0 19		48			Missing packets		
C.	16.400483	0.001	BLE LL - Adv Scan Request	55 82 70 8A	OD F1	90 FD 9F C8	F0 19 1			Missing packets		
	16.403052	0.001	BLE LL - Adv Scan Request	55 82 70 8A	12.50	21 09 IE B2	25.38 1			Missing packets		
	16 601001	0.001	BLE Adv - Scan Request/Response	71 59 95 AG	12 50	4A ED 04 JJ	E0 10 2					
	16.730039	0.147	BLE LL Control - Feature Exchange Procedure	90 FD 9F C8	EF FC	71 59 93 AC	12 50 2					
	16.730258	0.098	BLE LL Control - Feature Exchange Procedure	71 59 93 AG	12 50	90 FD 9F C8	EF FC 2					
	16 701076	0.001	DLE Adv. Coop Doquet/Decourse	זם דר דם רד	AC AC	44 FD 04 66						Ň
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Ever	its total:15,2	53 shown:14,949 Deco	ders: Bluetooth Low Energy, Default Profile									
	Lime	Type	Summary		MAC		MAC Dest	Event	error status	Event warning s	tatus	~
	16 210227	Packet	BLE LL - Adv Indication		90 FD							
	16.319105	Packet	BLE LL - Adv Indication		90 FD	9F C8 FF FC						
	16.365321	Packet	BLE LL - Adv Indication		4A EB	84 55 D6						
	16.384659	Packet	BLE LL - Adv Scan Request		55 82	70 8A 0D F1	70 01 B9 EA 9	3B				
Γ.	16.399877	Packet	Unprovisioned Device Beacon		90 FD	9F C8 F0 19						
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œ	16.401846	Packet	BLE LL - Ad No destination address	sioned Device Bea	icon	C8 F0 19						
	16.402622	Packet	BLE LL - Ad Show only source: 90 FD 9F C	8 F0 19		C8 F0 19						
	16.403429	Packet	BLE LL - Ad Show only status: <none></none>			C8 F0 19	E1 00 1E D2 2	20				
	16.420675	Packet	BLE LL - Ad Show only type: Packet			02 70 79	51 09 IE BZ Z	50				
h	16.499882	Packet	Unprovision Hide type: Packet			C8 F0 19						
li –	16.500417	Packet	Unprovision Append to file			C8 F0 19						
1	16.500921	Packet	Unprovision Extract to			C8 F0 19						
	16.517548	Packet	BLE LL - Ad Unset zero-time			C8 EF FC						
	16.518347	Packet	BLE LL - Ad Set zero-time anchor to this	event		C8 EF FC						
	16.519145	Packet	BLE LL - Ad			C8 EF FC						
	16.545929	Packet	BLE LL - Ad Add bookmark			55 D6						
	16.546318	Packet	BLE LL - Ad			AC 12 50	4A EB 84 55 D	6				
	16.546645	Packet	BLE LL - Adv Scan Response		4A EB	84 55 D6						
	16.599887	Packet	BLE LL - Adv Indication		90 FD	9F C8 F0 19						
	16.601091	Packet	BLE LL - Adv Indication		71 50	9F C6 F0 19	90 ED 9E C8 E	10				
	16.601499	Packet	BLE LL - Adv Scan Response		90 FD	9F C8 F0 19	5010 51 601					
	16.601866	Packet	BLE LL - Adv Indication		90 FD	9F C8 F0 19						
1	16.699893	Packet	Unprovisioned Device Beacon		90 FD	9F C8 F0 19						
1	16.700398	Packet	Unprovisioned Device Beacon		90 FD	9F C8 F0 19						
1	16.700934	Packet	Unprovisioned Device Beacon		90 FD	9F C8 F0 19						
	16.710655	Packet	BLE LL - Adv Indication		4B 76	31 93 70 78						
	16.714238	Packet	BLE LL - Adv Indication		75 D2	69 28 6D						~

2. Enter the bookmark name.

┣ sl_	btmesh_api.h	I sl_btmesh_lib.c	🗈 sl_btmesh_se 💽 sl	_bt_api.h	🖸 main.c	⊡ sl_s	system_i	⊡ sl_e	event_ha	sl_bt	tmesh.c	🖸 sl_bt	mesh_ge	🚄 *battery se	👝 battery ser	💊 batter
2 sa	ved filters AN	ND														
3.64.	100 sp/s	a line a first of the state of		A						-		er an en begel fersen an		- and the second se		
Tim	e:16.300977s	Real time:lan 1 07:14:10	6 Nodes:10 Event:EEP Tv	nacket												
	e.10.5990775	Real timesan. 1, 07:14.10	6 Nodes: 10 Evenilerk IX	раскет												^
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		000440144682	0004491 000010144651										-			
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Tran	sactions tota	al-1 589 shown:1 523											7222.7	/		⊽ 🗖
	Time	Duration	Summary				NWK Src		NWK Dest		P#	M#	F#	Error Status	Warning Sta	tus ^
1	16.399877	2.803	BT Mesh - Looking for	Provisioner (E	Device: 53 6	9 6C 6	90 FD 9F C	8 F0 19			48			Missing packets		
P	16.400483	0.001	BLE LL - Adv Scan Requ	Jest			55 82 70 8	A 0D F1	90 FD 9F C8	F0 19	1			Missing packets		
	16.403652	0.001	BLE LL - Adv Scan Requ	Jest			55 82 70 8	A 0D F1	51 09 1E B2	25 38	1			Missing packets		
	16.546318	0.001	BLE Adv - Scan Reques	t/Response			71 59 93 A	C 12 50	4A EB 84 55	5 D6 D6	2					
	16.601091	0.001	BLE Adv - Scan Reques	t/Response			71 59 93 A	C 12 50	90 FD 9F C8	F0 19	2					
	16.730039	0.147	BLE LL Control - Feature	e Exchange P	rocedure		90 FD 9F C	8 EF FC	71 59 93 AC	12 50	2					
	16.730258	0.098	BLE LL Control - Featur	e Exchange P	rocedure		71 59 93 A	C 12 50	90 FD 9F C8	EF FC	2					~
<	16 771 776	0.001	Si Boo	kmark			73 87 37 8	T AC AC	AA ED OA ES	DE DE	X					>
Ever	nts total:15,2	53 shown:14,949 Decc	oders: Bluetooth Lo													
	Time	Type	Summary Enter I	abel for a bo	okmark							Ever	t error status	Event warning	status	^
	16.317538	Packet	BLE LL - A test													
	16.318337	Packet	BLE LL - A		6 200076											
	16.319105	Packet	BLE LL - A	ig at time:	0.599670											
L _	16.365321	Packet	BLE LL - A													
	16.384659	Packet	BLE LL - A						ОК	Canc	el	3B				
	16.399877	Packet	Unprovisioned De	ine Dessen				00.5	D OF CO FO 10	_						
æ	16.400412	Packet	BLE LL - Adv Scan	Request				90 F	2 70 9A 0D F1	00 ED		10				
U.	16 400947	Packet	Unprovisioned De	vice Beacon				90 F	D 9F C8 F0 19	5010	51 60 10	19				
Ľ.	16.401846	Packet	BLE LL - Adv Indice	ation				90 F	D 9F C8 F0 19							
	16.402622	Packet	BLE LL - Adv Indica	ation				90 F	D 9F C8 F0 19							
	16.403429	Packet	BLE LL - Adv Indica	ation				90 F	D 9F C8 F0 19							
	16.403652	Packet	BLE LL - Adv Scan	Request				55 8	2 70 8A 0D F1	51 09	1E B2 25	38				
	16.439675	Packet	BLE LL - Adv Indice	ation				4B 7	76 31 93 70 78							
1	16.499882	Packet	Unprovisioned De	vice Beacon				90 F	D 9F C8 F0 19							
Ľ.,	16.500417	Packet	Unprovisioned De	vice Beacon				90 F	D 9F C8 F0 19							
Ľ .	16.500921	Packet	Unprovisioned De	vice Beacon				90 F	D 9F C8 F0 19							
	16 518347	Packet	BLE LL - Adv Indic	ation				90 F								
	16,519145	Packet	BLE LL - Adv Indice	ation				90 F	D 9F C8 FF FC							
	16.545929	Packet	BLE LL - Adv Indic	ation				4A E	EB 84 55 D6							
	16.546318	Packet	BLE LL - Adv Scan	Request				71 5	i9 93 AC 12 50	4A EB	84 55 D					
	16.546645	Packet	BLE LL - Adv Scan	Response				4A 8	EB 84 55 D6							
	16.599887	Packet	BLE LL - Adv Indice	ation				90 F	D 9F C8 F0 19							
	16.600663	Packet	BLE LL - Adv Indic	ation				90 F	D 9F C8 F0 19							
	16.601091	Packet	BLE LL - Adv Scan	Request				71 5	9 93 AC 12 50	90 FD	9F C8 F0	19				
	16.601499	Packet	BLE LL - Adv Scan	Kesponse				90 F	D 9F C8 F0 19							
.	16 699892	Packet	Linnrovisioned De	vice Reacon				90 F	D 9F C8 F0 19							
li –	16.700398	Packet	Unprovisioned De	vice Beacon				90 F	D 9F C8 F0 19							
1	16.700934	Packet	Unprovisioned De	vice Beacon				90 F	D 9F C8 F0 19							
	16.710655	Packet	BLE LL - Adv Indic	ation				4B 7	76 31 93 70 78							
	16.714238	Packet	BLE LL - Adv Indica	ation				75 C	02 69 28 6D							~

3. See the bookmark recorded (highlighted in yellow).

h s	l_btmesh_api.h	sl_btmesh_lib.c	sl_btmesh_se 🖻 sl_bt_api.h	i main.c i sl	_system_i	sl_event_ha	sl_btmesh.c	sl_btmes	sh_ge 🤞	*battery se	battery ser	a batt
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Ti	me:16.399877s	Real time:Jan. 1, 07:14:16	Nodes:10 Event:EFR Tx packet									t
			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1									
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Tra	ansactions tot	al-1 589 shown-1 523	*****						700075			⊽ [
	Time	Duration	Summary		NWK Src	NWK Dest	P#	M#	F#	Error Status	Warning St	atus (
	16 399877	2.803	BT Mesh - Looking for Provision	er (Device: 53.69.6C.6	90 ED 9E C8 E0	19	48	1410	E.,	Missing packet	t turning bu	
æ	16,400483	0.001	BLE LL - Adv Scan Request		55 82 70 8A 0D	0 F1 90 FD 9F C8	F0 19 1			Missing packet	5	
ľ	16.403652	0.001	BLE LL - Adv Scan Request		55 82 70 8A 0D	0 F1 51 09 1E B2	25 38 1			Missing packet	5	
	16.546318	0.001	BLE Adv - Scan Request/Respon	se	71 59 93 AC 12	4A EB 84 55	D6 D6 2			2.		
	16.601091	0.001	BLE Adv - Scan Request/Respon	se	71 59 93 AC 12	50 90 FD 9F C8	F0 19 2					
	16.730039	0.147	BLE LL Control - Feature Exchan	ge Procedure	90 FD 9F C8 EF	FC 71 59 93 AC	12 50 2					
	16.730258	0.098	BLE LL Control - Feature Exchan	ge Procedure	71 59 93 AC 12	2 50 90 FD 9F C8	EF FC 2					
<	16 701076	0.001	DLE Adv. Coop Deguest/Desper	**	71 07 27 05 46	AC 4A FD 04 EE	DEDE D					
E	ente total:151	254 shown:14 950 Decod	ders: Rivetooth Low Energy, Default	Profile								
	Time	234 SHOWN, 14,930 Decou	Summany	Profile		MAC Sec	MAC Dest	Event or	ror status	Eventwarpin	a status	
R.	16 300875	Bookmark	tect			MAC SIC	MAC Dest	Event er	TOT Status	Event warnin	y status	- i
1	16.399877	Packet	Unprovisioned Device Read	on		90 ED 9E C8 E0 19				_		
1	16,400412	Packet	Unprovisioned Device Bea	on		90 FD 9F C8 F0 19						
æ	16.400483	Packet	BLE LL - Adv Scan Request			55 82 70 8A 0D F1	90 FD 9F C8 F0	19				
1	16.400947	Packet	Unprovisioned Device Bear	on		90 FD 9F C8 F0 19						
	16.401846	Packet	BLE LL - Adv Indication			90 FD 9F C8 F0 19						
	16.402622	Packet	BLE LL - Adv Indication			90 FD 9F C8 F0 19						
Ι.	16.403429	Packet	BLE LL - Adv Indication			90 FD 9F C8 F0 19						
	16.403652	Packet	BLE LL - Adv Scan Request			55 82 70 8A 0D F1	51 09 1E B2 25	38				
	16.439675	Packet	BLE LL - Adv Indication			4B 76 31 93 70 78						
15	16.499882	Packet	Unprovisioned Device Bear	on		90 FD 9F C8 F0 19						
Ľ.,	16.500417	Packet	Unprovisioned Device Bear	on		90 FD 9F C8 F0 19						
Ľ.	16.500921	Packet	Unprovisioned Device Bear	on		90 FD 9F C8 F0 19						
	16.51/548	Packet	BLE LL - Adv Indication			90 FD 9F C8 EF FC						
	16.518347	Packet	BLE LL - Adv Indication			90 FD 9F C8 EF FC						
	16.5/19143	Packet	BLE LL - Adv Indication			40 FB 84 55 D6						
	16.546318	Packet	BLE LL - Adv Scan Request			71 59 93 AC 12 50	4A FB 84 55 D	5				
	16,546645	Packet	BLE LL - Adv Scan Respons			4A EB 84 55 D6						
	16.599887	Packet	BLE LL - Adv Indication	-		90 FD 9F C8 F0 19						
	16.600663	Packet	BLE LL - Adv Indication			90 FD 9F C8 F0 19						
	16.601091	Packet	BLE LL - Adv Scan Request			71 59 93 AC 12 50	90 FD 9F C8 F0	19				
	16.601499	Packet	BLE LL - Adv Scan Respons	ę		90 FD 9F C8 F0 19						
	16.601866	Packet	BLE LL - Adv Indication			90 FD 9F C8 F0 19						
1	16.699893	Packet	Unprovisioned Device Bea	on		90 FD 9F C8 F0 19						
1	16.700398	Packet	Unprovisioned Device Bea	on		90 FD 9F C8 F0 19						
1	16.700934	Packet	Unprovisioned Device Bear	on		90 FD 9F C8 F0 19						
	16.710655	Packet	BLE LL - Adv Indication			4B 76 31 93 70 78						
	16.714238	Packet	BLE LL - Adv Indication	_		75 D2 69 28 6D						
	16,717500	Packet	BLE LL - Adv Scan Respons	2		75 D2 69 28 6D						
	16 719250	Packet	BLE LL - Adv Indication									
	16.719127	Packet	BLE LL - Adv Indication			90 FD 9F C8 EF FC						

3.5 Set Zero-Time Anchor

When studying a particular event or transaction, it is sometime useful to set it as the time reference. Practically, this means setting the timestamp corresponding to that event or transaction to zero, and then seeing all subsequent timestamps updated according to the new time reference. Using this Network Analyzer feature is also an excellent way to verify the Bluetooth Low Energy advertising or connection timings (advertising interval, connection interval, and so on).

