



**frontline<sup>®</sup>**  
**Debug Communications *Faster<sup>SM</sup>***

# BPA 500™

Meeting the *Bluetooth*® Challenge with  
Frontline Tools and Services

# Frontline Test Equipment

## The *Bluetooth* Experts

- **25 years** of protocol analysis experience
- **84 of the Fortune 100 companies** use our products
- **Involved with *Bluetooth* wireless technology** initiatives from the beginning (~10 years)
- **Work closely with the *Bluetooth* SIG** – specifications, working groups, technology committees
- Frontline products support **every *Bluetooth* specification, profile and protocol**



# Frontline Customers

**CSR (Cambridge Silicon Radio)**

**Qualcomm**

**Broadcom**

**Motorola**

**Infineon**

**Intel**

**Texas Instruments**

**Siemens**

**Atheros**

**Marvell**

**Alps**

**MSI**

**Apple**

**ISSC**

**Sony**

**Sony Ericcson**

**Kyocera**

**VW**

**Ford**

**Audi**

**Microsoft**

**Panasonic**

**Hitachi**

**Symbol Technology**

**NXP**

**Continental**

**Plantronics**

**BenQ**

**MiTek**

**Sybase**

**Sybase**

**Cisco**

**Visteon**

**BMW**

**Daimler Chrysler**

**Delphi**

**Nissan**

**Johnson Controls**

**US Government**

**Toyota**

**IVT**

**Samsung**

**LG**

**MP**

# Meeting *Bluetooth* Challenges

## How to fix problems with your *Bluetooth* solution

The BPA 500 is to a developer what an X-ray machine is to a doctor.



# Meeting *Bluetooth* Challenges

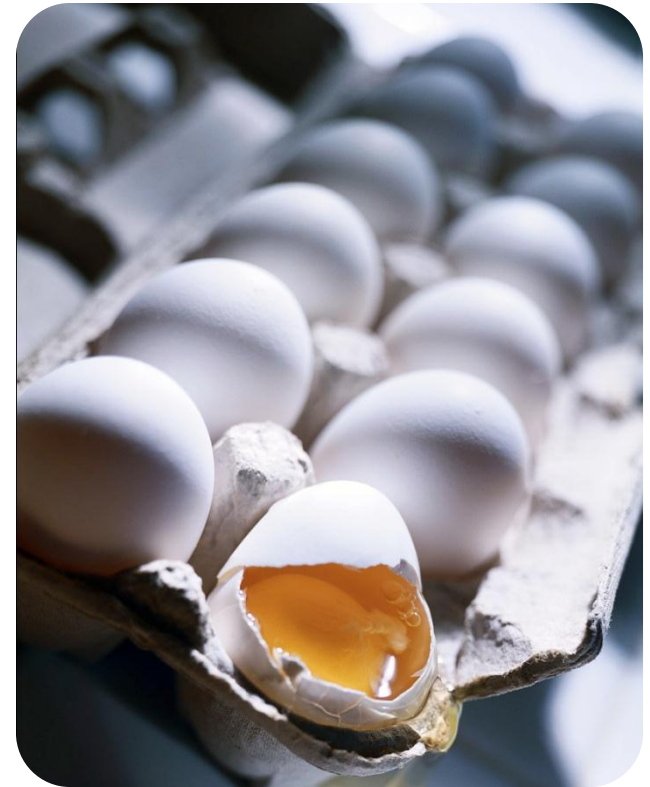
## How to fix problems with your *Bluetooth* solution

- Use a protocol analyzer to  
Pin-point the problem.



# Find and Fix Problems Early

- The earlier in the development process bugs are found, the cheaper they are to fix
- Avoid expensive product recalls





# Find and Fix Problems Early

## Examples



Bad audio quality on  
*Bluetooth* device

Audio extraction  
in BPA 500

A2DP music  
doesn't pause

A2DP, AVDTP  
decoders show  
you if  
“SUSPEND”  
command is  
being sent from  
SRC

Single...	Ma...	SUSPEND
Single...	Slave	SUSPEND



# Find and Fix Problems Early

## Examples



Battery life on *Bluetooth* device too short

LMP decodes allow you to see if device goes into Sniff mode to conserve battery power

Hands-free call being hung up too early

Hands free decoder shows AT+CHUP from HF device being sent at incorrect time

# BPA 500™ Dual Mode Protocol Analyzer

- ✓ Dual mode – “Classic” (BR/EDR) and low energy
- ✓ Live decoding and decryption
- ✓ Made for Developers and Test Engineers
- ✓ Easy to use
- ✓ CSR Corporate standard
- ✓ Debug, Test and Verify **FAST!**



