

# BLE sniffer guide

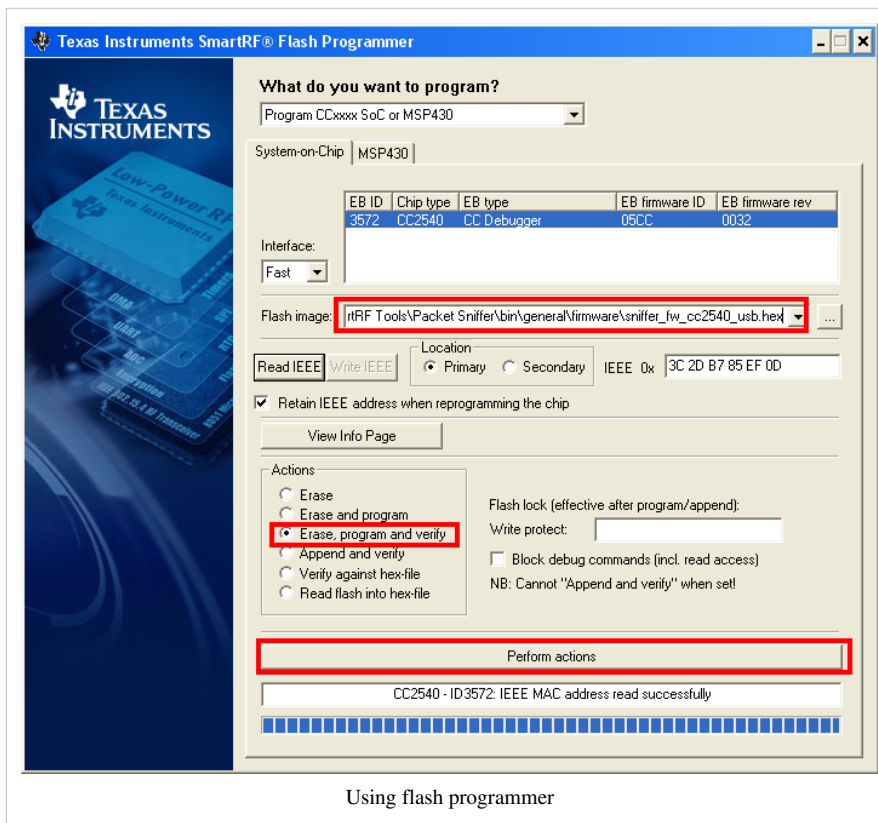
Bluetooth Low Energy Wiki Main Page <sup>[1]</sup>

## Introduction

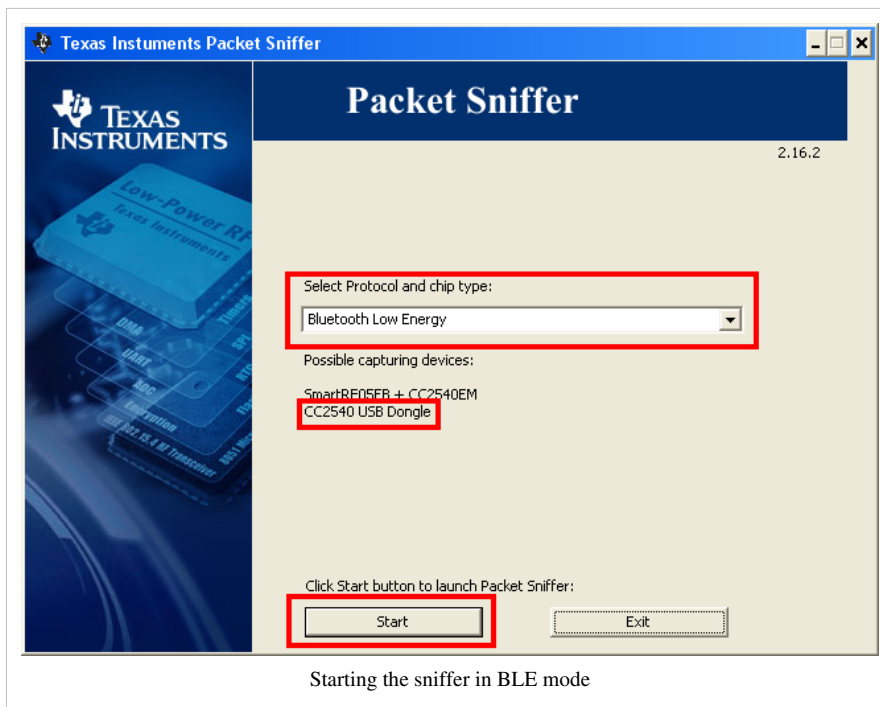
The TI Packet Sniffer can be used to look at everything that goes on between two BLE devices over the air, and is as such a good tool for debugging or just learning about Bluetooth Low Energy applications.