The following describes how this can be done, using a Bluetooth LE Initiating connection (CONNECT_IND) state as an example. Select the particular transaction or event, right-click to open the context menu, and then click **Set zero-time event anchor to this event**.

abat	tery server test	new Studio v5.isd	battery server test new Studio v5.isd, 7 segments								
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		(2010)	(2012) (2012)			(2010)				
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				(C00	0)				(2006)		
Tran	actions total	1-2 225 shown-2 168									~ 8
man	Time	Duration	Summan/	NWK Src	NWK Doct	D#	14#	C#	Error Status	Warning Status	^
	11.004250	0.001	PLE Adv - Scan Request/Response	55 92 70 9A OD E1	AD 76 21 02 70 79	2	IVI#	C#	Enor Status	warning status	
	11.007952	0.001	BLE Adv - Scan Request	72 B7 27 BF 46 A6	4B 76 31 93 70 78	1			Missing packets		
	11.327283	0.001	BLE LL - Adv Scan Request	55 82 70 8A 0D F1	18 B4 30 DF 0F F6	1			Missing packets		
	11.516854	0.001	BLE LL - Adv Scan Request	7F A7 32 2E 14 92	67 A7 A7 29 51 3F	1			Missing packets		
	11.518517	0.001	BLE Adv - Scan Request/Response	7F A7 32 2E 14 92	90 FD 9F C8 EF FC	2					
	11.533994	0.001	BLE Adv - Scan Request/Response	7F A7 32 2E 14 92	75 D2 69 28 6D 6A	2					
	11.603593	0.001	BLE Adv - Scan Request/Response	55 82 70 8A 0D F1	90 FD 9F C8 F0 19	2					
	11.906122	0.001	BLE LL - Adv Scan Request	55 82 70 8A 0D F1	60 AB D2 08 A9 52	1			Missing packets		
	12.000871	0.001	BLE Adv - Scan Request/Response	55 25 59 DF 08 41	90 FD 9F C8 F0 19	2					
	12.118520	0.001	BLE Adv - Scan Request/Response	7F A7 32 2E 14 92	90 FD 9F C8 EF FC	2					
	12.197481	0.004	BLE Adv - Scan Request/Response	71 59 93 AC 12 50	90 FD 9F C8 F0 19	2					
	12.201278	0.001	BLE Adv - Scan Request/Response	50 4A D4 8D 5B 5B	90 FD 9F C8 F0 19	2					
P	12.217315	1.991	BT Mesh - Looking for Provisioner (Device: 53 69 6C 6	90 FD 9F C8 EF FC	71 59 93 AC 12 50	41					
	12.352364	0.099	BLE LL Control - Feature Exchange Procedure	90 FD 9F C8 EF FC	71 59 93 AC 12 50	2					
	12.352583	0.098	BLE LL Control - Feature Exchange Procedure	71 59 93 AC 12 50	90 FD 9F C8 EF FC	2					
	12.399653	2.803	BT Mesh - Looking for Provisioner (Device: 53 69 6C 6	90 FD 9F C8 F0 19	74 50 00 4 5 40 50	45			Missing packets		
	12.498696	0.098	BLE LL Control - Data Length Update Procedure	90 FD 9F C8 EF FC	71 59 93 AC 12 50	2					
	12.54/061	0.050	BLE LL Control - Version Exchange Procedure	71 59 93 AC 12 50		2					
	12.044303	0.001	RIE ATT - Read Ry Group Type Request/Response	71 50 93 AC 12 50		2					
	12,095320	0.000	BLE ATT - Read by Gloup Type Request Response	50 4A D4 8D 58 58	18 B4 30 E1 E7 6D	1			Missing packets		
	12.790822	0.050	BLE ATT - Read By Group Type Request/Response	71 59 93 AC 12 50	90 ED 9E C8 EE EC	2			Wissing packets		
	12,799461	0.004	BLE Adv - Scan Request/Response	55 82 70 8A 0D F1	90 FD 9F C8 F0 19	2					~
<											>
Even	ts total:27,08	6 shown:26,500 Decod	ers: Bluetooth Low Energy, Default Profile								
	Time	Туре	Summary	MAC	Src MAC	Dest	Event err	or status	Event warning status		^
Ð	12.318127	Packet	BLE LL - Adv Indication	90 FI	O 9F C8 EF FC						
E	12.318554	Packet	BLE LL - Adv Connect Indication	71 5	9 93 AC 12 50 90 FE) 9F C8 EF [*					
	12.338022	Packet	BLE LL - Adv Indication	4A E	B 84 55 D6		Show on	ily summar	y: BLE LL - Adv Connect In	dication	
	12.346733	Packet	BLE LL - Adv Indication	75 D	2 69 28 6D		Show on	ily destinat	1001: 90 FD 9F C8 EF FC		
	12.347475	Packet	BLE LL - Adv Scan Response	75 D	2 69 28 6D		Show on	ly source.	(DODE)		
	12.352051	Packet	BLE LL - Empty PDU	71 5	9 93 AC 12 50 90 FC	9F C8 EF I	Show on	ly type: Pa	cket		
	12.352364	Packet	BLE LL Control: Slave Feature Request	90 FI	O 9F C8 EF FC 71 59	93 AC 12	Hide typ	ny type: ru ne: Packet	chet		
	12.352583	Packet	BLE LL Control: Feature Request	71 5	9 93 AC 12 50 90 FE	9 9F C8 EF I	Append	to file			
	12.352970	Packet	BLE LL Control: Slave Feature Request	90 FI	D 9F C8 EF FC 71 59	93 AC 12	Append	to me			
	12.353788	Packet	Unprovisioned Device Beacon	90 FI	D 9F C8 EF FC		Extract t	0			
	12.354323	Packet	Unprovisioned Device Beacon	90 FI			Unset ze	ro-time			
	12 362056	Packet	BLETL - Adv Indication	90 FI 4R 7	5 31 93 70 78		Set zero	-ume anch	or to this event		
	12 399653	Packet	Unprovisioned Device Reacon	40 F	0 9F C8 F0 19		Show in	Energy Pro	ofiler		~

The timestamps of all events and transactions are then updated, taking into account the new anchor as time reference, as shown in the following figure.

🚄 ba	ttery server test n	ew Studio v5.isd 💊	battery server test new Studio v5.isd, 7 segments 🛙							
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Tim	e:0.000000s Rea	l time:Jan. 1, 07:14:12	Nodes:0 Event:EFR Rx packet							
	-15	dBn								
		♦<	* * * * * *	* *			• •			• •
	C	00440144682	00044014000000440144681 (2012) (2012)				(2010)			
	• • `	• • •			۲	• •		۰		1
				(000	u)				(2006)	
Tran	sactions total:3	3.235 shown:3.168								▽ 🗖
	Time	Duration	Summary	NWK Src	NWK Dest	P#	M#	E#	Error Status	Warning Status
	-1.314204	0.001	BLE Adv - Scan Request/Response	55 82 70 8A 0D F1	4B 76 31 93	70 78 2				Training status
	-1.310602	0.001	BLE LL - Adv Scan Request	72 B7 27 BF 46 A6	4B 76 31 93	70 78 1			Missing packets	
	-0.991271	0.001	BLE LL - Adv Scan Request	55 82 70 8A 0D F1	18 B4 30 DE	0E F6 1			Missing packets	
	-0.801700	0.001	BLE LL - Adv Scan Request	7F A7 32 2E 14 92	67 A7 A7 29	51 3F 1			Missing packets	
	-0.800037	0.001	BLE Adv - Scan Request/Response	7F A7 32 2E 14 92	90 FD 9F C8	EF FC 2				
	-0.784560	0.001	BLE Adv - Scan Request/Response	7F A7 32 2E 14 92	75 D2 69 28	6D 6A 2				
	-0.714961	0.001	BLE Adv - Scan Request/Response	55 82 70 8A 0D F1	90 FD 9F C8	F0 19 2				
	-0.412432	0.001	BLE LL - Adv Scan Request	55 82 70 8A 0D F1	60 AB D2 08	A9 52 1			Missing packets	
	-0.31/683	0.001	BLE Adv - Scan Request/Response	55 25 59 DF 08 41	90 FD 9F C8	F0 19 2				
	-0.200034	0.004	BLE Adv - Scan Request/Response	71 50 03 AC 12 50		EF FC 2				
	-0.117276	0.001	BLE Adv - Scan Request/Response	50 4A D4 8D 5B 5B	90 FD 9F C8	F0 19 2				
Ø	-0.101239	1.991	BT Mesh - Looking for Provisioner (Device: 53 69 6C 6	90 FD 9F C8 EF FC	71 59 93 AC	12 50 41				
Ť	0.033810	0.099	BLE LL Control - Feature Exchange Procedure	90 FD 9F C8 EF FC	71 59 93 AC	12 50 2				
	0.034029	0.098	BLE LL Control - Feature Exchange Procedure	71 59 93 AC 12 50	90 FD 9F C8	EF FC 2				
	0.081099	2.803	BT Mesh - Looking for Provisioner (Device: 53 69 6C 6	90 FD 9F C8 F0 19		45			Missing packets	
	0.180142	0.098	BLE LL Control - Data Length Update Procedure	90 FD 9F C8 EF FC	71 59 93 AC	12 50 2				
	0.228507	0.050	BLE LL Control - Version Exchange Procedure	71 59 93 AC 12 50	90 FD 9F C8	EF FC 2				
L _	0.326011	0.001	BLE LL Control - Connection Update procedure	71 59 93 AC 12 50	90 FD 9F C8	EF FC 1				
	0.374766	0.050	BLE ATT - Read By Group Type Request/Response	71 59 93 AC 12 50	90 FD 9F C8	EF FC 2				
	0.421188	0.001	BLE LL - Adv Scan Request	50 4A D4 8D 5B 5B	18 B4 30 E1	E7 6D 1			Missing packets	
	0.472208	0.050	BLE ATT - Read by Group Type Request/Response BLE Adv - Scan Request/Response	71 59 93 AC 12 50	90 FD 9F C8	EF FC 2				
<	0.400507	0.004	DEL Adv - Scan Request Response	55 62 70 64 60 11	5010 51 00					>
Ever	nts total:27,086	shown:26,500 Decod	ers: Bluetooth Low Energy, Default Profile							
	Time	Туре	Summary	MAC	Src	MAC Dest	Event err	or status	Event warning state	us ^
Ø	-0.000427	Packet	BLE LL - Adv Indication	90 FE	O 9F C8 EF FC					
	0.000000	Packet	BLE LL - Adv Connect Indication	71 59	9 93 AC 12 50	90 FD 9F C8 EF	FC)	
	0.019468	Packet	BLE LL - Adv Indication	4A E	B 84 55 D6					
	0.028179	Packet	BLE LL - Adv Indication	75 D	2 69 28 6D					
	0.028921	Packet	BLE LL - Adv Scan Response	75 D	2 69 28 6D	00 50 05 60 55	50			
	0.033497	Packet	BLE LL - Empty PDU BLE LL Control: Slave Feature Request	/1 3	9 93 AC 12 50	90 FD 9F C8 EF	FC 50			
	0.034029	Packet	BLE LL Control: Slave realure Request	71 50	93 AC 12 50	90 FD 9F C8 FF	FC			
	0.034416	Packet	BLE LL Control: Slave Feature Request	90 FI	0 9F C8 EF FC	71 59 93 AC 12	50		Retransmitted Pack	(et
	0.035234	Packet	Unprovisioned Device Beacon	90 FC	O 9F C8 EF FC					
	0.035769	Packet	Unprovisioned Device Beacon	90 FE	O 9F C8 EF FC					
	0.036274	Packet	Unprovisioned Device Beacon	90 FC	O 9F C8 EF FC					
	0.043502	Packet	BLE LL - Adv Indication	4B 70	5 31 93 70 78					
	0.081099	Packet	Unprovisioned Device Beacon	90 FI	9F C8 F0 19					~

To remove the anchor, right-click the selected event or transaction and click Unset zero-time.