# BPA 500™ Dual Mode Protocol Analyzer

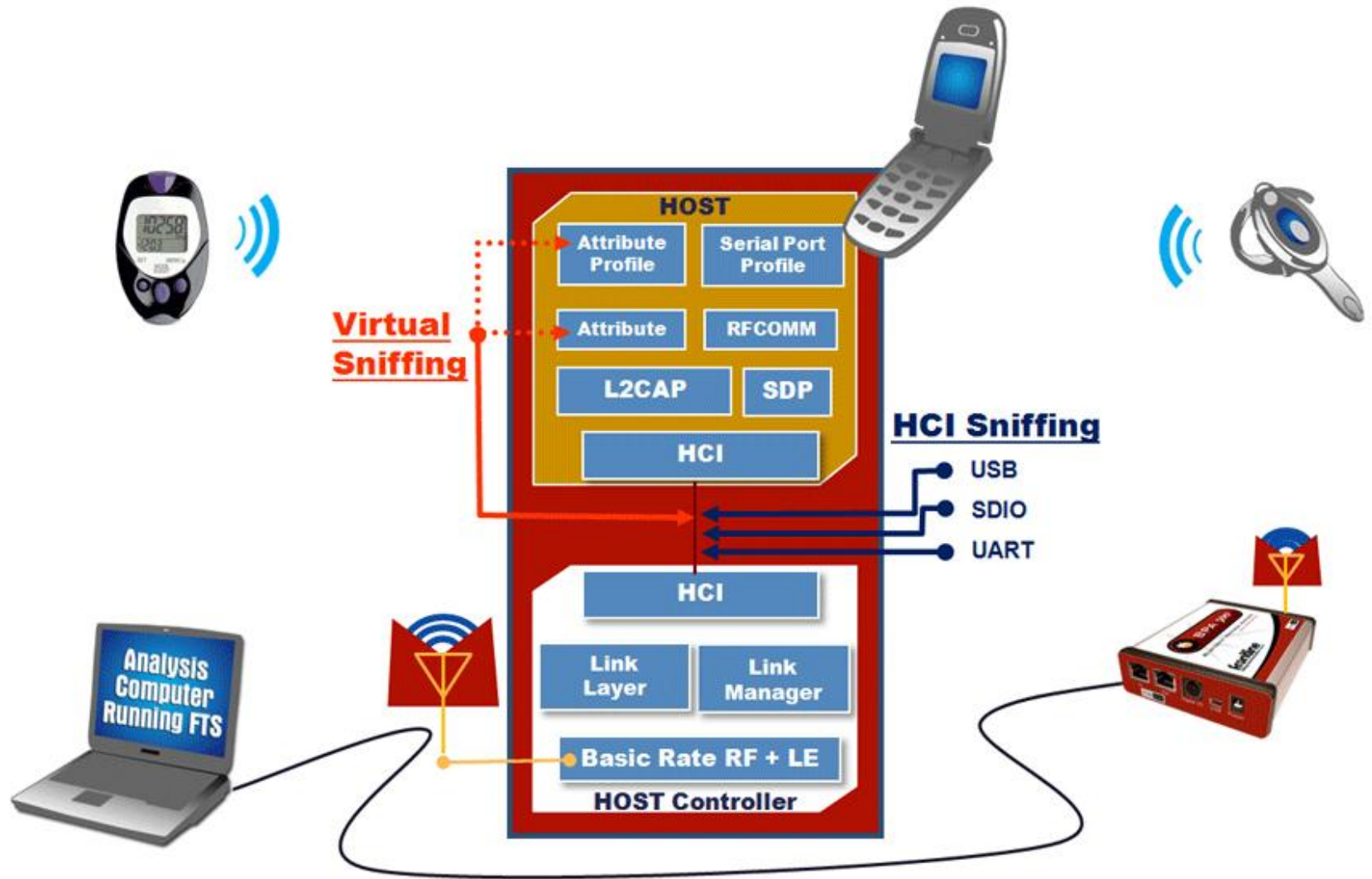
## Key Benefits

- Visibility into *Bluetooth* Dual Mode (le or BR/EDR) stacks
- Supports every *Bluetooth* specification, protocol and profile
- Extracts audio into WAV files: ***supports A2DP, HSP and HF profiles***
- Includes Frontline's **DecoderScript™**
- Improved capture of pre-connection traffic
- MSC (Message Sequencing Chart)

# low energy Features

- Easy setup – **JUST START CAPTURING**
- No need to synchronize to devices
- Scans and captures all three advertising channels concurrently
- Decodes all traffic:
  - Advertising packets
  - Data packets
  - LL control packets
  - ...and more!
- Includes DecoderScript which allows writing decoders for custom protocols
  - Advertising packets
  - Data packets
  - LL control packets
  - ...and more!

# Points of Observation



# Sniffs “Virtually”

- The Live Import feature permits any application to feed data into BPA 500
- Use virtual sniffing instead of rudimentary hex dumps and traces



# Frame Display

- Easy to “drill down” to bit level on a selected frame
- Single Tab Protocol filtering
- Flag errors in **RED**
- Protocol visibility in a selected frame
- Includes Frontline’s DecoderScript™



# Frame Display

- Panes:
  - Summary
  - Detail
  - Radix
- Protocol Filter Tabs
- Errors are flagged in **RED**

The screenshot shows the 'Frame Display' application window for 'PXA 920 - Coby CV290 - Confirmed.cfa'. The interface includes a menu bar, a toolbar, and a filter bar. The filter bar shows a filter: 'Include each frame where the protocol "LMP" exists »AND where the protocol "Baseband" exists'. The 'Summary' tab is selected, showing a table of frames.

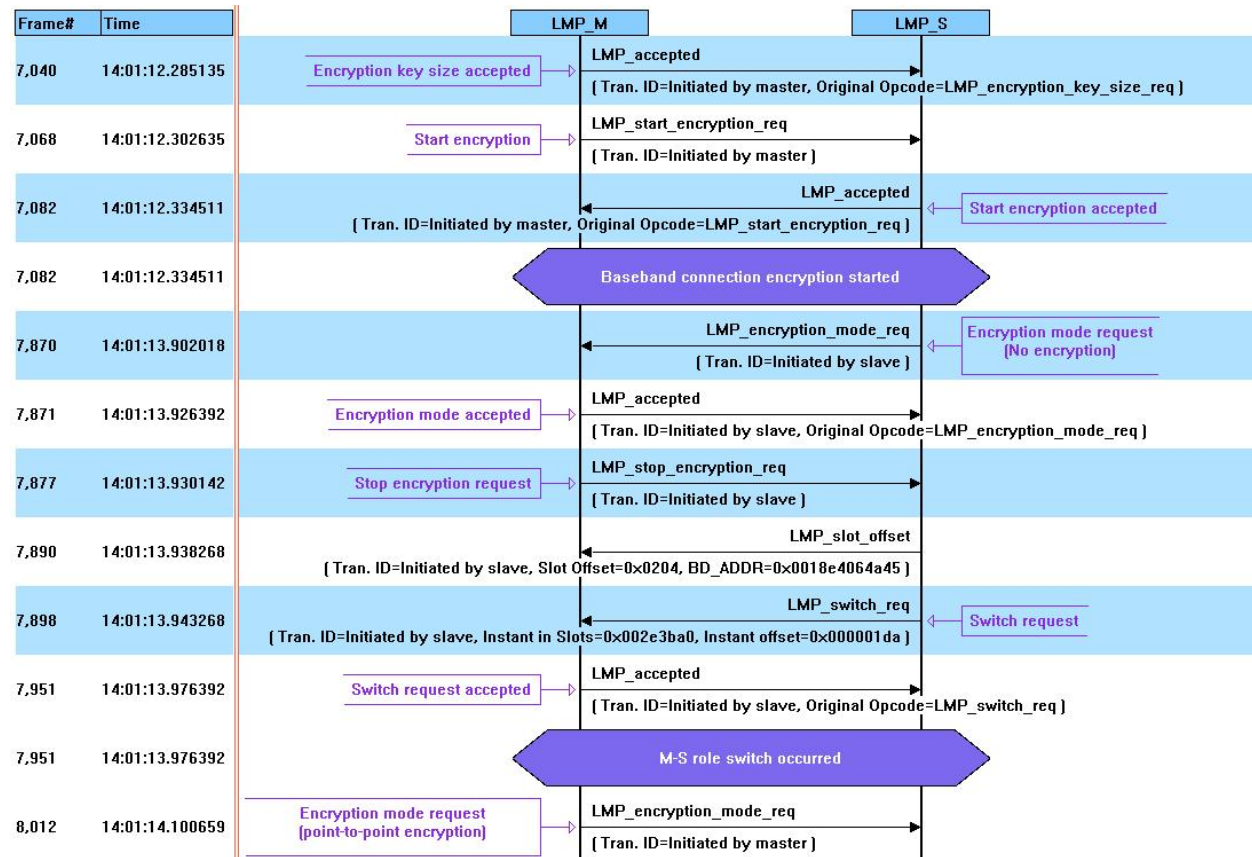
B...	Frame#	LT_Addr	Original Opcode	Opcode	Role	Initiated by	Fram...	Delta	Timestamp
●	122	7		features_req	Master	master	24		9/13/2011 2:00:01.764814 PM
●	130	7		features_res	Slave	master	18	00:00:00.004375	9/13/2011 2:00:01.769189 PM
●	133	7		features_req_ext	Master	master	21	00:00:00.001875	9/13/2011 2:00:01.771064 PM
●	140	7		features_res_ext	Slave	master	21	00:00:00.004375	9/13/2011 2:00:01.775439 PM