## Installation and setup, using a CC2540 USB dongle as sniffer hardware

1. Download and install the SmartRF Packet Sniffer from [2]
2. Using SmartRF Flash Programmer, program the CC2540 USB dongle with the image found in `\program files\Texas Instruments\SmartRF Tools\Packet Sniffer\bin\general\firmware\sniffer_fw_cc2540_usb.hex` after installation.

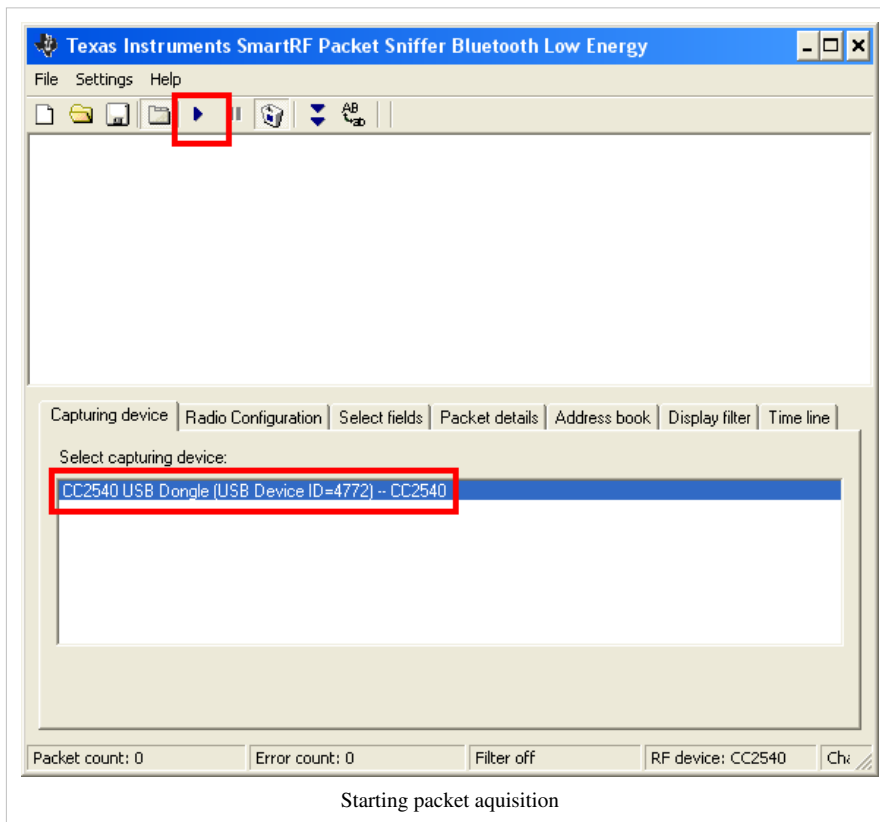


3. Start the sniffer, select Bluetooth Low Energy and press Start



## Using the sniffer

To start sniffing, select the now programmed USB dongle, and press the play button.



The received packets will be parsed according to the packet format laid out in the Bluetooth 4.0 Core Specification[3] Volume 6, Part B, chapters 2.1, 2.3 and 2.4.



## Timeline

TODO

## Packet types

According to the state the device is in, different communication channels are applicable.