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-0.000700 0.001 BE LL -Adv Scan Request 7F A7 322 E1 492 67 A7 32 51 3F 1 Missing packets -0.000077 0.001 BE Adv - Scan Request/Response 7F A7 322 E1 492 50 50 26 06 A 2 -0.014660 0.001 BE Adv - Scan Request/Response 55 22 70 8A 0D F1 60 AB D2 08 A9 52 1 Missing packets -0.014661 0.001 BE Adv - Scan Request/Response 55 23 50 r0 64 19 010 PG G5 F1 9 2 -0.01004 0.001 BE Adv - Scan Request/Response 7F A7 32 2E 1492 90 F0 9G G5 F1 9 2 -0.01003 0.001 BE Adv - Scan Request/Response 7F A7 32 2E 1492 90 F0 9G G5 F1 9 2 -0.010123 1.991 BT Meh - Looking GP Provisioner (Device: 53 69 G C. 90 F0 9G G5 F1 9 2 - -0.01023 1.991 BT Meh - Looking GP Provisioner (Device: 53 69 G C. 90 F0 9G G5 FF C 71 599 AC 12 50 2 - -0.01024 0.096 BE LL Control - Feature Exchange Procedure 71 599 AC 12 50 90 F0 9G G5 FF C 2 - -0.012726 0.050 BE LL Control - Looking Drivisioner (Device: 53 69 G C L 90 F0 9F G5 FF C 2 -		-0.991271	0.001	BLE LL - Adv Scan Request	55 82 70 8A 0D F1	18 B4 30 DE	0E F6 1			Missing packets	
-0.00037 0.001 BE Adv - Scan Request/Reponse TA 32 22 1492 50 199 C6 BF C 2 -0.764560 0.001 BE Adv - Scan Request/Reponse 55 82 70 8A 00 F1 60 A8 22 60 A4 2 -0.474651 0.001 BE Adv - Scan Request/Reponse 55 82 70 8A 00 F1 60 A8 22 68 A9 22 1 Missing packets -0.474632 0.001 BE Adv - Scan Request/Reponse 55 82 70 8A 00 F1 60 A8 22 68 A9 22 1 Missing packets -0.471432 0.001 BE Adv - Scan Request/Reponse 77 A3 22 E1 492 90 D9 FC 68 D1 9 2 -0.17276 0.001 BE Adv - Scan Request/Reponse 71 593 AC 12 50 90 D9 FC 68 D1 9 2 -0.17276 0.001 BE Adv - Scan Request/Reponse 71 593 AC 12 50 2 2 -0.010239 D19 BT Mein - Locking for Provisioner (Device: 35 69 C6 L. 90 FD 9 C6 BF FC 71 593 AC 12 50 2 -0.010129 D18 BE LL Control - Teature Brichange Procedure 71 593 AC 12 50 2 2 -0.01029 D18 BE LL Control - Teature Brichange Procedure 71 593 AC 12 50 20 FD 9 C6 BF FC 2		-0.801700	0.001	BLE LL - Adv Scan Request	7F A7 32 2E 14 92	67 A7 A7 29	51 3F 1			Missing packets	
-0.74560 0.001 BE Adv - Scan Request/Reponse 77 A3 22 E 1492 70 D9 C 80 D19 2 -0.714961 0.001 BE Adv - Scan Request/Reponse 55 82 70 8.00 P1 0/10 9C 66 10 9 2 -0.174322 0.001 BE Adv - Scan Request/Reponse 75 82 70 8.00 P1 0/10 9C 66 10 9 2 -0.17263 0.001 BE Adv - Scan Request/Reponse 71 73 22 E 1492 0/10 9C 68 10 9 2 -0.17276 0.001 BE Adv - Scan Request/Reponse 71 73 22 E 1492 0/10 9C 68 10 9 2 -0.17276 0.001 BE Adv - Scan Request/Reponse 71 59 33 AC 12 50 91 D 9F C 81 19 2 -0.01239 1991 BT Meth - Locking for Provisioner (Device: 35 66 C.6. 90 FD 9F C 68 119 2 41 -0.03800 0.098 BE LL Control - Fature Exchange Procedure 71 59 33 AC 12 50 2 41 -0.01230 1991 BT Meth - Locking for Provisioner (Device: 35 66 C.6. 90 FD 9F C 8 FF C 71 59 33 AC 12 50 91 D 9F C 8 FF C 2 -0.01230 0.098 BE LL Control - Netwise Exchange Procedure 71 59 39 3AC 12 50 <t< td=""><td></td><td>-0.800037</td><td>0.001</td><td>BLE Adv - Scan Request/Response</td><td>7F A7 32 2E 14 92</td><td>90 FD 9F C8 I</td><td>EF FC 2</td><td></td><td></td><td></td><td></td></t<>		-0.800037	0.001	BLE Adv - Scan Request/Response	7F A7 32 2E 14 92	90 FD 9F C8 I	EF FC 2				
-0.01/24961 0.000 BLE AdV: Scan Request/Reponse 55 82 / 0 84 00 F1 Missing packets -0.01/2423 0.001 BLE AdV: Scan Request/Reponse 55 25 59 0F 08 41 001 D9 F C8 F0 19 2 -0.01/2430 0.001 BLE AdV: Scan Request/Reponse 77 A7 32 22 14 42 00F D9 F C8 F1F C 2 0 -0.01/239 1.91 BT Mesh: - Looking for Provisioner (Device: 53 69 5C 6. 00F D9 F C8 F1F C 71 59 33 AC 12 50 2 -0.01/239 0.99 BLE LL Control - Feature Exchange Procedure 90F D9 F C8 F1F C 71 59 33 AC 12 50 2 -0.030409 0.098 BLE LL Control - Feature Exchange Procedure 90F D9 F C8 F1F C 17 59 33 AC 12 50 2 -0.041099 2.098 BLE LL Control - Feature Exchange Procedure 90F D9 F C8 F1F C 1 91 59 3 AC 12 50 2 -0.041099 2.098 BLE LL Control - Keating Exchange Procedure 91 59 3 AC 12 50 2 2 2 -0.041099 2.091 BLE AdV Scan Request 75 93 3 AC 12 50 91 59 5 C8 F1C 2 2 2 2 2 2 2		-0.784560	0.001	BLE Adv - Scan Request/Response	7F A7 32 2E 14 92	75 D2 69 28	6D 6A 2				
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-0.2000-9 0.001 BLE AdV - San Request/Response // Adv 22 at 12.50 901.0 91 C BF 1C 2 -0.121073 0.004 BLE AdV - San Request/Response 75.993 AC 12.50 901.0 91 C BF 1C 2 -0.1217276 0.001 BLE AdV - San Request/Response 50 40 AP 48 D 58 B 90 ED 91 C BF 1C 2 0.033810 0.099 BLE LL Control - Feature Exchange Procedure 90 FD 91 C BF FC 71 59 93 AC 12.50 2 0.034029 0.098 BLE LL Control - Feature Exchange Procedure 90 FD 91 C BF FC 2 45 0.081042 0.098 BLE LL Control - Feature Exchange Procedure 90 FD 91 C BF FC 1 45 Missing packets 0.1810142 0.098 BLE LL Control - Version Exchange Procedure 90 FD 91 C BF FC 2 45 Missing packets 0.282011 0.001 BLE LL Control - Version Exchange Procedure 71 59 93 AC 12 50 90 FD 91 C BF FC 2 45 0.42118 0.001 BLE LL Control - Version Exchange Procedure 71 59 93 AC 12 50 90 FD 91 C BF FC 2 44 45 45 45 45<		-0.317683	0.001	BLE Adv - Scan Request/Response	55 25 59 DF 08 41	90 FD 9F C8 I	19 2				
ULL 10/13 UKM Dit A VM Sam Request/Response 1/1 59 3 A CL 250 90 FD 9F CR 10 19 2 90 -0.11275 0.001 BLE AVM Sam Request/Response 50 A D 4 B D 5 B S 90 FD 9F CR 119 2 90 -0.101223 1.991 BT Mesh Looking for Provisioner (Device: 33 89 GC 6. 90 FD 9F CR BFF C 71 59 3 A CL 250 2 0.033810 0.098 BLE LL Control - Feature Exchange Procedure 70 59 3 A CL 250 90 FD 9F CR BFF C 2 0.081099 2.803 BT Mesh Looking for Provisioner (Device: 53 69 GC 6. 90 FD 9F CR BFF C 2 Missing packets 0.1801142 0.098 BLE LL Control - Version Exchange Procedure 71 59 93 A CL 250 90 FD 9F CR BFF C 2 0.226507 0.050 BLE LL Control - Connection Update procedure 71 59 93 A CL 250 90 FD 9F CR BFF C 2 0.327676 0.050 BLE LL - Adv Scan Request/Response 71 59 93 A CL 250 90 FD 9F CR BFF C 2 0.421188 0.001 BLE LL - Adv Scan Request/Response 71 59 93 A CL 250 90 FD 9F CR BFF C 2 4 <td></td> <td>-0.200034</td> <td>0.001</td> <td>BLE Adv - Scan Request/Response</td> <td>7F A7 32 2E 14 92</td> <td>90 FD 9F C8 1</td> <td>EF FC 2</td> <td></td> <td></td> <td></td> <td></td>		-0.200034	0.001	BLE Adv - Scan Request/Response	7F A7 32 2E 14 92	90 FD 9F C8 1	EF FC 2				
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Time Type Summary MAC Src MAC Dest Event error status Event warning status A 9 -0.000427 Packet BLE LL - Adv Indication 90 FD 9F C8 EF FC Not Dest Event warning status A 0.000000 Packet BLE LL - Adv Indication 71 59 93 AC 12 50 90 FD 9F C8 FF FC Show only summary: BLE LL - Adv Connect Indication Show only summary: BLE LL - Adv Connect Indication 0.019468 Packet BLE LL - Adv Indication 4A E8 84 55 D6 Show only summary: BLE LL - Adv Connect Indication 0.028921 Packet BLE LL - Adv Indication 75 D2 69 28 6D Show only source: 71 59 93 AC 12 50 Show only source: 71 59 93 AC 12 50 0.033497 Packet BLE LL Control: Slave Feature Request 90 FD 9F C8 FF FC Show only source: 71 59 93 AC 12 50 0.033407 Packet BLE LL Control: Slave Feature Request 90 FD 9F C8 FF FC Show only type: Packet 0.033407 Packet BLE LL Control: Feature Request 90 FD 9F C8 FF FC Show only status: <non> 0.033407 Packet BLE LL Control: Feature Request 90 FD 9F C8 FF C 71 59 93 AC Show only test actor 0.033524 Packet</non>	Ever	nts total:27,086	shown:26,500 Decod	lers: Bluetooth Low Energy, Default Profile							
Image: Section of the sectin and the section of the secting and the section of t		Time	Туре	Summary	MA	C Src	MAC Dest	Event er	ror status	Event warning statu	s
0.000000PacketBLE LL - Adv Connect Indication71 59 93 AC 12 5090 FD 9F C8FF FC0.019468PacketBLE LL - Adv Indication4A EB 84 55 D6Show only summary: BLE LL - Adv Connect Indication0.028179PacketBLE LL - Adv Indication75 D2 69 28 6DShow only destination: 90 FD 9F C8 FF C0.038407PacketBLE LL - Adv Scan Response75 D2 69 28 6DShow only sumce: 71 59 93 AC 12 500.033497PacketBLE LL - Empty PDU71 59 93 AC 12 5090 FD 9F C80.033402PacketBLE LL Control: Slave Feature Request90 FD 9F C8 FFC71 59 93 AC0.034416PacketBLE LL Control: Slave Feature Request90 FD 9F C8 FFC71 59 93 AC0.035769PacketUnprovisioned Device Beacon90 FD 9F C8 FFC71 59 93 AC0.035769PacketUnprovisioned Device Beacon90 FD 9F C8 FFC10 set zero-time Set zero-time anchor to this event	P	-0.000427	Packet	BLE LL - Adv Indication	90 F	D 9F C8 EF FC					
0.019468PacketBLE LL - Adv Indication4A EB 84 55 D6Show only summary: BLE LL - Adv Connect Indication0.028179PacketBLE LL - Adv Indication75 D2 69 28 6DShow only destination: 90 FD 9F C8 EF FC0.028921PacketBLE LL - Adv Scan Response75 D2 69 28 6DShow only summary: BLE LL - Adv Cannect Indication0.038407PacketBLE LL - Empty PDU71 59 93 AC 12 50Show only sumare: 71 59 93 AC 12 500.033409PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 AC0.034029PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 AC0.03416PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 AC0.035234PacketUnprovisioned Device Beacon90 FD 9F C8 EF FC71 59 93 AC0.035769PacketUnprovisioned Device Beacon90 FD 9F C8 EF FC11 59 34 C0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FC11 59 34 C0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FC11 59 34 C0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FC11 59 34 C0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FC11 59 56 560.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FC56 zero-time0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FC56 zero-time anchor to this event	=	0.000000	Packet	BLE LL - Adv Connect Indication	71 5	9 93 AC 12 50	90 FD 9F C8	FF FC	-		
0.028179PacketBLE LL - Adv Indication75 D2 69 28 6DShow only destination: 90 FD 9F C8 EF FC0.028921PacketBLE LL - Adv Scan Response75 D2 69 28 6DShow only destination: 90 FD 9F C8 EF FC0.033497PacketBLE LL - Empty PDU71 59 93 AC 12 5090 FD 9F C80.033810PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FCShow only status: <none>0.034029PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FCShow only status: <none>0.034016PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FCHide type: Packet0.035234PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCAppend to file0.035769PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCUnset zero-time0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCSet zero-time anchor to this event</none></none>		0.019468	Packet	BLE LL - Adv Indication	4A 8	B 84 55 D6		Show only	summary: E	BLE LL - Adv Connect Indic	ation
0.028921PacketBLE LL - Adv Scan Response75 D2 69 28 6DShow only source: 71 59 93 AC 12 500.033407PacketBLE LL - Empty PDU71 59 93 AC 12 5090 FD 9F C8Show only source: 71 59 93 AC 12 500.033810PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 ACShow only source: 71 59 93 AC 12 500.034029PacketBLE LL Control: Slave Feature Request71 59 93 AC 12 5090 FD 9F C8Hide type: Packet0.034416PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 ACAppend to file0.035234PacketUnprovisioned Device Beacon90 FD 9F C8 EF FC15 99 3ACAppend to file0.035769PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCUnset zero-time0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCSet zero-time anchor to this event		0.028179	Packet	BLE LL - Adv Indication	75 t	02 69 28 6D		Show only	destination	1: 90 FD 9F C8 EF FC	
0.033497PacketBLE LL - Empty PDU71 59 93 AC 12 5090 FD 9F C8Snow only status: snone>0.033810PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 ACShow only type: Packet0.034029PacketBLE LL Control: Feature Request71 59 93 AC 12 5090 FD 9F C8Hide type: Packet0.034416PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 ACAppend to file0.0335234PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCT1 59 93 ACAppend to file0.035769PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCUnset zero-time0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCSet zero-time anchor to this event		0.028921	Packet	BLE LL - Adv Scan Response	75 C	02 69 28 6D		Show only	source: 71	59 93 AC 12 50	
0.033810PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 ACSnow only uppe: racket0.034029PacketBLE LL Control: Feature Request71 59 93 AC 12 5090 FD 9F C8Hide type: Packet0.034416PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 ACAppend to file0.035234PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCExtract toExtract to0.035769PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCExtract toUnset zero-time0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCSet zero-time anchor to this event		0.033497	Packet	BLE LL - Empty PDU	71 5	9 93 AC 12 50	90 FD 9F C8	Show only	status: <no< td=""><td>ne></td><td></td></no<>	ne>	
0.034029PacketBLE LL Control: Feature Request71 59 93 AC 12 5090 FD 9F C8Inder type: racket0.034416PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 ACAppend to file0.035234PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCExtract to0.035769PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCUnset zero-time0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCSet zero-time0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCSet zero-time anchor to this event		0.033810	Packet	BLE LL Control: Slave Feature Request	90 F	D 9F C8 EF FC	71 59 93 AC	Show only	type: Packet	n.	
0.034416PacketBLE LL Control: Slave Feature Request90 FD 9F C8 EF FC71 59 93 ACAppend to file0.035234PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCExtract to0.035769PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCUnset zero-time0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCSet zero-time0.036274PacketUnprovisioned Device Beacon90 FD 9F C8 EF FCSet zero-time		0.034029	Packet	BLE LL Control: Feature Request	71 5	9 93 AC 12 50	90 FD 9F C8	nice type:	Facket		
UU35254 Packet Unprovisioned Device Beacon 90 FD 9F C8 EF FC Extract to 0.035769 Packet Unprovisioned Device Beacon 90 FD 9F C8 EF FC Unset zero-time 0.036274 Packet Unprovisioned Device Beacon 90 FD 9F C8 EF FC Set zero-time		0.034416	Packet	BLE LL Control: Slave Feature Request	90 F	D 9F C8 EF FC	71 59 93 AC	Append to	file		
0.035/b9 Packet Unprovisioned Device Beacon 90 FD 9F C8 EF FC Unset zero-time 0.036274 Packet Unprovisioned Device Beacon 90 FD 9F C8 EF FC Set zero-time		0.035234	Packet	Unprovisioned Device Beacon	90 F	D 9F C8 EF FC		Extract to		-	
UU302/4 Packet Unprovisioned Device Beacon 90 FD 9F C8 EF FC Set zero-time anchor to this event		0.035769	Packet	Unprovisioned Device Beacon	90 F	D 9F C8 EF FC		Unset zero	-time		
0.042502 Diselect DLE LL Advindication 40.76.24.03.70.70		0.036274	Packet	Unprovisioned Device Beacon	90 F	U 9F C8 EF FC		Set zero-ti	me anchor	to this event	
UV453VZ FACKEL BELLE - AQVINIALCATION 45/03/13/07/0 0.08100 Backet Upsychological Device Baccon option Call for 10 Show in Energy Profiler V		0.043502	Packet	Lipprovisioned Device Passon	48 /	D OF C9 E0 10		Show in En	ergy Profile	er	

3.6 Filters

Network Analyzer supports use of a set of built-in and manual filters.