Below the table, there are three panes: 'BINARY PANES', 'HEX PANES', and 'CHARACTER PANES'. The 'BINARY PANES' pane shows a binary representation of the frame data. The 'HEX PANES' pane shows the hexadecimal representation of the frame data. The 'CHARACTER PANES' pane shows the character representation of the frame data.

At the bottom of the window, a status bar shows: 'Total Frames: 9,241 | Frames Filtered In: 122 | Frame #s Selected: 130; (1 total) [1 bytes]'.

## Message Sequencing Chart

- Simple and easy-to-understand terms
- MSC makes it easy to see:
  - Physical links
  - Logical links
  - Protocol level activities
  - Profile level activities

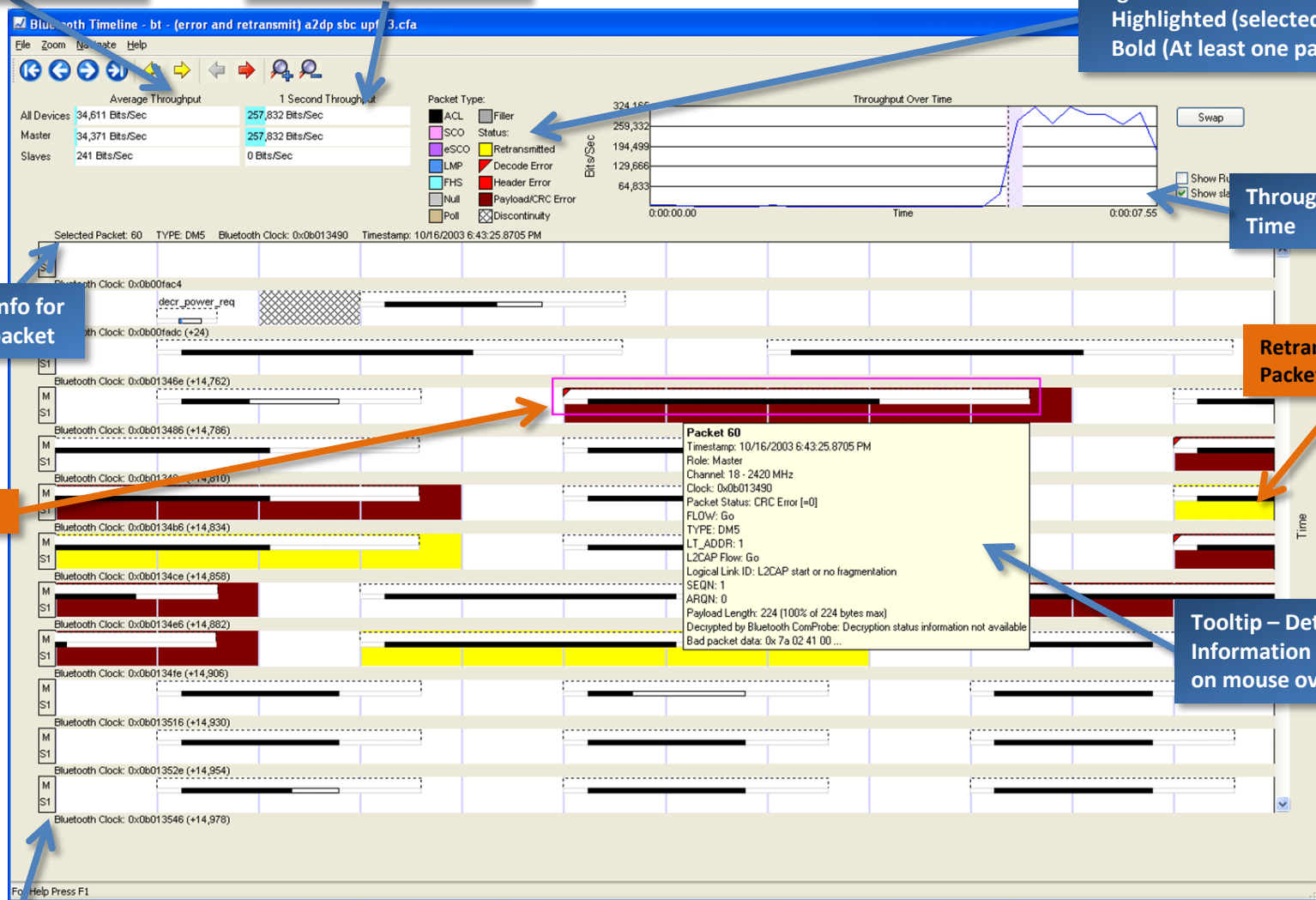


# Bluetooth Classic Timeline

Average Throughput

One Second Throughput

Legend –  
Highlighted (selected packet)  
Bold (At least one packet seen)



