Meeting the *Bluetooth*® Challenge with

Frontline's BPA 600 Dual Mode *Bluetooth* Protocol Analyzer

BPA 600™

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Frontline Test Equipment

- 27 years of protocol analysis expertise
- 84 of the Fortune 100 companies use our protocol analyzers
- Involved with Bluetooth wireless technology initiatives from the beginning (~12 years)
- Work closely with the Bluetooth SIG – specifications, working groups, technology committees
- Frontline products support every Bluetooth specification, profile, and protocol

Bluetooth® Wireless Technology

- BPA 600 - Bluetooth v4.0 + HS – v4.1 when ready
  - “Classic” (BR/EDR)
  - low energy
  - 802.11 - High Speed

Bluetooth® Challenges

- Dual Mode “Classic” (BR/EDR) and low energy
- Complex software
- Ever changing specifications
- Interoperability
- Time to market

Why *Bluetooth*® Dual Mode Tools?

- Many next generation *Bluetooth* devices use both Classic and low energy
- Powerful portability in a handheld box
- Simplifies development and debugging of *Bluetooth* devices

BPA 600™

- Dual Mode – “Classic” (BR/EDR) and low energy
- Live decoding
- Easy to use
- Bluetooth industry Standard
- Debug, Test, & Verify FAST!

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BPA 600 – Key Features

- Improved synching without the need for a second ComProbe (Interlaced Page Scanning as standard)
- Support every *Bluetooth* specification, protocol and profile
- Includes “*ProbeSync*” for accurate time stamped data.
- Includes Frontline’s DecoderScript™
- Improved capture of pre-connection traffic (FHS packet visibility)
- MSC (Message Sequence Chart)

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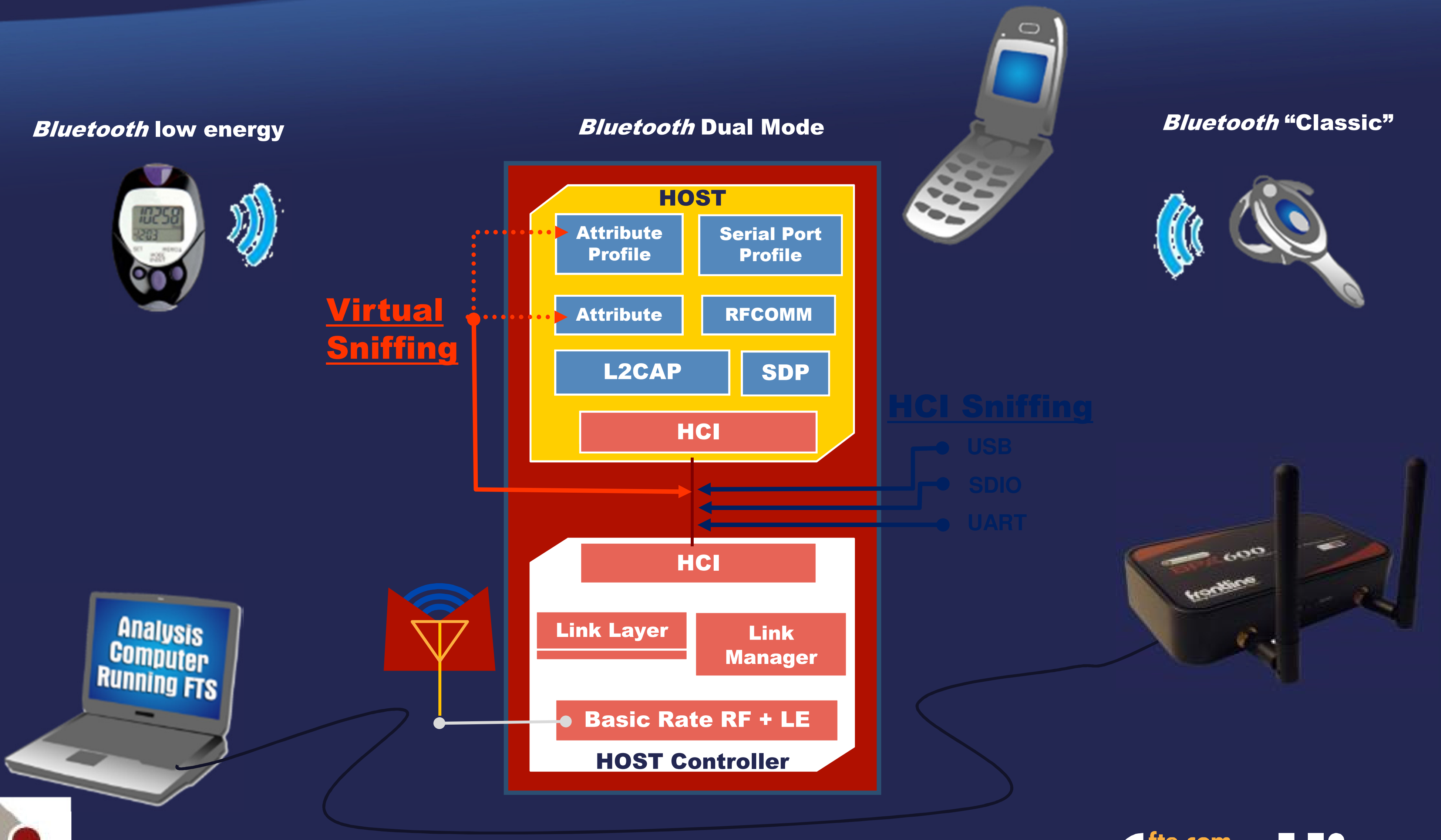
Air Sniffing Features: Low energy