3.6.1 Built-In Filters

The following built-in filters can be enable/disabled when visualizing PTI data:



For example, you can filter Bluetooth LE data out in order to focus on Bluetooth mesh traffic. Radio errors and diagnostics can also be filtered out. Note that radio errors can be useful for debugging.

3.6.2 Manual Filters

The filter bar is used to filter transactions and events. Each capture session has its own filters settings. When a session's filter is changed and the filter is applied by clicking **Apply** in the Filter pane toolbar, Network Analyzer will refresh the display showing only the corresponding transactions or events. When you exit Network Analyzer, all sessions filters are cleared and must be reapplied when Network Analyzer is restarted.

Network Analyzer provides two ways to edit filters:

- Filter Manager: Maintains internally a set of saved filters that you can review and edit. You can also add new filters. You specify any of the saved filters for display on the Filters menu, where they are accessible for use in one or more sessions.
- Filter Bar: An editor that attaches to a given session, where you can enter one or more filter expressions on the fly. Network Analyzer discards filter bar expressions for all sessions when it exits. It does, however, store the expression for easier future access.

Multiple filters can be combined using logical expressions:

- & & And operator
- || Or operator

Alternatively, conditions for individual filters can also be used:

- == Equals
- != Not equal
- | = Contains

The following table shows examples of filtering in Bluetooth mesh traffic:

Filter example	Meaning
transaction.summary = "BT Mesh"	Show transactions where the summary field contains the text "BT Mesh"
transaction.summary = "Generic" && transaction.dest == "C001"	Summary contains string Generic and the destination address is 0xC001
transaction.summary != "EFR Rx packet"	Do not show transactions with summary "EFR Rx packet" -> Hide those transactions that Network Analyzer cannot decode

The following figure shows an example of saved combined filters.

			_			
2 saved filters	AND	transaction.summary = "BT Mesh"	~	静 (9 6	
		transaction.summary = "BT Mesh"	^			
896,00 p/	ST.	transaction.summary == "BT Mesh - Looking for Provisioner (Device: 53 69 6C 61 62 73 44 65 76 .		98 m		<u> </u>
-U,UUUS					/9,/	/55
Time:68 33857	72s Rez	transaction.summary == "EFR Rx packet" && transaction.summary == "EFR Rx packet"		Deta	1 .	
1111111100,00000		transaction.summary == "EFK Rx packet"				~ ⊔
		transaction.summary = "Generic"		dverti	seme	nt [^
T		transaction.summary = "Generic" && transaction.dest == "C001"		dvertis	emen	nt H
Iransactions	total: I	transaction.summary = "Generic" && transaction.dest == "COUI" && transaction.dest == "COU	~	Rx Ar	ddress	: P
Time	Dur	Contraction.summary = Generic exectransaction.dest == 0004		Tx Ac	dress	: Pi
65 7372	24	BT Mesh - Looking for 00.0D 11 Missing	_	PDU	Type:	Ad
	my					

Alternatively, you can right-click and select preset filters.

		04,309204	0,001	BLE Adv - Scal	n kequest/kesponse	0/11990F0041	90 FD 9F /B 81 25	2	
		64,328037	0,001	BLE Adv - Scar	n Request/Response	67 11 99 5F 55 41	90 FD 9F 5F D2 81	2	
	1	64,331057	0,001	BLE Adv C	D 1/D	C7 44 00 CE CE 44	70.04.00 47.04.00	4	
		64,343655	2,601	BLE Adv	Also show only summary: BLE Adv - Scan	Request/Response			
		64,358124	8,001	BLE Adv	Also show only destination: 7C 64 56 A7 21	1 25			
		64,606055	0,001	BLE LL	Also show only source: 67 11 99 5F 55 41				
		64,608806	0,001	BLE LL	Also show only status: <none></none>				
		68,366434	0,001	BLE LL	Also show only type: BleAdv				
1		68,374347	0,001	BLE Adv	Also hide type: BleAdy				
-		68,582459	0,001	BLE LL	and the operation of the				

4 Network Analyzer for Bluetooth LE and Mesh

This section describes how the Network Analyzer can be used for Bluetooth Low Energy and Bluetooth mesh traffic monitoring. The current version of the Bluetooth core specification supported is 5.2. The current version of Bluetooth mesh profile and model specification is 1.0.1.

Bluetooth Low Energy profile support is limited. Additionally, there is no support for Bluetooth LE random addresses resolving.

4.1 Network Analyzer for Bluetooth LE

This section reviews the capabilities of Network Analyzer for the Bluetooth LE protocol.

When Bluetooth Low Energy data is captured, Network Analyzer displays Bluetooth LE transactions and the corresponding events, as shown in the following figure.

Time	e:52.667723s Real t	time:Jan. 1, 07:14:52	Nodes:0 Event:BLE Attributes Protocol							
Tran	sactions total:3,23	5 shown:3,168								~ 🗆
	Time	Duration	Summary	NWK Src	NWK Dest	P#	M# E#	Error Status	Warning Status	^
	52.521465	0.050	BLE LL Control - Version Exchange Procedure	71 59 93 AC 12 5	0 90 FD 9F C8	F0 19 2				
	52.618970	0.001	BLE LL Control - Connection Update procedure	71 59 93 AC 12 5	0 90 FD 9F C8	F0 19 1				
I	52.667723	0.050	BLE ATT - Read By Group Type Request/Response	71 59 93 AC 12 5	0 90 FD 9F C	F0 19 2				
	52.813978	0.050	BLE ATT - Read By Group Type Request/Response	71 59 93 AC 12 5	0 90 FD 9F C8	Fo 19 2				
	52.917734	0.009	BLE ATT - Read By Group Type Request/Response	71 59 93 AC 12 5	0 90 FD 9F C8	F0 19 2				
	52.932734	0.009	BLE ATT - Read By Type Request/Error	71 59 93 AC 12 5	0 90 FD 9F C8	F0 19 2				
	52.947734	0.009	BLE ATT - Read By Type Request/Response	1 59 93 AC 12 5	0 90 FD 9F C8	F0 19 2				
	52.962736	0.009	BLE ATT - Read By Type Request/Error	71 55 73 AC 12 5	0 90 FD 9F C8	F0 19 2				
	52.971368	1.340	BT Mesh - Looking for Provisioner (Device: 53 69 6C 61 62	. 90 FD 9F . 50 19	9 71 59 93 AC	12 50 23				
	52.977738	0.009	BLE ATT - Find Info Request/Response	71 59 93 AC 12	90 FD 9F C8	F0 19 2				` ~
<										>
Ever	nts total:27,086 sho	own:26,500 Decoder	rs: Bluetooth Low Energy, Default Profile							
	Time	Туре	Summary		MAC Src	MAC Dest	Event error status	Event warning status		^
Γ.	52.667723	Packet	BLE ATT: Read By Group Type Request		71 59 93 AC 12 50	30 FD 9F C8 F0 19				
œ	52.668126	Packet	BLE LL - Empty PDU		90 FD 9F C8 F0 19	71 59 93 AC 12 50				
ш.	52.716789	Packet	BLE ATT: Read By Group Type Response		90 FD 9F C8 F0 19	71 59 93 AC 12 50	_			
œ	52.717728	Packet	Unprovisioned Device Beacon		90 FD 9F C8 F0 19					
	52.718262	Packet	Unprovisioned Device Beacon		90 FD 9F C8 F0 19					
	52.718767	Packet	Unprovisioned Device Beacon		90 FD 9F C8 F0 19					
	52.813978	Packet	BLE ATT: Read By Group Type Request		71 59 93 AC 12 50	90 FD 9F C8 F0 19				
	52.814382	Packet	BLE LL - Empty PDU		90 FD 9F C8 F0 19	71 59 93 AC 12 50				
	52.819523	Packet	BLE LL - Adv Indication		90 FD 9F C8 EF FC					
	52.820321	Packet	BLE LL - Adv Indication		90 FD 9F C8 EF FC					
	52.821090	Packet	BLE LL - Adv Indication		90 FD 9F C8 EF FC					
	52.863046	Packet	BLE ATT: Read By Group Type Response		90 FD 9F C8 F0 19	71 59 93 AC 12 50	_			
	52.863915	Packet	Unprovisioned Device Beacon		90 FD 9F C8 F0 19					
	52.864450	Packet	Unprovisioned Device Beacon		90 FD 9F C8 F0 19					
	52.864955	Packet	Unprovisioned Device Beacon		90 FD 9F C8 F0 19					
	52.895392	Packet	BLE LL - Adv Indication		4B 76 31 93 70 78					
	52.899337	Packet	BLE LL - Adv Non-connectable Indication		D8 7C B3 C4 71 3D					_
	F2047724	Dealart	DIF ATT. D. J. D. C. T. D. D. C		71 50 02 40 12 50	00 50 05 00 50 40				*

It shows that related packets like requests and responses together make a transaction. These transactions are listed separately in the Transactions pane. To find the first packet of the transaction, simply click on the transaction. To see the details of the packet, simply click on the packet. You can see both the raw and the parsed format of the packet in the Hex Dump / Event Detail pane (see section 3.2.2 Interval Editor for more detail).

To disable the display of some transactions that are not of interest, use **Preference > Network Analyzer > Decoding > Transaction Grouper**. The following figure shows an example of "BLE Advertisement Grouper".

S Preferences		— D X
type filter text	Transaction Groupers	← → ⇒ 8
type hiter text General C(++) Help Install/Update MCU Vetwork Analyzer Capture Configuration Capture File Storage Connectivity Display Decoding Bluetooth Frames and Fields Reports Security Keys Stack Versions Transaction Groupers Energy Profiler Integration Node Icons Optional Dialogs Stream Visualization Timeline Wireshark Run/Debug Simplicity Studio Team Terminal Wireless Development	Transaction Groupers Enable groupers (takes effect only in new streams): 15.4 Association Grouper 15.4 Grouper Alarm BLE Advertisement Extension Grouper BLE Advertisement Grouper BLE Advertisement Extension Grouper BLE Advertisement Grouper BLE Attribute Commands and Notifications BLE Attribute Protocol Grouper BLE Attribute Protocol Grouper BLE Attribute Protocol Grouper BLE May Control Grouper BT Ink Layer Control Grouper BT Mesh Advertisement Grouper Show only toplevel transactions Transaction types that will be hidden if not further grouped: 15.4 MAC transaction BLE Advertisement BLE Advertisement Extensions BLE Attribute Protocol BLE Attribute Strotocol BLE Flairing BT Mesh Access Message Transactions BT Mesh Advertisement BT Mesh Advertisement BT Mesh Advertisement BT Mesh Advertisement	
		Restore Defaults Apply
0 è 14		Apply and Close Cancel

4.1.1 Bluetooth Low Energy Transaction Example



The Event Detail pane allows you to inspect packets at various levels, down to radio data. The example above shows a description of a Bluetooth Low Energy connection being established between a central and peripheral.

When the feature exchange transaction is selected, the Event panes display the corresponding Bluetooth LE events. Scroll up in the Event pane to find the Connection Indication packet.



The packets corresponding only to a particular Bluetooth LE connection can be filtered using the radio synchronization word. To do so, in the Radio info in the Event detail pane, right-click on "Sync word" and add to the filter.

Once the Bluetooth LE connection is established, ATT transactions can take place. The following example illustrates a "Read by Group Type" ATT request and the corresponding response. Use the Event Detail pane on the right side to inspect the content of the request.