Summary info for selected packet

Throughput Over Time

Retransmit Packet

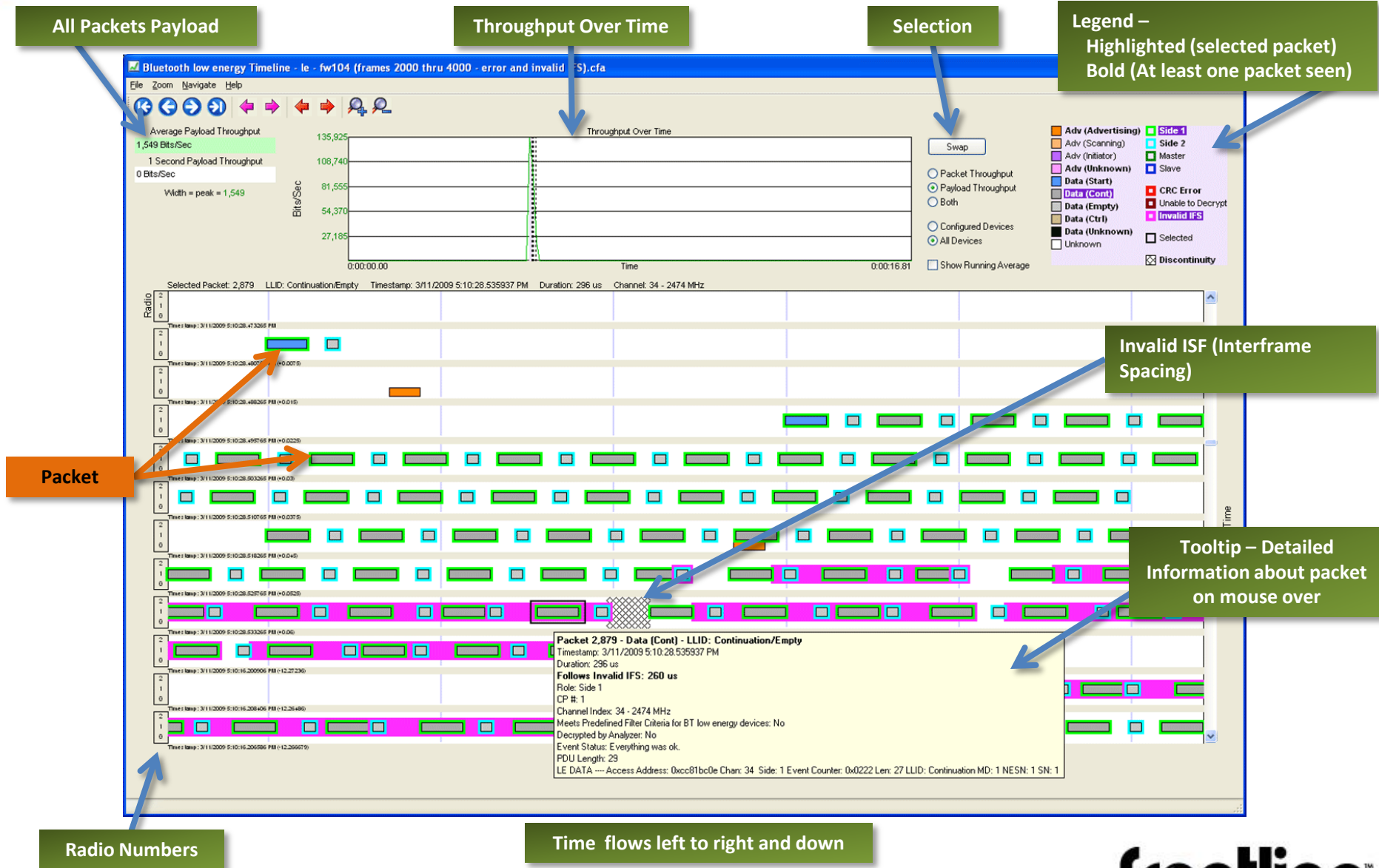
Packet

Tooltip – Detailed Information about packet on mouse over

Master / Slave

Time flows left to right and down

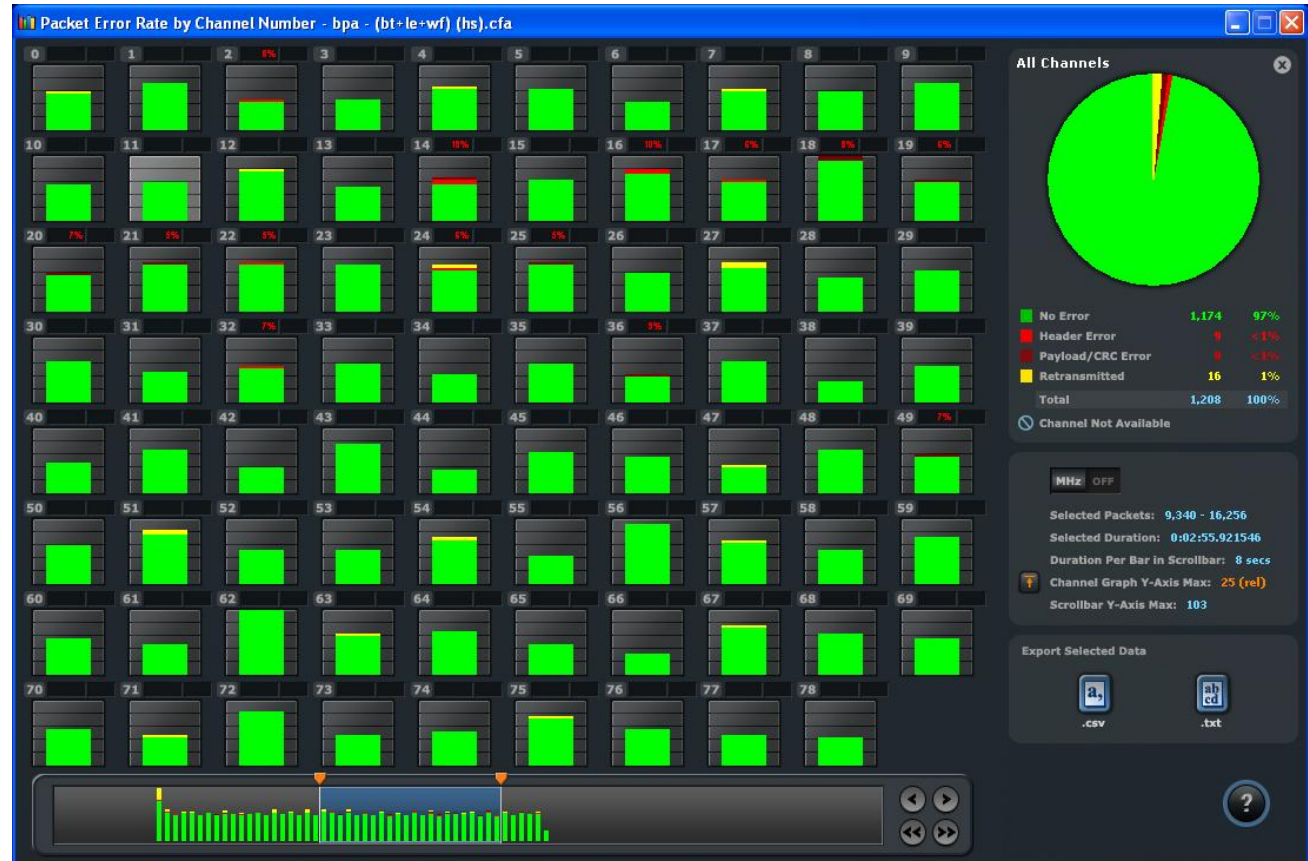
# Bluetooth LE Timeline





# Other Useful Features

- Real-time packet error analysis
  - CRC and Header errors for all 79 RF channels
  - Understands performance around other 2.4GHz devices



# Audio Extraction

- Ability to capture SCO data and replay it in a **WAV** file format
  - Great to verify audio quality of your *Bluetooth* device
  - BPA 500 will create one stereo file or two mono files



# Filter for Decoded Fields

**Frame Display - Data throughput**

File Edit View Format Filter Options Window Help

Filter: Include frames where the protocol SDP exists

Summary: SDP Baseband with Auto-traverse

Unfiltered Baseband LMP L2CAP SDP RFCOMM SPP

Book...	Frame#	Role	Addr.	Trans...	PDU ID	Param Len	UUID/Svc H.
	118	Master	6	0x0000	Search Request	8	SerPort
	121	Slave	6	0x0000	Search Response	9	0x 00 01 00 00
	122	Master	6	0x0001	Attribute Request	14	0x 00 01 00 00
	125	Slave	6	0x0001	Attribute Response	43	
	126	Master	6	0x0002	Attribute Request	16	0x 00 01 00 00
	129	Slave	6	0x0002	Attribute Response	48	

Frame 129: (Slave) Len=33  
\* means that the data were reconstructed.

**Baseband:**

- Role: Slave (0x00a096136169)
- Channel: 34 - 2436 MHz
- Clock: 0x0043dace
- Packet Status: OK
- FLOW: Go
- TYPE: DM3
- LT\_ADDR: 6
- L2CAP Flow: Go
- Logical Link ID: L2CAP start or no fragmentation
- SEQN: 0
- ARQN: 0
- Payload Length: 19
- Decrypted by Bluetooth ComProbe: Feature not Avail

**L2CAP:**

- Role: Slave
- Address: 6
- PDU Length: 15
- Channel ID: 0

**SDP:**

- Role: Slave
- Address: 6
- PDU ID: SDP