- Advertising channel: 37 (2402MHz), 38 (2426 MHz) and 39 (2480 MHz)
- Data channel: 0-36 (2404-2478 MHz) excluding (2426 MHz)

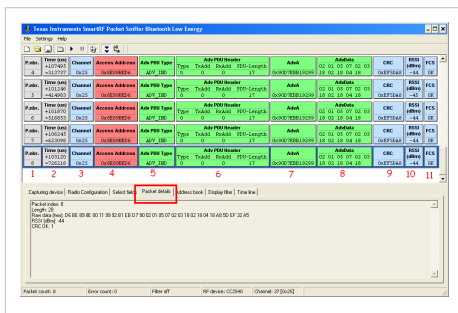
The advertising channel and data channel allow different Protocol Data Unit (PDU) types

## PDU Types

Channel	State	PDU Type	Explanation	Core spec chapter
Advertising	Advertising	ADV_IND	Connectable undirected advertising event. Contains AdvA and AdvData.	6.B.2.3.1.1 // 6.B.4.4.2.3 // 3.C.11 // 3.C.18.1 (payload)
		ADV_DIRECT_IND	Connectable directed advertising event. Contains AdvA and InitA	6.B.2.3.1.2 // 6.B.4.4.2.4
		ADV_NOCONN_IND	Broadcast. Contains AdvA and AdvData	6.B.2.3.1.3 // 6.B.4.4.2.6
		ADV_SCAN_IND	Connectable directed advertising event. Scannable.	6.B.2.3.1.4 // 6.B.4.4.2.5
	Scanning	ADV_SCAN_REQ	Request for more information from LL in scanning state. ScanA, AdvA.	6.B.2.3.2.1 // 6.B.4.4.2.5
Advertising	Advertising	ADV_SCAN_RSP	Response.	6.B.2.3.2.2 // 6.B.4.4.3.2
		CONNECT_REQ	Sent by initiator to establish a connection	6.B.2.3.3.1 // 6.B.4.4.4
Data	Data	LLID field is 1 or 2. Empty PDUs allow the slave to respond with any PDU.	General data	6.B.2.4 // 6.B.4.5
	Control	LLID field is 3. PDU can not be empty	Control data, see core spec	6.B.2.4.2 // 6.B.4.5

## Advertisement packets

You will immediately start receiving captured advertisement packets, given that a peripheral is advertising. Fields 1,2,3,4 and 9,10,11 are common to all captured packets.





## Empty connection events

After connection establishment we are in the connected state as defined by 6.B.4.5 in the BT Core spec. The data header is defined in 6.B.2.4 and is summarized below.

Pkts.	Time (ms)	Channel	Access Address	Data Type	Data Header	CRC	RESN (dBm)	FCS
269	+99770 -115232545	0x23	0x5718A5E	LLID-C	LLID NESN SN MD PDU-Length 0 0 0 0	0xP2F68	-31	0E
	Time (ms)	Channel	Access Address	Data Type	Data Header	CRC	RESN (dBm)	FCS
270	+430 -115232575	0x23	0x5718A5E	LLID-C	LLID NESN SN MD PDU-Length 1 0 0 0	0xP2F68	-30	0E
	Time (ms)	Channel	Access Address	Data Type	Data Header	CRC	RESN (dBm)	FCS
271	+99770 -115232545	0x0E	0x5718A5E	LLID-C	LLID NESN SN MD PDU-Length 1 1 0 0	0xP2F013	-30	0E
	Time (ms)	Channel	Access Address	Data Type	Data Header	CRC	RESN (dBm)	FCS
272	+421 -115452976	0x0E	0x5718A5E	LLID-C	LLID NESN SN MD PDU-Length 0 1 0 0	0xP2F6C0	-40	0E

## Data header

Field	Long name	Explanation	Core spec chapter
LLID	Link Layer ID	0x1 = Data PDU; continued fragment or empty, 0x2 Data PDU Start of fragmented data or complete message, 0x3 Control PDU.	6.B.2.4 / 6.B.4.5
NESN	Next expected sequence number	1-bit, used with SN for ack/nack	6.B.2.4 / 6.B.4.5.9
SN	Sequence number	1-bit, used with NESN for ack/nack	6.B.2.4 / 6.B.4.5.9
MD	More Data	Used to indicate whether more data is coming. See table in spec.	6.B.4.5.6
PDU Length	Length of payload + MIC in octets.	PDU Length is maximum 27 octets. MIC 4 octets if present.	6.B.2.4

In this example we can see that the central device has SN = NESN indicating new data, and the peripheral device responds with ACK (SN!=NESN because it expects next packet).

## Read request, read response

TODO

## Write request, write response

TODO

## References

- [1] <http://processors.wiki.ti.com/index.php/Category:BluetoothLE>
- [2] <http://www.ti.com/tool/packet-sniffer>
- [3] [http://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc\\_id=229737](http://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=229737)

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