🕒 sl	_btmesh_apiJ	.h 🛛 🛛 sl_btmesh	h_lib.c 🛛 🗷 sl_btmesh_se	sl_bt_api.h	🛿 main.c	🛽 sl_system_i	I sl_event	_ha 🔽 sl_t	otmesh.c	☑ sl_btr	mesh_ge 💽 sl_t	btmesh_bg [sl_blue	etooth.h	🚄 battery ser	a battery ser	82 ³⁹ 7	- 0
2 sa	wed filters	AND																- > 0 0 🖻
	00 - 410	(82-																
-0.1	000-2000	1238 Concernance	and a second state		- Anna Anna Anna An					- Annual			يمساما	hand here	ter ter and the set of the set of the			286.2098
Tim	ne:12.693320	s Real time:lan. 1	1.07:14:12 Nodes:0 Ev	ent:BLE Attributes Pro	tocol									S Even	t Detail			
Tra	nractions t	total:2.225 chown:2	2 160										~ []	× BLE	Data [2 bytes]			
IIIa	Time	Durat	tion Cummon			NUMIX See	MMK Deet	D#	140	C.e.	Error Status	Warning Status	-	н	eader: 0x020B			
	10 517656	0.001	DIE Adu, Saan I	Participation and a		FO 4A DA 9D ER	NWK DESI	FF FC 2	IVI T	L.#	Error Status	warning status			CTE Info Present: fa	alse		
	10.517030	0.001	BLE Adv - Scan	Request/Response		73 P7 37 PE 46 A6	40 ED 94 EE 1								More Data: false			
	10.719474	0.004	BLE Adv - Scan	Request/Response		55 25 50 DE 00 41	4A ED 04 33 1	EEEC 2							Sequence Number	: 0x00		
	10.710679	0.001	BLE Adv - Scani	Request/Response		55 92 70 9A 0D F1	90 50 95 68 6								Next Expected Sec	quence Number: 0xl	00	
	10.919258	0.001	BLE Adv - Scan	Request/Response		7F A7 32 2F 14 92	90 FD 9F C8 F	EFFC 2							LL ID: L2CAP start of	or complete (2)		
	10.928807	0.001	BLETL - Adv Sc	in Request		72 B7 27 BE 46 A6	44 F8 A7 7A	10 D0 1			Missing packets				Length: 0x0B			
	11.004350	0.001	BLE Adv - Scan	Request/Response		55 82 70 8A 0D F1	4B 76 31 93 7	70 78 2			mining packets			✓ L2CA	P Protocol [4 bytes]			
	11 007952	0.001	BLETL - Adv Sca	in Request		72 B7 27 BF 46 A6	4B 76 31 93 7	70 78 1			Missing packets			Le	ingth: 7			
	11.327283	0.001	BLELL - Adv Sc	in Request		55 82 70 8A 0D F1	18 B4 30 DE	0F F6 1			Missing packets				nannel ID: Attribute	Protocol (0x0004)		
	11.516854	0.001	BLE LL - Adv Sci	in Request		7E A7 32 2E 14 92	67 A7 A7 29	51.3E 1			Missing packets			Attri	Dute Protocol (7 byt	esj		
	11.518517	0.001	BLE Adv - Scan	Request/Response		7F A7 32 2E 14 92	90 FD 9F C8 E	EF FC 2							Authentication Sig	inature Elac: No. (0)		
	11.533994	0.001	BLE Adv - Scan	Request/Response		7F A7 32 2E 14 92	75 D2 69 28 (6D 6A 2							Command Flag: Dr	(00)		
	11.603593	0.001	BLE Adv - Scan	Request/Response		55 82 70 8A 0D F1	90 FD 9F C8 F	F0 19 2							Method: Read By (Group Type Reques	t (16)	
	11.906122	0.001	BLE LL - Adv Sca	in Request		55 82 70 8A 0D F1	60 AB D2 08	A9 52 1			Missing packets			St	arting Handle: 0x00	01		
	12.000871	0.001	BLE Adv - Scan	Request/Response		55 25 59 DF 08 41	90 FD 9F C8 F	F0 19 2						Er	ding Handle: 0xFFF	F		
	12.118520	0.001	BLE Adv - Scan	Request/Response		7F A7 32 2E 14 92	90 FD 9F C8 E	EF FC 2						A	ttribute Group Type:	Primary Service (0:	x2800)	
	12.197481	0.004	BLE Adv - Scan	Request/Response		71 59 93 AC 12 50	90 FD 9F C8 F	F0 19 2						✓ Radie	o Info EFR32 [12 byt	tes]		
	12.201278	0.001	BLE Adv - Scan	Request/Response		50 4A D4 8D 5B	90 FD 9F C8 F	F0 19 2						C	c3: 27 F5 26			
Ð	12.217315	1.991	BT Mesh - Looki	ng for Provisioner (De	evice: 53 69	90 FD 9F C8 EF FC	71 59 93 AC	12 50 41						н	W End: Rx Success (0xF9)		
	12.352364	0.099	BLE LL Control -	Feature Exchange Pro	ocedure	90 FD 9F C8 EF FC	71 59 93 AC	12 50 2						R	SSI: -17 dBm (0xEF)			
	12.352583	0.098	BLE LL Control -	Feature Exchange Pro	ocedure	71 59 93 AC 12 50	90 FD 9F C8 E	EF FC 2						Sj	mc Word: 50 65 4D	9C		
P	12.399653	2.803	BT Mesh - Looki	ng for Provisioner (De	evice: 53 69	90 FD 9F C8 F0 19		45			Missing packets			Ra	adio info: 0x0D			
	12.498696	0.098	BLE LL Control -	Data Length Update	Procedure	90 FD 9F C8 EF FC	71 59 93 AC	12 50 2							Antenna Select: 0x	00		
	12.547061	0.050	BLE LL Control -	Version Exchange Pro	ocedure	71 59 93 AC 12 50	90 FD 9F C8 8	EF FC 2						_	Sync Word Select:	0x00		
	12.644565	0.001	BLE LL Control -	Connection Update p	procedure	71 59 93 AC 12 50	90 FD 9F C8 E	EF FC 1							Channel Number: I	RF channel 13, 2428	, MHz (13)	
1	12.693320	0.050	BLE ATT - Read	By Group Type Reque	st/Response	71 59 93 AC 12 50	90 FD 9F C8 E	EF FC 2						St	atus byte: 0x03	(0)		
P	12.739742	0.001	BLE LL - Adv Sca	in Request		50 4A D4 8D 5B	18 B4 30 E1 E	7 6D 1			Missing packets		~		Protocol ID: RLE /2	s (U)		
<													>	In	fo Configuration: Dr	(59) (69)		
Eve	ents total:2	7,086 shown:26,50	0 Decoders: Bluetooth	Low Energy, Default P	Profile										TxRx Indicator: Rx	(1)		
	Time	Туре	Summary			MAG	Src	MAC Dest	Event err	or status	Event warning s	tatus	^		Appended info Ler	nath: 0x05		
F	12.693320	Packet	BLE ATT: Re	ad By Group Type Rec	quest	71 5	9 93 AC 12	90 FD 9F C8 EF							Appended Info Ver	rsion: 0x00		
æ	12.693723	Packet	BLE LL - Em	oty PDU		90 F	D 9F C8 EF	71 59 93 AC 12										
æ	12.701804	Packet	BLE LL - Adv	Indication		4A E	B 84 55 D											
P	12.704978	Packet	BLE LL - Adv	Indication		4A E	B 84 55 D											
P	12.716512	Packet	BLE LL - Adv	Non-connectable In	dication	D8 7	C B3 C4 7											
Ð	12.739742	Packet	BLE LL - Adv	Scan Request		50 4	A D4 8D 5	18 B4 30 E1 E7										
P	12.742072	Packet	BLE LL - Em	pty PDU		71 5	9 93 AC 12 9	90 FD 9F C8 EF										
É.	12.742385	Packet	BLE ATT: Re	ad By Group Type Res	sponse	90 F	D 9F C8 EF	71 59 93 AC 12										
P	12.743322	Packet	Unprovision	ed Device Beacon		90 F	D 9F C8 EF											
	12.743828	Packet	Unprovision	ed Device Beacon		90 F	D 9F C8 EF							Hex Du	mp [26 bytes]			⊽ 🗖
	12.744364	Packet	Unprovision	ed Device Beacon		90 F	D 9F C8 EF							F8 02	OB 07 00 04 0	0 10 01 00 F		····· ^
	12.790822	Packet	BLE ATT: Re	ad By Group Type Rec	quest	71 5	9 93 AC 12 9	90 FD 9F C8 EF						50 0D	27 F5 26 F 03 68	9 EF 9C 4D 6	> ===(('-	аMe
	12.791226	Packet	BLE LL - Em	pty PDU		90 F	D 9F C8 EF 1	71 59 93 AC 12										
	12.799461	Packet	BLE LL - Adv	Scan Request		55 8	2 70 8A 0D 9	90 FD 9F C8 F0										
	12.799676	Packet	Unprovision	ed Device Beacon		90 F	D 9F C8 F0											
	12,800210	Packet	Unprovision	ed Device Beacon		90 F	D 9E C8 E0											

After a Bluetooth Low Energy connection is established, the next step is typically the GATT discovery of the GATT Client. A dedicated view is available for that under **Preferences > Network Analyzer > Decoding > Bluetooth**, which lists all GATT services/characteristics/descriptors and handles, can be used. There, the ability to save the view is also provided.

For more information on how Bluetooth Low Energy operates and how it can be monitored with Network Analyzer, refer to the <u>Bluetooth</u> LE connection and GATT connection flowcharts.

Additionally, the Event Difference pane can be used as a diffing tool between two different events. The following figure illustrates the event diff between a scan request and response.

I Radio Info 🖆 Ev	ent Dif 🕺 🖁 Conne	ctiv 🖒 Data Can 👘 🗖	T	ransactions	total:3,235 sho	own:3,168					
	chi Dhi to to conne	S 100 S	E	vents total:2	7,086 shown:2	26,500 Decoders: Bluetooth Low Energy,	Default Profi	le			
Time difference: 0	002020-			Time	Туре	Summary	MAC Src	MAC Dest	Event error	Event warni	
Time difference: -0.	0028305		Г	58.395361	Packet	BLE LL - Adv Scan Request	7F A7 32	90 FD 9F			
Field	58.395361	58.398191		58.395989	Packet	BLE LL - Adv Indication	90 FD 9F				J
originator	000440144682	000440144681		58.396722	Packet	BLE LL - Adv Indication	90 FD 9F				
✓ bleAdvHeader	present	different	æ	58.397426	Packet	BLE LL - Adv Indication	90 FD 9F				
header	430c	406	ĭ	58 398191	Packet	BLE LL - Adv Scan Response	90 ED 9E				
rxAdd	0	0	-	50,00007	Packet	PLE LL - Adv Indication	00 ED 0E				
txAdd	1	0		50.419627	Packet	DEC LL Advindication	00 50 05				
chSel	0	0		58.420626	Packet	BLE LL - Adv Indication	90 FD 9F				
pduType	3	4		58.421327	Раскет	Access Message: Config Composition	90 FD 9F				
length	с	6		58.421395	Packet	BLE LL - Adv Indication	90 FD 9F				
scanA	7F A7 32 2E 14 92	missing		58.421942	Packet	Access Message: Config Composition	90 FD 9F				
advA	90 FD 9F C8 F0 19	90 FD 9F C8 F0 19		58.422526	Packet	Access Message: Config Composition	90 FD 9F				
advACompa	9502111	9502111		58.425361	Packet	Access Message: Config Composition	90 FD 9F				
advACompa	13168665	13168665		58.425977	Packet	Access Message: Config Composition	90 FD 9F				
> radioInfoEfr32	present	different		58.426591	Packet	Access Message: Config Composition	90 FD 9F				

4.1.2 Bluetooth Low Energy Data Decryption

Network Analyzer decrypts Legacy encryption automatically. In effect, the keys are harvested from the Bluetooth LE traffic data. When packets are encrypted using Secure Connection on the other hand, they can only be decrypted when using the security manager of the

Bluetooth Low Energy stack in debug mode. In the Silicon Labs Bluetooth Low Energy stack, this can be turned on using the following routine:

sl_status_t sl_bt_sm_set_debug_mode(void)

When using Secure Connections, this has the effect of having the Security Manager using debug keys. Those keys are also known by the Network Analyzer, which allows it to decrypt the Bluetooth LE data traffic.

To disable debug mode, restart the device. For more information, please refer to docs.silabs.com.

4.2 Network Analyzer for Bluetooth Mesh

This section presents the capabilities of Network Analyzer for the Bluetooth mesh protocol. Network Analyzer offers the following features:

- Decryption of the Bluetooth mesh packets at all levels (network, application...)
- Handles Network-level segmentation / reassembly.
- Tracing packets from nodes out of RF reach from the PC (over Ethernet)
- Tracing packets from multiple nodes at once (several WSTKs connected over Ethernet)

As a reminder, Network Analyzer currently supports the Bluetooth mesh 1.0.1 profile and model specification. Support of Bluetooth mesh devices properties is limited. Provisioning Data PDUs cannot be decrypted and the map pane is not reliable.

4.2.1 Default IV Index Value

A Bluetooth mesh live or recorded session that has a non-zero IV index will not be decrypted properly. This can be adjusted in the Bluetooth decoder (**Preferences > Network Analyzer > Decoding > Bluetooth**) by setting the default IV index value. The following figure illustrates this.

S Preferences		
type filter text	Bluetooth	⇔ ▼ ⇔ ▼ 8
✓ Decoding	Default IVI value(c): 00.00.00.20	
Bluetooth		
Frames and Fields	Enable persistent cache of connection records.	
Reports	> Today: 71 59 93 AC 12 50 ⇒ 90 FD 9F C8 EF FC	d Delete
Security Keys	> Today: 71 59 93 AC 12 50 ⇒ 90 FD 9F C8 F0 19	
Stack Versions	> Today: 60 EE A9 E6 F0 62 ⇒ 16 17 FE 9F 03 03	I Delete all
Transaction Groupers		
Energy Profiler Integration		
Node Icons		
Optional Dialogs		
Stream Visualization		
Timeline		
Wireshark		
> Run/Debug		
> Simplicity Studio		
> Team		
Terminal		
> Wireless Development	Destern Defaulte	Annaha
×	Restore Defaults	Apply
	Apply and Close	Cancel

Make sure to import the ISD capture file again to see the change being applied.

Note: More information on the IV index can be found in AN1318: IV Update in a Bluetooth Mesh Network.

4.2.2 Keys

The Bluetooth mesh stack is composed of several layers, starting from the network layer up to the access layer. Data traffic can be encrypted in various context (that is, stack layer levels):

- Network: Each Bluetooth mesh network has its associated network key. A node can have several network keys.
- Device: Each device in a particular network has its own device key.
- Application: Each application, depending on how it is configured, has its own application key.

For more detail on how Bluetooth mesh security and encryption work, refer to the Bluetooth mesh profile specification.

When building a Bluetooth mesh network using a smart phone application or a gateway, it should be possible to export the corresponding security keys. The security keys can correspond to any of the three types: network, device, or application. The provisioner should allow you to export the keys in a text format that can then be shared with other applications.

This is useful typically in the case of analyzing network traffic or rebuilding a network from scratch. Network Analyzer can import and export Bluetooth mesh keys. With the Silicon Labs Bluetooth mesh mobile application, a JSON text format is used for keys import/export.

The following steps indicates how to export keys using the Silicon Labs Bluetooth mesh phone application. Note that the steps are independent from the phone operating system, but the graphic layout of the smart phone application might differ.

1. Browse to the export menu.



2. Use the Export cryptographic keys button to create the corresponding JSON file. The JSON file called **MeshDictionary.json** can now be sent via email.



This should make a menu open allowing the user to select by which mean it wished to send the MeshDictionary.json file.

The content of the (generated) **MeshDictionary.json** JSON file is human readable text and contains a collection of keywords and hexadecimal coded Bluetooth mesh keys.

The following steps indicates how to import the corresponding keys in Network Analyzer.