- Transaction ID
- Parameter Length
- Attribute List
- \* Attribute List
- \* Attribute List
- \* Attribute List
- \* Attribute List
- Bytes for con

Right-click on any Decoded Field to create Filter tab or separate screen

This is the Decode Pane

- Copy Selection to Clipboard
- Select Entire Frame
- ✓ Tall Decode Pane
- ✓ Collapse All
- Expand All
- Hide "L2CAP" Layer In All Frames
- Filter in Channel ID = 0x0047
- Filter Dialog (field equals)...
- Provide AVDTP Rules...
- Provide L2CAP Rules...
- Provide RFCOMM Rules...
- Set Subsequent Decoder Parameters...
- Hide This Pane
- Show Hidden Panes

00010 11001110 11011010 01000011 00000000 11010110 01111000 00000010 01101001  
00001 00010011 10010110 10100000 00000000 00001111 00000000 01000111 00000000  
00101 00000000 00000010 00000000 00001010 00000000 00000111 00000000 00100101  
00100 01000011 01001111 01001101 00110000 00000000  
ce da 43 00 d6 78 02 69 61 13 96 a0 00 0f 00 47 00 05 00 02 00 0a 00 07 00 25 04  
ACN D x x i a % b u i u G u b u x u f u l u 8 T C O M 0 N u

Total Frames: 136, 15  
Filter when this field is equal



# Filter Conditions

**Filter set up**

**Rename Filter Tab**

**Set Filter Conditions Dialogue Box**

The screenshot shows the 'Frame Display - Amp Manager Example.cfa' application. The main window has a menu bar (File, Edit, View, Format, Filter, Bookmarks, Options, Window, Help) and a toolbar. The 'Filter' menu is open, showing a list of filter tabs: Unfiltered, Baseband, LMP, L2CAP, AMP Manager, SDP, OBEX, 802.11 Radio, 802.11 MAC, LLC 802.2, IPv4, Data, FTP, and Non-Captured Info. The 'AMP Manager' tab is selected. The 'Summary' field shows '802.11 Radio' and '802.11 Radio with Auto-traverse'. The 'Filter' field shows 'Include each frame where the protocol "AMP Manager" field "802.11 A'.