1. Go to Preferences > Network Analyzer > Decoding > Security Keys.

recences					
type filter text	Se	curity Keys			Q ¥ Q ¥ 1
> Install/Update	^	heck to activate. Enter	16 char ASCII or 32 char Hex		
> MCU			To char Abell of SE char nex		1
 Network Analyzer 		A I Name	Key	louched ^	New
Capture Configuration		C App Bootload	65 6D 62 65 72 20 45 4D 32 35 30 20 61 62 6C 4C	Sep. 15, 20	Import
Capture File Storage	E	C App Bootload	65 6D 62 65 72 20 45 4D 32 35 30 20 61 62 6C 4E	Sep. 15, 20	
Connectivity Display	5	ConnectSampl	AA	Sep. 15, 20	Clone
✓ Decoding	6	C Default Frame	05 05 05 05 05 05 05 05 05 05 05 05 05 0	Sep. 15, 20	Delete
Bluetooth	E	E Default Frame	04 04 04 04 04 04 04 04 04 04 04 04 04 0	Sep. 15, 20	
Frames and Fields	E	C Default IP Test	BF BE BD BC BB BA B9 B8 B7 B6 B5 B4 B3 B2 B1 B0	Sep. 15, 20	Invert
Reports	E	C Default OWL	12 34 56 78 9A BC DE F0 12 34 56 78 9A BC DE F0	Sep. 15, 20	Clear All
Security Keys	5	C Default OWL	22 22 22 22 22 22 22 22 22 22 22 22 22	Sep. 15, 20	
Stack Versions	6	F Device Key: (5)	54 A1 9A A8 97 C6 E0 AB BA FD 0A 1E 7B E5 E8 22	Jun. 1	Run HMAC
Transaction Groupers	6	F Device Key: (6)	A3 FD CF DE 6A 26 10 23 96 8A 6A CB 63 FF FD 30	Jun. 1	ASCIL edit
Energy Profiler Integration	5	Harvested	4E 3D AB 1A 54 83 18 FD 57 AF 13 9D C0 BA 14 C7	Today	
Node Icons	6	F Net Key: (2)	06 EC 38 C4 91 4C 36 06 60 89 ED E9 6E CE 4B 46	Jun. 1	
Optional Dialogs	F	C Sensor/Sink Link	5A 69 67 62 65 65 20 53 65 63 75 72 69 74 79 21	Sep. 15. 20	
Stream Visualization	F	E Sensor/Sink N	65 6D 62 65 72 20 45 4D 32 35 30 20 63 68 69 70	Sep. 15, 20	
Timeline		C Smart Energy	12 33 33 33 33 33 33 33 33 33 33 33 33 33	Sep. 15, 20	
Wireshark		C Smart Energy	56 77 77 77 77 77 77 77 77 77 77 77 77 77	Sep. 15, 20	
> Run/Debug		A C Canadalana Da		Con 15,20	
> Simplicity Studio	4	<		>	
> Team		Save decryption keys	in ISD files Disable keys when not used for 3	65 days	
Terminal					
> Wireless Development	~		Rest	ore Defaults	Apply

- 2. Deselect all default and saved keys that are already present and click Import...
- 3. Browse to the MeshDictionary.json file.

Encryption Key File			×	Preferences						
← → × ↑ 📕 > This PC	> Downloads > keys	Search keys	م	type filter text	Security K	rys				0.40.4
Organize • New folder			· · 0	> General	Check to act	ivate. Enter 16 ch	ar ASCII or 32 char Hex			
	Name	^	Date modified	> Help	A	T	Name	Key		New
Quick access	C			> Install/Update		D	ZigBeeAlliance09	5A 69 67 42 65 65 41 6C 6C 69 61 6E 63 65 30 39		Import
	MeshDictionary.jsor	n	2021-06-03 12:20	> MCU		D	Super Parent Network	53 75 70 65 72 50 61 72 65 6E 74 4E 65 74 77 4B		mipors
 OneDrive 				 Network Analyzer 		D	Super Parent Link	53 75 70 65 72 50 61 72 65 6E 74 4C 69 6E 6B 4B		Clone
This PC				Capture Configuration		D	Standalone Bootloader Netw	65 6D 62 65 72 20 45 4D 32 35 30 20 6E 77 6B 20		Delet
Duritor				Capture File Storage		D	Standalone Bootloader Link	65 6D 62 65 72 20 45 4D 32 35 30 20 6C 69 6E 68		
Desktop				Connectivity Display		D	Smart Energy Network	56 77 77 77 77 77 77 77 77 77 77 77 77 77		Inver
Documents				✓ Decoding		D	Smart Energy Link	12 33 33 33 33 33 33 33 33 33 33 33 33 33		Clear
Downloads				Bluetooth		D	Sensor/Sink Network	65 6D 62 65 72 20 45 4D 32 35 30 20 63 68 69 70		
Music				Frames and Fields		D	Sensor/Sink Link	5A 69 67 62 65 65 20 53 65 63 75 72 69 74 79 21		Run HM
				Reports		F	Net Key: (2)	06 EC 38 C4 91 4C 36 06 60 89 ED E9 6E CE 4B 46		ASCILO
Pictures				Security Keys		н	Harvested	4E 3D AB 1A 54 83 18 FD 57 AF 13 9D C0 BA 14 C7		
Videos				Stack versions		F	Device Key: (6)	A3 FD CF DE 6A 26 10 23 96 8A 6A CB 63 FF FD 30		
USDisk (C:)				Factor Dealing Interaction		F	Device Key: (5)	54 A1 9A AB 97 C6 E0 AB BA FD 0A 1E 7B E5 E8 22		
				blade large		D	Default OWL AES Key 2	22 22 22 22 22 22 22 22 22 22 22 22 22		
Network				Ontional Dialogr		D	Default OWL AES Key 1	12 34 56 78 9A BC DE F0 12 34 56 78 9A BC DE F0		
				Stream Visualization		D	Default IP Test Event Key	BF BE BD BC 88 8A 89 88 87 86 85 84 83 82 81 80		
				Timeline		D	Default Framework V1 Nwk Key	04 04 04 04 04 04 04 04 04 04 04 04 04 0		
	¢			Wiresbark		D	Default Framework V1 Lnk Key	05 05 05 05 05 05 05 05 05 05 05 05 05 0		
File name	MeshDictionarvison			> Run/Debug		D	ConnectSampleAppKey	AA		
				> Simplicity Studio		D	App Bootloader Network	65 6D 62 65 72 20 45 4D 32 35 30 20 61 62 6C 4E		
		Open	Cancel	> Team		D	App Bootloader Link	65 6D 62 65 72 20 45 4D 32 35 30 20 61 62 6C 4C		
				Terminal						
		10.040303	Packet	> Wireless Development						
		18,695135	Packet		4					>
		18.792325	Packet		Save dec	ryption keys in ISD	files Disable keys when not us	ed for 365 days		
		18.889631	Packet						Pertore Defaults	Analy
		18.938696	PECKEE						nestore Detaults	Abbiy
		18.987649	Packet							
		19.064639	Packet						Apply and Close	Cancel
		22.900007	PACKES							

4. Click **Open** and see the keys imported in the "Security Keys" window. For debugging purposes, the decryption keys can be saved in the ISD file (by checking the corresponding checkbox). This is not best practice from a security point of view but is acceptable for debugging. These instructions assume you have checked this.

5. Click Apply and Close.

type filter text	Security	Keys				* 0 * 8
> General	Check to	schuste Enter 16 ch	AND AND AN AND AN AND AND AND AND AND AN			
> C/C++	Check to i	scuvate, Litter TV Li	al Poci of Sz chai Hex			
> Help	A	T	Name	Кеу	^	New
> Install/Update		D	ZigBeeAlliance09	5A 69 67 42 65 65 41 6C 6C 69 61 6E 63 65 30 39		Import.
> MCU		D	Super Parent Network	53 75 70 65 72 50 61 72 65 6E 74 4E 65 74 77 4B		
 Network Analyzer 		D	Super Parent Link	53 75 70 65 72 50 61 72 65 6E 74 4C 69 6E 6B 4B		Clone
Capture Configuration		D	Standalone Bootloader Network	65 6D 62 65 72 20 45 4D 32 35 30 20 6E 77 6B 20		Delete
Capture File Storage		D	Standalone Bootloader Link	65 6D 62 65 72 20 45 4D 32 35 30 20 6C 69 6E 6B		o erere
Connectivity Display		D	Smart Energy Network	56 77 77 77 77 77 77 77 77 77 77 77 77 77		Invert
✓ Decoding		D	Smart Energy Link	12 33 33 33 33 33 33 33 33 33 33 33 33 33		Clear All
Bluetooth		D	Sensor/Sink Network	65 6D 62 65 72 20 45 4D 32 35 30 20 63 68 69 70		
Frames and Fields		D	Sensor/Sink Link	5A 69 67 62 65 65 20 53 65 63 75 72 69 74 79 21	R	Run HMAC
Reports		F	Net Key: (2)	06 EC 38 C4 91 4C 36 06 60 89 ED E9 6E CE 4B 46	4	ASCII edit
Security Keys		F	Net Key:	6A F3 88 87 57 87 FA 84 D0 93 FE 31 E4 57 FE 85		
Stack Versions		н	Harvested	4E 3D AB 1A 54 83 18 FD 57 AF 13 9D C0 BA 14 C7		
Transaction Groupers		F	Device Key: (6)	A3 FD CF DF 6A 26 10 23 96 8A 6A CB 63 FF FD 30		
Energy Profiler Integration		F	Device Key: (5)	54 A1 9A A8 97 C6 F0 AB BA FD 0A 1E 7B F5 F8 22		
Node Icons		D	Default OWL AES Key 2	22 22 22 22 22 22 22 22 22 22 22 22 22	_	
Optional Dialogs		D	Default OWL AES Key 1	12 34 56 78 9A BC DE F0 12 34 56 78 9A BC DE F0		
Stream Visualization		0	Default IP Test Event Key	RE RE RD RC RR RA R9 R8 R7 R6 R5 R4 R3 R2 R1 R0		
Timeline		D	Default Framework VI Nek Key	D4 04 04 04 04 04 04 04 04 04 04 04 04 04		
Wireshark		0	Default Framework VI Lok Key	05 05 05 05 05 05 05 05 05 05 05 05 05 0		
> Kun/Debug		0	ConnectSampleAppKey			
> Simplicity Studio		E	Ann Kee	ST BE AA SC ET AE OD TO DT EA DC SE AE AT DO DE		
> leam	<u> </u>	0	App Ney.	32 63 A4 34, ET 40 35 TO 33 EA DA, 33 4F 42 50 80		
Terminal		0	App Bootloader Network	05 0D 02 05 72 20 45 4D 32 35 30 20 01 02 0C 4E	~	
> wireless Development	<		ann woowshiler Liny		>	

- 6. After importing the keyfile, select File > Other Network Analyzer Actions ... > Reload to refresh the data.
- 7. Finally, save the ISD file (checkbox in the bottom left of the security key dialog box).

The access layer Bluetooth mesh data should now be decrypted. The following sections show the expected result, in green on the top right corner of the figures.

4.2.3 Bluetooth Mesh Advertising Packets

The Bluetooth mesh technology is based on Bluetooth LE advertising packets. Bluetooth mesh traffic is differentiated from the regular Bluetooth LE traffic through the AD types used by the Bluetooth mesh advertising packets. Network Analyzer can filter advertising packets in a number of ways.

The following AD types are used for advertising bearer-based Bluetooth mesh traffic:

AD Type value	Data type name	Reference for definition
0x29	PD-ADV	Bluetooth Mesh Profile specification section 5.2.1
0x2A	Mesh Message	Bluetooth Mesh Profile specification section 3.3.1
0x2B	Mesh Beacon	Bluetooth Mesh Profile specification section 3.9

Based on this information, Bluetooth mesh advertising packets can be filtered. The following filters can be entered in the filter bar:

• bleAdv.adv_type_0 == 0x2b. This shows only Bluetooth mesh beacons that are used essentially for provisioning and secure data information propagation (secure beacons). The following shows an example.

∎ sl_	btmesh_api.h	sl_btmesh_lib.c	I sl_btmesh_se I sl_bt_api.h	n 🖪 main.c	sl_system_i	sl_event_ha	sl_btmes	h.c 尾	sl_btmesl	h_ge	sl_btmesh_bg	sl_bluetooth.h	🚄 bat	tery ser	battery ser	. 23 ³⁹ 7	-	
2 sa	ved filters Al	ND bleAdv.adv_type_0	== 0x28														× 📜 🔿 🎯	C
277.	00 p/g A A	32.3015																
-0.0	00:00:00	and the second states which the	The second state of the second sec					- Anna - Anna	and the second	en der er ber		Advention from the sec					286.2	19:
Tim	e:32.301267s	Real time:Jan. 1, 07:14:3	2 Nodes:0 Event:EFR Tx packet											R Even	t Detail		0	-
			\sim										Â	→ BLE A	Advertisement Da	.a [2 bytes]		^
		•		• •	• •			•	•	•	• •	• • •		Â	dv_ien_u: ux 14	aacon (0x2P)		
		000440144682 (2010)	00044910000144681 (2012) (2012)					(20)	10)					RIE	dvertisement He	eder (8 bytes))	
	•			• •		• •	• •				• •	•		Y BT M	esh Beacon [19 b	rtes]		
														B	eacon Type: Unpro	visioned Dev	ice Beacon (0)	à
-						(C000)					(2006)		~	D	evice UUID: 53 69	6C 61 62 73 4	4 65 76 2D 19	
Tran	sactions tot	al:3,235 shown:25											0 U	0	OB Information: 0	x0000		
	Time	Duration	Summary		NWK Src	NWK Dest	P	*	M#	E#	Error Status	Warning Status	^		On Device: false			
	24.600334	2.003	BT Mesh - Looking for Provision	er (Device: 53 69	6C 6 90 FD 9F C8 I	F0 19	3	3			Missing packets				Inside Manual: fa	ilse		
	26.803235	1.200	BT Mesh - Looking for Provision	er (Device: 53 69	6C 6 90 FD 9F C8 I	F0 19	2	1			Missing packets				On Piece Of Pape	er: false		
	28.200534	1.405	BI Mesh - Looking for Provision	er (Device: 53 69	6C 6 90 FD 9F C8 F	F0 19	2	4			Missing packets				Inside Box false			
	29,803402	1.403	BI Mesh - Looking for Provision	er (Device: 53 69	6C 6 90 FD 9F C8 F	F0 19	2	4			Missing packets				On Box: false			
	31.403522	2.800	BI Mesh - Looking for Provision	er (Device: 53 69	6C 6 90 FD 9F C8 I	F0 19	4	8			Missing packets				String: Taise			
	34.403689	3.000	BI Mesh - Looking for Provision	er (Device: 53 69	6C 6 90 FD 9F C8 1	F0 19	4	8			Missing packets		- 10		Number: raise			
	40,701000	2.903	BT Mesh - Looking for Provision	er (Device: 53 69	6C 6 90 FD 9F C8 1	F0 19		0 E			Missing packets				Rar Code: false			
	40.701250	2.005	BT Mesh - Looking for Provision	er (Device: 55.69	6C 6 90 FD 9F C8 1	FU 19					Missing packets				2 D Machine Rea	dable Code: f	alse	
	45.704365	2.999	BT Meth - Looking for Provision	er (Device: 53.69	6C 6 90 FD 9F C8 F	EO 19	-	5			Missing packets				Electronic Uri: fa	lse		
	40.004523	4.407	BT Mesh - Looking for Provision	er (Device: 53.69	6C 6 90 ED 9E C8 I	E0 10 71 50 93 A	C 12 50 6	5			missing pockets				Other: false			
	52 971368	1 340	BT Mesh - Looking for Provision	er (Device: 53.69	6C 6 90 ED 9E C8 I	EO 19 71 59 93 A	C 12 50 2	2						v Radi	o Info EFR32 [11 b	ytes]		
<	52.571500	1.540	of Mean - Looking for Fronsion	ci (bence: 55 65	0000	1015 7155554	C 12 30 2	,					>	0	c3: 36 22 16			
														Н	W End: Tx Success	(0xFD)		
Ever	its total:27,0	186 shown:1,044 Deco	ders: Bluetooth Low Energy, Default	Profile										Sj	nc Word: 8E 89 B	: D6		
_	Time	Type	Summary			MAC Src	MAC Dest		Event err	or status	Event warning st	atus	^	Ri	adio info: 0x00			
	32.301267	Packet	Unprovisioned Device Beau	con		90 FD 9F C8 F0 19									Antenna Select:	Jx00		
1 I	32.301803	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19									Sync Word Selec	2 0x00		
D - 1	32.500774	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19									Channel Number	: ICP channel U	i, 2402 MHZ (U	
10 - I	32,501308	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19								3	atus byte: 0x05			~
12 - I	32.501813	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19								<			>	
12 - I	32.700784	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19								Hex Du	mp [41 bytes]		0	
10 - I	22,701218	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19								FC 02	1B 19 F0 C8 2B 00 53 69	9F FD .	.+.Sila	^
10 - I	22,002560	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19								62 73	44 65 76 2D	19 F0 E	sDev	
12 - I	32,003500	Packet	Unprovisioned Device Beau	con		90 ED 9E C8 E0 19								16 FD	FD 90 00 00 D6 BE 89 8E	36 22 .		
R -	22,904600	Packet	Unprovisioned Device Bea	con		90 ED 9E C8 E0 19								20				
18 - I	33,003611	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
16 - I	33.004145	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
1i -	33,004650	Packet	Unprovisioned Device Bear	con		90 ED 9E C8 E0 19												
1i -	33,200813	Packet	Unprovisioned Device Bea	con		90 FD 9F C8 F0 19												
1i -	33,201347	Packet	Unprovisioned Device Bea	con		90 FD 9F C8 F0 19												
i -	33,201852	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
1.1	33.403604	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
1 - I	33.404138	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19							- 10					
1 - I	33.404643	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
1 - I	33.600834	Packet	Unprovisioned Device Beau	con		90 FD 9F C8 F0 19												
1.	33.601338	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
1 - I	33.601874	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
1 - I	33.803656	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
1 - I	33.804191	Packet	Unprovisioned Device Beau	con		90 FD 9F C8 F0 19												
L	33.804695	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
P	34.003667	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19												
	34.004172	Packet	Unprovisioned Device Bear	con		90 FD 9F C8 F0 19							~					