The 'Set Condition' dialog box is open, showing the 'Currently Active Condition: Association Request'. The 'Include' radio button is selected. The 'Condition' section shows 'Select each frame where the protocol' with a dropdown menu set to 'AMP Manager'. The 'field' dropdown is set to '802.11 AMP Assoc'. The 'Is Present' checkbox is checked. The 'Advanced...' button is visible. The 'OK', 'Cancel', and 'Help' buttons are at the bottom.

The main window displays a list of frames with columns: B..., Frame#, Rate, Freq, Cha..., Type, Signal, Noise, SSI, Fra, Delta, and Timestamp. The first frame is 'Frame 1: (Slave) Len=24'. The 'Baseband' tab is selected, showing a hex dump of the frame data.

Total Frames: 62,427 | Frames Filtered In: 1 | Frame #s Selected: 1; (1 total)

For Help Press F1

Filtering...

# Additional Features

- Counts retransmitted packets
- Export into CSV and other formats
- Graphic display of packet error rate
- Automation API
- Reads BTSnoop files

# DecoderScript™

## User-Defined Protocol Decoding

- Vendor extensions are easily decoded with Frontline's built-in DecoderScript
- DecoderScript Development Kit included **FREE** with BPA 500

# Supported Profiles and Protocols

802.11 MAC  
802.11 Radio  
*Bluetooth* PRP  
802.11 AMP  
NMEA\_0183  
Virtual Sniffer  
PTS  
WiMedia  
BlueCore Serial Protocol  
Three-Wire UART  
A2DP  
AMP Manager  
AVRCP  
AVCTP  
AVDTP Media  
AVDTP Recover  
AVDTP Report  
AVDTP Signaling  
AVDTP  
AVRCP Browsing  
Baseband  
BNEP

CAPI  
CMTTP  
Extended Inquiry Response  
FAX  
*Bluetooth* FHS  
GAP (Generic Access Profile)  
H4DS  
Hands-Free  
HCI SCO/eSCO  
HCI UART  
HCI  
HCRP Control  
HCRP Data  
HDP (Health Device Profile)  
Headset  
IEEE11073  
BT-HID  
L2CAP  
LMP  
LPMP  
Non-Captured Info  
BIP

BPP  
FTP  
MAP  
OPP  
PBAP  
SYNC  
OBEX  
RFCOMM  
SCO/eSCO  
SDIO  
SDIO-HCI  
SDP  
SIM Application  
SIM ACCESS  
SPP  
TCS  
UDI  
Bluetooth USB  
VCP  
VDP  
*Bluetooth* Virtual  
Transport Frame Info

Encapsulated AsyncPPP  
mSBC  
MCAP Control  
SyncML  
WUSB  
ATT  
LE ADV  
LE BB  
LE DATA  
LE LL Ctrl  
LE PKT  
SMP

# Sniffs Air – Classic

- Simple and easy piconet synchronization
- Decodes all *Bluetooth* protocols and profiles

Bluetooth Device 1



Bluetooth Device 2



# Sniffs Air – low energy

- Virtually no setup
- Scans and captures on all three advertising channels concurrently
- Decodes all traffic: advertising traffic, data packets, LL control packets and more...

low energy *Bluetooth* Device



*Bluetooth* Device



# Sniffs Air – Dual Mode

- Sniffs low energy and “Classic” Bluetooth devices
- Displays all packets into a single view





# BPA 500 Add-Ons

## ComProbe 802.11

802.11 ComProbe and antennas to monitor *Bluetooth* packets across a Wi-Fi transport

## USB ComProbe Add-on

USB HCI sniffer hardware using the USB ComProbe II

## SDIO ComProbe Add-on

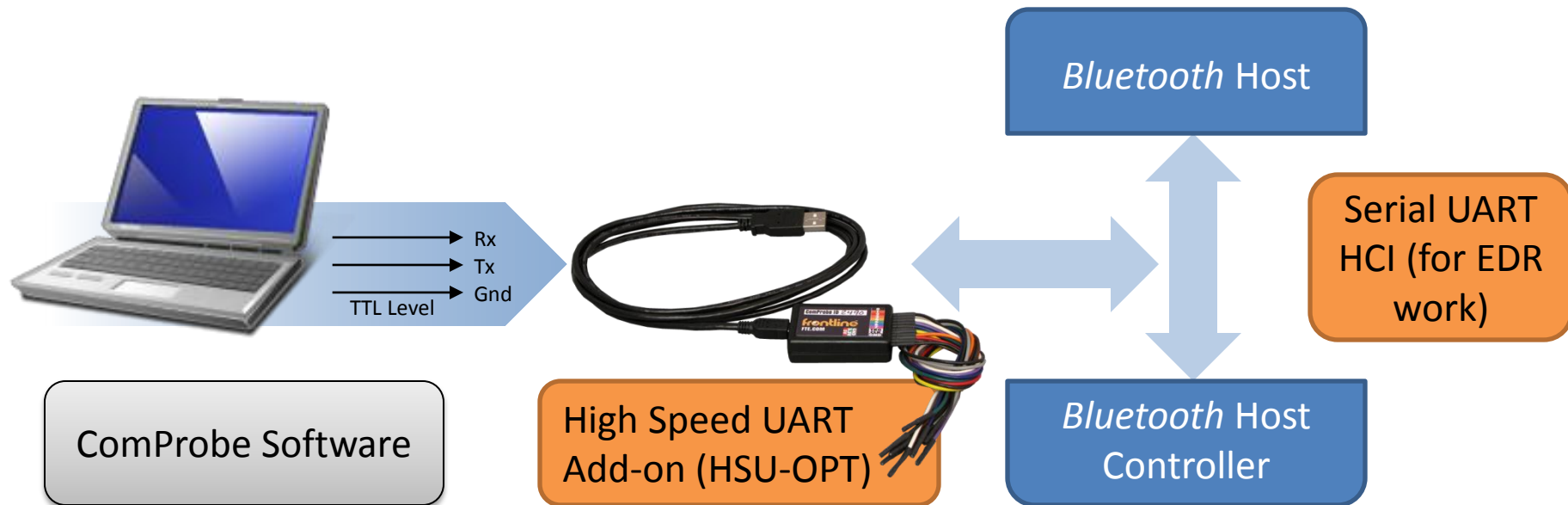
SDIO sniffer hardware using the SDIO ComProbe