• bleAdv.adv_type_0 == 0x2a. Shows Bluetooth mesh messages. Bluetooth mesh messages are used for common Bluetooth mesh data traffic. The payload of those mesh advertising packets is called "Network PDUs" (specified by the Bluetooth mesh profile specification). "Network PDUs" are the containers of the Network layer data. This is very useful because it allows you to display only the data traffic using the advertising bearer on provisioned nodes in a network. The following figure shows an example:

sl_btmesh_api.h	sl_btmesh_lib.c	i sl_btmesh_se i sl_bt_apih i mainc i sl	system_i 🖸 sl_s	event_ha 🕡	sl_btmesh.c	☑ sl_btmes	h_ge	d sl_btmesh_bg	sl_bluetooth.h	d batter	y ser. battery ser. 11 *** ***
saved filters. AND	bleAdv.adv_type_0 =	== 0x2a									- 1 00
77.00 p/81.thore		anness And Station Follow and a clinic from the strength	and the second second second						San Jan James		A. 286.20
Time:S8.100700s Real	timeJan. 1, 07:14:58	Nodes:0 EventEFR Tx packet								•	Event Detail
-11 (17m									^	BT_MESH_NETWORK crypto: ROOT, 06 EC 38 C4 91 http://doi.org/10.20
		DODAADI MUMADIAAADI					•				BT_MESH_APPLICATION crypto: ROOT, A3 FD CF D
(2	010)	(2012) (2012)				(2010)					- IVE 00 00 00 20
	• •			• •	٠	• •	•	• •	•		 BLE Advertisement Data [2 bytes]
			(C0	(00)				(2006)		~	Adv_len_0: 0x19
fransactions total:3,2	35 shown:96									~ -	Adv_type_0: Mesh Packet (0x2A)
Time	Duration	Summary	NWK Src	NWK Dest	P#	M#	E#	Error Status	Warning Status	^	BLE Advertisement Header (8 bytes)
58.049214	0.294	Config GATT Proxy Set Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 10						 ET Mesh Lower Transport Lawer (Access Message) I
58,390478	0.294	Config Composition Data Get Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 18						 BT Mesh Edwer Transport Layer (Rocess message) [RT Mesh Arriers Message (3 hytes)
58,780499	0.197	Config Node Identity Set Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 10						BI Mesh Network Encryption MIC [4 bytes]
63.460721	0.245	Config AppKey Add Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 11						> BT Mesh App Encryption MIC [4 bytes]
67.555912	0.343	Config Model App Bind Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 14						 Radio Info EFR32 [11 bytes]
68.043443	0.392	Config Model Publication Set Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 15						Crc3: 4E 6D FB
68.530975	0.245	Config Model Subscription Add Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 14						HW End: Tx Success (0xFD)
68.920992	0.294	Config Model App Bind Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 14						Sync Word: 8E 89 BE D6
69.311008	0.294	Config Model Publication Set Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 15						Radio info: 0x0C
69.701024	0.294	Config Model Subscription Add Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 14						Antenna Select: 0x00
70.139792	0.245	Config Model App Bind Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 14						Sync Word Select: 0x00
70.529808	0.343	Config Model Publication Set Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 15						Channel Number: RF channel 12, 2426 MHz
70.968575	0.245	Config Model Subscription Add Transaction	71 59 93 AC 12 50	90 FD 9F C8 F0	19 14					-	Status byte: 0x03
150.013705	13.948	BT Mesh Control Message: Friend Request	90 FD 9F C8 F0 19	FFFD	6						Error Code: Success (0)
150.115113	0.003	BT Mesh Control Message: Friend Offer	90 FD 9F C8 EF FC	2012	3						Protocol ID: BLE (3)
150.125187	0.056	BT Mesh Control Message: Friend Poll	90 FD 9F C8 F0 19	2010	9						T-Pa Indicator: U(20
150.165230	0.016	BT Mesh Control Message: Friend Update	90 FD 9F C8 EF FC	2012	6						Anonediat into Length: 0x04
150.185029	0.097	BT Mesh Control Message: Friend Subscription List Add	90 FD 9F C8 F0 19	2010	12						Appended into cengin 0x00
150.196435	0.098	BT Mesh Control Message: Friend Subscription List Co.,	90 FD 9F C8 EF FC	2012	9						Appended and teratin two
152.341463	0.003	BT Mesh Control Message: Friend Request	90 FD 9F C8 F0 19	FFFD	3						<
152.442884	0.003	BT Mesh Control Message: Friend Offer	90 FD 9F C8 EF FC	2012	3						Hex Dump (46 bytes)
152,452338	9.131	BT Mesh Control Message: Friend Poll	90 FD 9F C8 F0 19	2010	18					F	C 02 20 19 F0 C8 9F FD
152.492298	9.103	BT Mesh Control Message: Friend Update	90 FD 9F C8 EF FC	2012	24					5	8 11 79 69 D6 42 28 CC X.y1.B(.
152.572447	0.037	BT Mesh Control Message: Friend Subscription List Add	90 FD 9F C8 F0 19	2010	6					0	8 B1 ED 42 A5 85 84 C6B
152.584688	0.035	BT Mesh Control Message: Friend Subscription List Co.,	90 FD 9F C8 EF FC	2012	6					8	E 89 8E 0C 03 20
156.910568	0.372	BT Mesh Control Message: Friend Poll	90 FD 9F C8 F0 19	2010	12					4	
********		17 11 C	00 FD 07 CO FF FC							>	
vents total:27,086 sl	nown:912 Decoder	rs: Bluetooth Low Energy, Default Profile									
Time	Type	Summary	MA	C Src M	AC Dest	Event en	ror status	Event warning sta	tus	^	
58.052422	Packet	BT Mesh Segment Acknowledgement Message	901	FD 9F C8 F0 19							
58.052966	Packet	BT Mesh Segment Acknowledgement Message	901	FD 9F C8 F0 19							
58.053542	Packet	BT Mesh Segment Acknowledgement Message	901	FD 9F C8 F0 19						100	
58,100700	Packet	Access Message: Config GATT Proxy Status [1/1]	901	FD 9F C8 F0 19							
58.101276	Packet	Access Message: Config GATT Proxy Status [1*/1]	901	FD 9F C8 F0 19							
58.101851	Packet	Access Message: Config GATT Proxy Status [1*/1]	901	FD 9F C8 F0 19							
58.393931	Packet	BT Mesh Segment Acknowledgement Message	901	FD 9F C8 F0 19							
58.394475	Packet	BT Mesh Segment Acknowledgement Message	90 1	FD 9F C8 F0 19							
58.395051	Packet	BT Mesh Segment Acknowledgement Message	901	FD 9F C8 F0 19							
58.421327	Packet	Access Message: Config Composition Data Status	1/3] 901	FD 9F C8 F0 19							
58.421942	Packet	Access Message: Config Composition Data Status	1*/3] 901	FD 9F C8 F0 19							
58.422526	Packet	Access Message: Config Composition Data Status	1*/3) 901	FD 9F C8 F0 19							
58.425361	Packet	Access Message: Config Composition Data Status	2/3] 901	FD 9F C8 F0 19							Base contract data (2 most)

• bleAdv.adv_type_0 == 0x29. This shows Bluetooth mesh provisioning advertising packets. Those packets use the PB-ADV provisioning bearer and are used to provision a device using "Provisioning PDUs".

4.2.4 Proxy Protocol

The Bluetooth mesh technology is mainly based on Bluetooth LE advertisement packets used along with Bluetooth mesh AD types. Nevertheless, in some cases, some devices are not able to advertise using the Bluetooth mesh AD types. As a consequence, the Bluetooth mesh specification allows communication over a GATT connection and uses what is called the Proxy protocol to exchange Network PDUs.

The proxy protocol is designed to enable nodes to send and receive Bluetooth mesh network packets over a connection-oriented bearer. As mentioned earlier, a node could support GATT but not be able to advertise the Bluetooth mesh Message AD Type. This node will establish a GATT connection with another node that supports the Bluetooth LE ATT bearer, called GATT bearer, and the advertising bearer, using the Proxy protocol to forward messages between these bearers.

Note: The term "GATT bearer", in effect, corresponds exactly to the ATT bearer as specified in the Bluetooth Host specification (Bluetooth Core specification, Host Vol. 3, 3.2.11).

Once the Bluetooth LE connection is established, the node can send and receive what are called "Proxy PDUs". A Proxy PDU is essentially a data container for the following PDUs:

Туре	Name	Description
0x00	Network PDU	The message is a Network PDU as defined in Section 3.4.4 of the profile spec.
0x01	Mesh Beacon	The message is a Bluetooth mesh beacon as defined in Section 3.9. of the profile spec.
0x02	Proxy Configuration	The message is a proxy configuration message as defined in Section 6.5. of the profile spec.
0x03	Provisioning PDU	The message is a Provisioning PDU as defined in Section 5.4.1. of the profile spec.

The Network PDU corresponds to all messages handled at the "Network Layer".

Network Analyzer allows you to filter Bluetooth mesh GATT bearer data in a live (or recorded) network session. Based on this information, Bluetooth mesh packets can be filtered. The following filters can be entered in the filter bar:

• btMeshProxy.type == 0x0. This shows all Network layer traffic. This is the GATT bearer equivalent to filter Bluetooth mesh Messages on advertising bearer traffic. The following figure shows an example (note the application and network key data in green in the top right corner).