## High Speed UART Add-on

UART HCI sniffer hardware

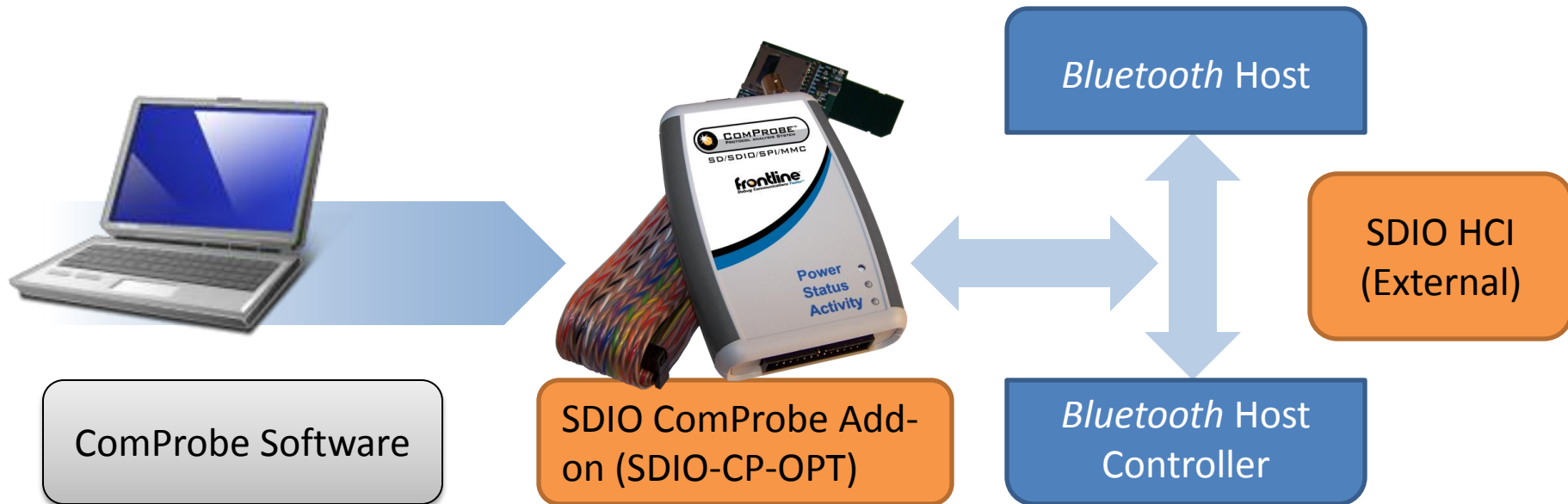
# HCI Sniffing – High Speed UART (HSU) Add-on

- HSU-OPT can sniff HCI UART, up to 8Mb/s
- Essential tool for HCI UART sniffing when using V2.0 + EDR



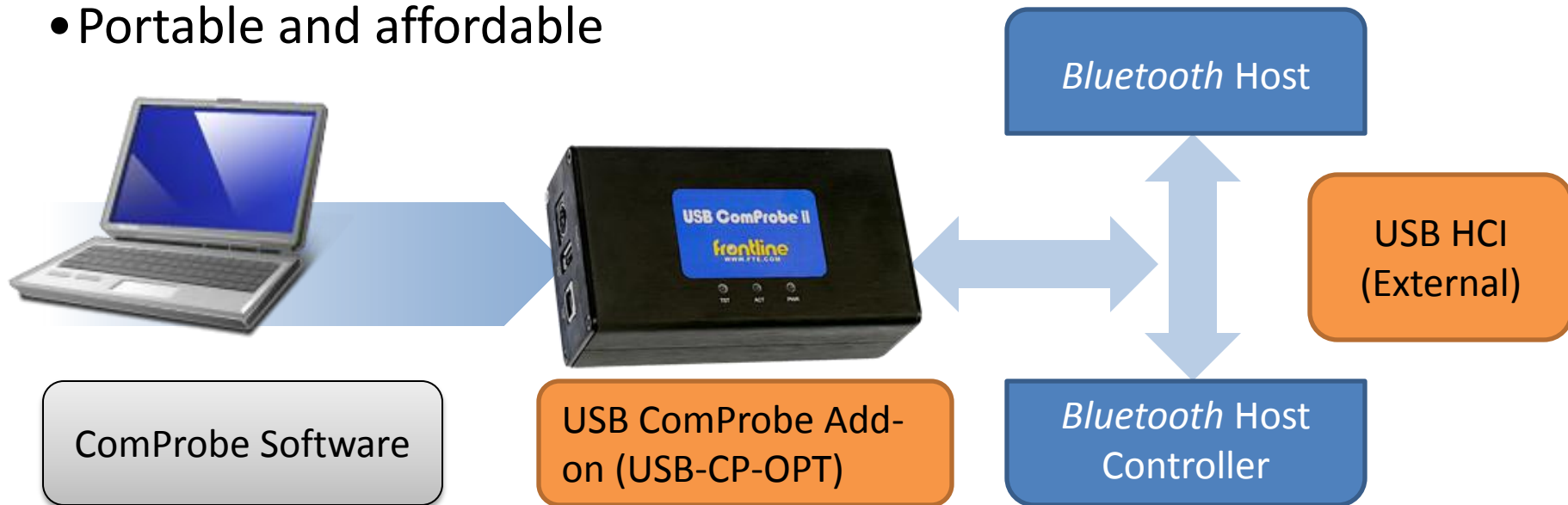
# HCI Sniffing – SDIO Add-on

- Decodes all *Bluetooth* data over SDIO transport
- Supports 1-bit and 4-bit transfer modes
- Supports clock frequencies up to 50 MHz
- Non-intrusive and continuous data capture



# HCI Sniffing – USB Add-on

- Decodes all *Bluetooth* data over USB transport
- Supports all three USB speeds: Low (1.5 Mbps), Full (12 Mbps) and High Speed (480 Mbps)
- No loss of packets with 64 MB on-board buffer
- Portable and affordable



# Bluetooth / 802.11 Coexistence

## ComProbe 802.11 Protocol Analyzer

- Never drop a packet - ~250 GB data buffer
- *Bluetooth* Coexistence easier than ever with ProbeSync
- Precise timestamps
- Full, stand-alone Wi-Fi decoding and protocol analysis



# ProbeSync™ Technology



The technology that allows Frontline analyzers to work seamlessly together and **share a common clock**.

With ProbeSync ComProbe analyzers can precisely synchronize communication streams and display the resulting packets in a single, shared or coexistence view.

# ProbeSync™ Technology

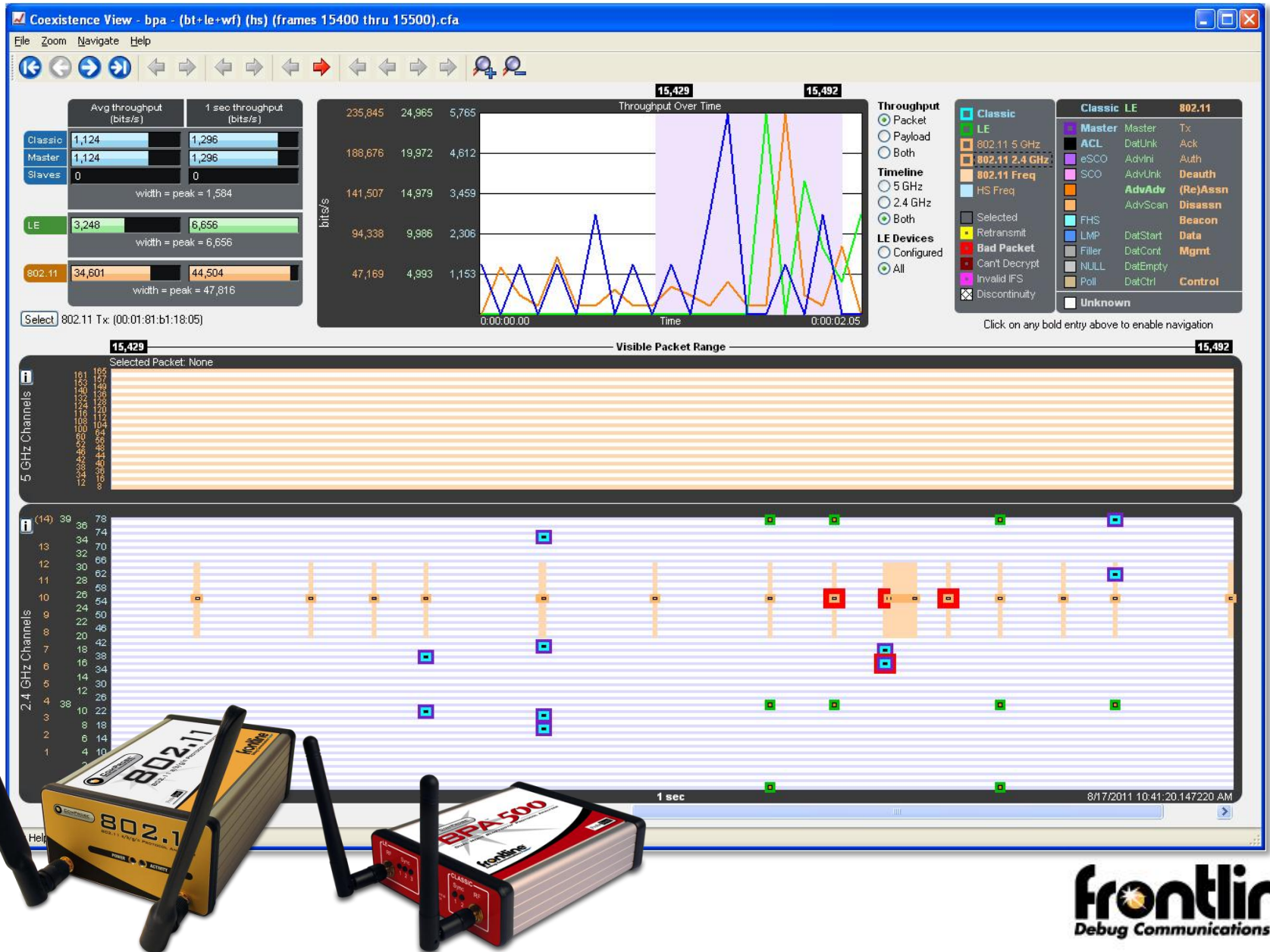
ProbeSync



**Example:** ComProbe BPA 500 and ComProbe 802.11 connected via ProbeSync provide precise packet timestamps for both *Bluetooth* and 802.11 packets together in a single coexistence view.



# Coexistence



# Frontline *Bluetooth* Interoperability (IOT)

- Biggest device library in the industry (1500+ devices)
- Lots of OEMs and cars
- 10 years of *Bluetooth* experience, instantly in your QA team
- International supply of Bluetooth devices, including China, Japan, Brazil, Europe and North America



# Why the need for IOT?

## You need to know your device will work with other devices.

Frontline has a comprehensive, current, and ever-expanding device library in-house. You can have confidence that your devices will work seamlessly with other key components in the ecosystem.

## You need to know your device will work in different markets.

Our testing facility is located in Charlottesville, VA where we test using North American mobile networks.

## You want to leverage Frontline as an extension of your QA department.

We have the experience and expertise in-house and have pre-existing relationships with all of the key chip manufacturers, phone companies, and peripherals companies. If there is a problem, we'll help you solve it.

# Why use Frontline IOT services?

## You want to improve your “out-of-box” experience.

We use pre-defined and customized test plans that will thoroughly test your device so that you can be sure it will work for your customers the first time and EVERY time.

## You need to test your products in automotive environments.

Frontline is building a comprehensive library of *Bluetooth* car kits used in mass produced vehicles. When we can't get the car kit, we buy the car.

## You want to reduce the costs involved with testing.

No more sending your employees around the world to test specific networks or devices. We've got everything you need in our labs.



# The Frontline Edge

Outstanding Technical Support

Trusted *Bluetooth* Expertise

**frontline**<sup>®</sup>  
Debug Communications *Faster*<sup>SM</sup>

**frontline**<sup>™</sup>  
Debug Communications *Faster*<sup>™</sup>

# Frontline Test Equipment



**Thank you!**

**frontline**<sup>®</sup>  
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**frontline**<sup>™</sup>  
*Debug Communications Faster*<sup>™</sup>