sl_btmesh_api.l	h 🔄 sl_btmesh_lib.c	sl_btmesh_se 🗟 sl_bt_api.h 🗟 main.c 🕻	sl_system_i [sl_event_ha	sl_btmesh.c	sl_btmesk	.ge (sl_btmesh_bg	sl_bluetooth.h	🚄 batter	y ser	battery ser	. 22 "7		•
2 saved filters	AND btMeshProxy.type =:	= 0x0												- 🔁 🔍	0
277.00 p/a	18.0120										_			49	-
-0.0005		and the second of the second			and the second second	1	and an in		endedana, here, here					286	2
Time:18.012289s	Real time:Jan. 1, 07:14:18	Nodes:0 Event:BT Mesh Access Message Transactio	15								Event !	Detail			
										^	BT_ME	SH_NETWORK or	ypto: ROOT	, 06 EC 38 C4	ŋ
	•	• • • • • • •					•	• •			- IVE 0	0 00 00 20			
	000440144682	00D4401400EER000144681									BT_MES	SH_APPLICATION	i crypto: RO	OT, 54 A1 94	4
	(2010)	(2012) (2012)			(2010)				~	- IVE 0	0 00 00 20			J
Transactions to	otal:3,235 shown:34									~ 🗆	> BLE Da	ita [2 bytes]			
Time	Duration	Summary	NWK Src	NWK Dest	P#	M#	E#	Error Status	Warning Status	^	> L2CAP	Protocol [4 byte:	s]		
18.012289	0.197	Config GATT Proxy Set Transaction	71 59 93 AC 12	50 90 FD 9F C8	B EF FC 10						> Attnbu	te Protocol [3 by	rtesj		
18.304802	0.489	Config Composition Data Get Transaction	71 59 93 AC 12	50 90 FD 9F C8	B EF FC 30						Proj	In Proxy Protocol	[bytes]		Ŧ
18.889831	0.197	Config Node Identity Set Transaction	71 59 93 AC 12	50 90 FD 9F C8	B EF FC 10						PIO	ig resider, onco	d Reaccomi	u informati	1
22.400007	0.294	Config AppKey Add Transaction	71 59 93 AC 12	50 90 FD 9F C	B EF FC 11							Message Type: N	etwork POU	(m)	T
25.422663	0.294	Config Model App Bind Transaction	71 59 93 AC 12	50 90 FD 9F C8	B EF FC 14						> BT Met	sh Network Laver	[9 bytes]	(*)	,
25.861432	0.294	Config Model Publication Set Transaction	71 59 93 AC 12	50 90 FD 9F C8	B EF FC 15						> BT Mer	sh Lower Transpo	rt Laver (Ac	cess Messao	e)
26.202700	0.294	Config Model Subscription Add Transaction	71 59 93 AC 12	50 90 FD 9F C8	B EF FC 15						> BT Mer	sh Access Messac	e [3 bytes]		
26.592718	0.245	Config Model App Bind Transaction	71 59 93 AC 12	50 90 FD 9F C8	B EF FC 14						> BT Mer	h Network Encry	ption MIC [4 bytes]	
26.982736	0.294	Config Model Publication Set Transaction	71 59 93 AC 12	50 90 FD 9F C8	B EF FC 15						> BT Mer	h App Encryptio	n MIC [4 by	tes]	
27.372757	0.245	Config Model Subscription Add Transaction	71 59 93 AC 12	50 90 FD 9F C8	B EF FC 14						> Radio I	Info EFR32 [12 by	rtes]		
27 714024	0.245	Confin Model Ann Rind Transaction	71 59 93 AC 12	50 90 ED 9E C	R FF FC 14					>					
Events total?	7.096 chown:190 Decoder	r: Rhistooth Low Energy Default Profile													
Time	Tupo	Summany		MAC Sec.	MAC Dort	Event or	or status	Event warning	status	-					
19.012290	Dacket	Access Mercane: Config GATT Prove Set [1/1]		71 50 02 AC 12 50		Cvenc en	or status	Event warning	510105						
18.061354	Packet	BT Meth (GATT Rearer) - BT Meth Segment Arl	nowledgement M	90 ED 9E C8 EE EC	71 59 93 AC 12 50	1									
18 110107	Packet	Access Message: Config GATT Provy Status [1/]	1	90 ED 9E C8 EE EC	71 59 93 AC 12 5										
18 207298	Packet	RT Mesh (GATT Rearer) - RT Mesh Segment Arl	nowledgement M	71 59 93 AC 12 50	90 ED 9E C8 EE EC										
18 304802	Packet	Access Message: Config Composition Data Get	(1/1)	71 59 93 AC 12 50	90 FD 9F C8 FF FC										
18.402621	Packet	BT Mesh (GATT Bearer) - BT Mesh Segment Ac	nowledgement M.	90 ED 9E C8 EE EC	71 59 93 AC 12 50	,									
18,451373	Packet	Access Message: Config Composition Data Sta	tus [1/6]	90 FD 9F C8 EF FC	71 59 93 AC 12 5	5									
18.500126	Packet	Access Message: Config Composition Data Sta	tus [2/6]	90 FD 9F C8 EF FC	71 59 93 AC 12 50)									
18,548879	Packet	Access Message: Config Composition Data Sta	tus [3/6]	90 FD 9F C8 EF FC	71 59 93 AC 12 5)									
18.597630	Packet	Access Message: Config Composition Data Sta	tus [4/6]	90 FD 9F C8 EF FC	71 59 93 AC 12 50)					Hex Dum	p [31 bytes]	00 52		
18.646383	Packet	Access Message: Config Composition Data Sta	tus [5/6]	90 FD 9F C8 EF FC	71 59 93 AC 12 50)				i	9 00 0	0 5D 05 00	01 08		2
18.695135	Packet	Access Message: Config Composition Data Sta	tus (6/6)	90 FD 9F C8 EF FC	71 59 93 AC 12 50)				2	0 01 20	3 10 80 04 . 1 63 C2 A9	20 00	·····	
18.792326	Packet	BT Mesh (GATT Bearer) - BT Mesh Segment Act	nowledgement M	71 59 93 AC 12 50	90 FD 9F C8 EF FC									,	
18.889831	Packet	Access Message: Config Node Identity Set [1/1		71 59 93 AC 12 50	90 FD 9F C8 EF FC										
18.938896	Packet	BT Mesh (GATT Bearer) - BT Mesh Segment Act	nowledgement M	90 FD 9F C8 EF FC	71 59 93 AC 12 50)									
18.987649	Packet	Access Message: Config Node Identity Status [1/1]	90 FD 9F C8 EF FC	71 59 93 AC 12 50)									
19.084839	Packet	BT Mesh (GATT Bearer) - BT Mesh Segment Act	nowledgement M	71 59 93 AC 12 50	90 FD 9F C8 EF FC										
22.400007	Packet	Access Message: Config AppKey Add [1/2]		71 59 93 AC 12 50	90 FD 9F C8 EF FC										
22.497512	Packet	Access Message: Config AppKey Add [2/2]		71 59 93 AC 12 50	90 FD 9F C8 EF FC										
22.546578	Packet	BT Mesh (GATT Bearer) - BT Mesh Segment Act	nowledgement M	90 FD 9F C8 EF FC	71 59 93 AC 12 50)									
22.595331	Packet	Access Message: Config AppKey Status [1/1]		90 FD 9F C8 EF FC	71 59 93 AC 12 5)									
22.692523	Packet	BT Mesh (GATT Bearer) - BT Mesh Segment Act	nowledgement M	71 59 93 AC 12 50	90 FD 9F C8 EF FC										
25.422663	Packet	Access Message: Config Model App Bind [1/1]		71 59 93 AC 12 50	90 FD 9F C8 EF FC										
25.520481	Packet	BT Mesh (GATT Bearer) - BT Mesh Segment Act	nowledgement M	90 FD 9F C8 EF FC	71 59 93 AC 12 50)									
25.569232	Packet	Access Message: Config Model App Status [1/2	0	90 FD 9F C8 EF FC	71 59 93 AC 12 50)									

• btMeshProxy.type == 0x1. This shows Bluetooth mesh beacons on GATT bearer. The following figure shows an example, and shows an example of the secure beacon:

e:17.818092s Real	time:Jan. 1, 07:14:18 440144682 10)	Nodes:0 EventEFR Tx packet	• •		(20		• • •	• •	
sactions total:3,2: Time 17.818092 58.000776	5 shown:2 Duration 0.002 0.002	Summary BT Meth (GATT Bearer) - Secure Network Beacon BT Meth (GATT Bearer) - Secure Network Beacon	NWK Src 90 FD 9F C8 EF FC 90 FD 9F C8 F0 19	NWK Dest 71 59 93 AC 12 5 71 59 93 AC 12 5	₽# 50 1 50 1	M# E#	Error Status	Warning Status	Proop Header: 0001 Segmentation and Reasembly inform Message Type: Meth Beacon (1) V Ef Mesh Beacon (12 type) Beacon Type: Secure Network Beacon (0) Figs: 0x00 In Update Flag: Normal Operation (0) Key Retein Flag: 0x00 Network DI C 239 F2 D0 B 25 59 43
total:27,086 sh Time 17,818092	wrc2 Decoders: B Type Packet	luetooth Low Energy, Default Profile Summary BT Mesh (GATT Bearer) - Secure Network Beacon	MA 90	C Src M FD 9F C8 EF FC 71	AC Dest 59 93 AC 12 50	Event error status	Event warning status		Authentication Value: 90 27 66 4F 3E 37 5 Radio Info EFR32 [11 bytes]
									Example 14 bytes) Free Dump [44 bytes] TC 05 1F 1A 00 04 00 18 10 06 11 01 00 02 08 02 20 06 27 66 47 38 37 50 00 20 07 76 47 38 17 50 00 10 08 73 00 FP 18 52 65 10 08 20 10 20

• btMeshProxy.type == 0x2. This shows Proxy client and server configuration messages. Proxy configuration messages are used to configure the proxy filters. The proxy server uses a filter to decide whether to forward the message to the proxy client or not. In practice that filter is only useful in certain specific cases.

• btMeshProxy.type == 0x3. This shows Provisioning PDUs over the GATT bearer. This is the GATT bearer equivalent of filtering PB-ADV adverting packet on advertising bearer Bluetooth mesh traffic. The following figure shows an example:

10 p/s 13 476s		- An Reserve							a hasher and				
:13.475834s Real	time:Jan. 1. 07:14:13	Nodes:0 Event:EFR Rx packet								Event	Detail		
-18 d	Bn									> BLE Da	ta [2 bytes]		
		• • • • • • • •								> L2CAP	Protocol [4]	bytes]	
000	440144692	000440140000040144681				/		* * *		> Attribu	te Protocol ([3 bytes]	
(20	10)	(2012) (2012)			(20	10)				BT Mes	h Proxy Prot	ocol [1 bytes	5]
actions total:3,23	15 shown:4								~ C	Prov	y Header: 0	x03	
Time	Duration	Summary	NWK Src	NWK Dest	P#	M#	E#	Error Status	Warning Status	9	egmentatio	n and Reasse	embly info
9 117146	5.091	BT Mesh - Looking for Provisioner (Device: 53 69 6C 61	90 FD 9F C8 FF F	C 71 59 93 AC	12 50 59					,	Aessage Type	e: Provisionin	ng PDU (3)
12 217315	1.991	BT Mesh - Looking for Provisioner (Device: 53 69 6C 61	90 FD 9F C8 FF F	C 71 59 93 AC	12 50 41					> BT Mes	h Provisionin	ng PDU [2 by	rtes]
49 904523	4 407	BT Mesh - Looking for Provisioner (Device: 53.69.6C.61	90 FD 9F C8 F0 1	9 71 59 93 AC	12 50 65					> Radio	nfo EFR32 [1	12 bytes]	
52 071269	1 240	PT Meth - Looking for Provisioner (Device: 53 69 6C 61	90 50 95 69 50 1	9 71 59 93 AC	12 50 22								
32.371300	1.540	of mean - cooking for Provisioner (perice, 55 65 66 61	5010 51 00101	19 71 39 30 AC	12 50 25								
									2				
ts total:27,086 sh	own:22 Decoders:	Bluetooth Low Energy, Default Profile							C				
Time	Туре	Summary		MAC Src	MAC Dest	Event err	or status	Event warning state	15				
13.475834	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning In	nvite	71 59 93 AC 12 50	90 FD 9F C8 EF FC								
13.524899	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning C	apabilities	90 FD 9F C8 EF FC	71 59 93 AC 12 50								
13.622091	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning S	tart	71 59 93 AC 12 50	90 FD 9F C8 EF FC								
13.719595	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning P	ublic Key	71 59 93 AC 12 50	90 FD 9F C8 EF FC								
13.866165	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning P	ublic Key	90 FD 9F C8 EF FC	71 59 93 AC 12 50								
13.914606	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning C	onfirmation	71 59 93 AC 12 50	90 FD 9F C8 EF FC								
13.963669	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning C	onfirmation	90 FD 9F C8 EF FC	71 59 93 AC 12 50								
14.012108	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning R	andom	71 59 93 AC 12 50	90 FD 9F C8 EF FC					1			-
14.061173	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning R	andom	90 FD 9F C8 EF FC	71 59 93 AC 12 50					-			
14.158364	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning D	lata	71 59 93 AC 12 50	90 FD 9F C8 EF FC	Encrypte	d BT Mesh F	Pr		Hex Dum	p [25 bytes]		
14.207431	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning C	omplete	90 FD 9F C8 EF FC	71 59 93 AC 12 50					13 00 0		58 05 E2	100
53.481486	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning Ir	nvite	71 59 93 AC 12 50	90 FD 9F C8 F0 19					F9 EE 9	3 4D 65 1	50 1D 03	- 10
53.579305	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning C	apabilities	90 FD 9F C8 F0 19	71 59 93 AC 12 50					68			h
53.676495	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning S	tart	71 59 93 AC 12 50	90 FD 9F C8 F0 19								
53.725251	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning P	ublic Key	71 59 93 AC 12 50	90 FD 9F C8 F0 19								
53 871824	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning P	ublic Key	90 FD 9F C8 F0 19	71 59 93 AC 12 50								
	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning C	onfirmation	71 59 93 AC 12 50	90 FD 9F C8 F0 19								
53.969018		BT Mesh (GATT Rearer) - Provisioning: Provisioning C	onfirmation	90 FD 9F C8 F0 19	71 59 93 AC 12 50								
53.969018 54.018085	Packet												
53.969018 54.018085 54.066527	Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning R	andom	71 50 03 AC 12 50	90 FD 9F C8 F0 19								
53.969018 54.018085 54.066527	Packet Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning R BT Mesh (GATT Bearer) - Provisioning: Provisioning R	andom	71 59 93 AC 12 50	90 FD 9F C8 F0 19 71 50 02 AC 12 50								
53.969018 54.018085 54.066527 54.115593 54.251540	Packet Packet Packet	BT Mesh (GATT Bearer) - Provisioning: Provisioning R BT Mesh (GATT Bearer) - Provisioning: Provisioning R BT Mesh (GATT Bearer) - Provisioning: Provisioning R	andom andom	71 59 93 AC 12 50 90 FD 9F C8 F0 19 71 59 93 AC 12 50	90 FD 9F C8 F0 19 71 59 93 AC 12 50	Encourte	d BT Mark 7	Pr					

Note: When using Bluetooth mesh, the node map may not be totally reliable. This is a known issue in Network Analyzer.

Alternatively, filtering can be done on both bearers using frame patterns. When selecting a packet containing Bluetooth mesh Network layer data, in the Event detail pane, right-click the Bluetooth mesh Network data of that packet and click **Filter by Frame Pattern**. This filters all Network messages regardless of the bearer. The same procedure can be done with Bluetooth mesh beacons and provisioning PDUs.

5 Bluetooth Mesh Networking and the Network Analyzer.

In a Bluetooth mesh network, especially on the field, node access can be challenging. Even when accessible, all nodes might not have the PTI pins exposed allowing network monitoring.

This section describes briefly what techniques can be used to monitor the Bluetooth mesh traffic in such environments.

The Silicon Labs recommendation for this use case is to set up a WSTK-based proxy node. That would be, in effect, a dedicated sniffer node. The sniffer node does not need to run any particular model beyond the basics. It would only need to have the network key associated with the Bluetooth mesh network to decipher the traffic.

Using a mobile phone application, connect to the proxy sniffer node that would be used with the Network Analyzer to see the Bluetooth mesh traffic. That way, not only traffic on the advertising channels can be monitored but also data using the GATT bearer. This can be quite helpful when debugging issues that occur between the mobile phone application and the nodes.



Alternatively, a sniffer node can be created in a Bluetooth mesh network by simply loading a demo or sample application that is constantly scanning onto a WSTK-based Bluetooth LE device (i.e. an EFR32BG radio board mounted on a WSTK).

As an example, the soc-thermometer-host, constantly scanning for health thermometer server devices, would receive all Bluetooth mesh advertising-based PDUs. The fact that it is not a Bluetooth mesh node is not a problem as this can be recorded and decoded later on in Network Analyzer (see section 4.2 Network Analyzer for Bluetooth Mesh)



Although this type of sniffer is very useful in the field, it has a couple of limitations: GATT bearer Bluetooth mesh data would not be sniffed and only packets within radio range will be caught. In practice, the latter can be mitigated if the sniffer node is close to a relay node.

Finally, a standalone Java-based packet trace tool exist that is worth mentioning. The data stream recorded can be decoded in Network Analyzer (and Wireshark) or can simply be stored in text or binary format. For more detail, refer to <u>Github</u>.

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