- Easy setup - Just start capturing
- No need to synchronize to devices
- Scans and captures all three advertising channels concurrently
- Follow multiple CONNECT_REQ from the same master and capture the resulting connections
- Follow CONNECTION_UPDATE_REQ and CHANNEL_MAP_REQ
- Follow pairing and decrypt encrypted traffic

Points of Observation



Bluetooth low energy

Bluetooth Dual Mode

Bluetooth “Classic”

HOST

Attribute Profile

Serial Port Profile

Attribute

RFCOMM

L2CAP

SDP

HCI

Virtual Sniffing

HCI Sniffing

USB

SDIO

UART

HCI

Link Layer

Link Manager

Basic Rate RF + LE

HOST Controller

Analysis Computer Running FTS

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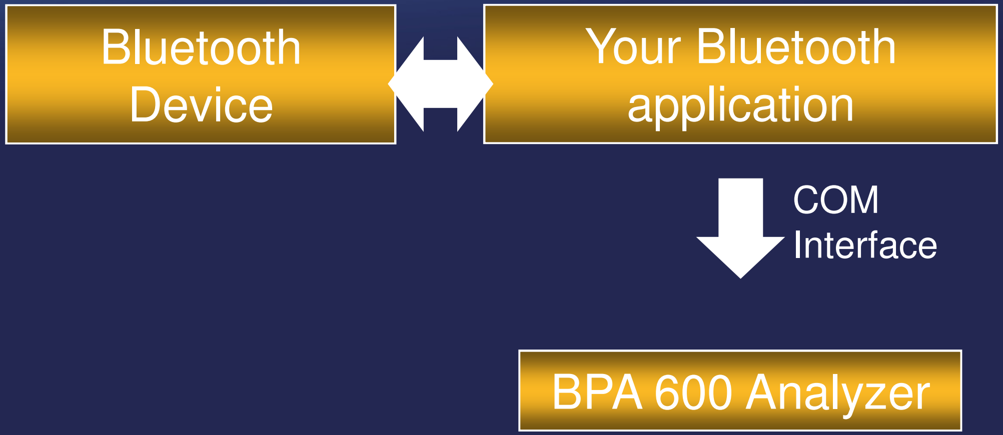
Sniffs “Virtually”

- The Live Import feature permits any application to feed data into BPA 600
- Use virtual sniffing instead of rudimentary hex dumps and traces



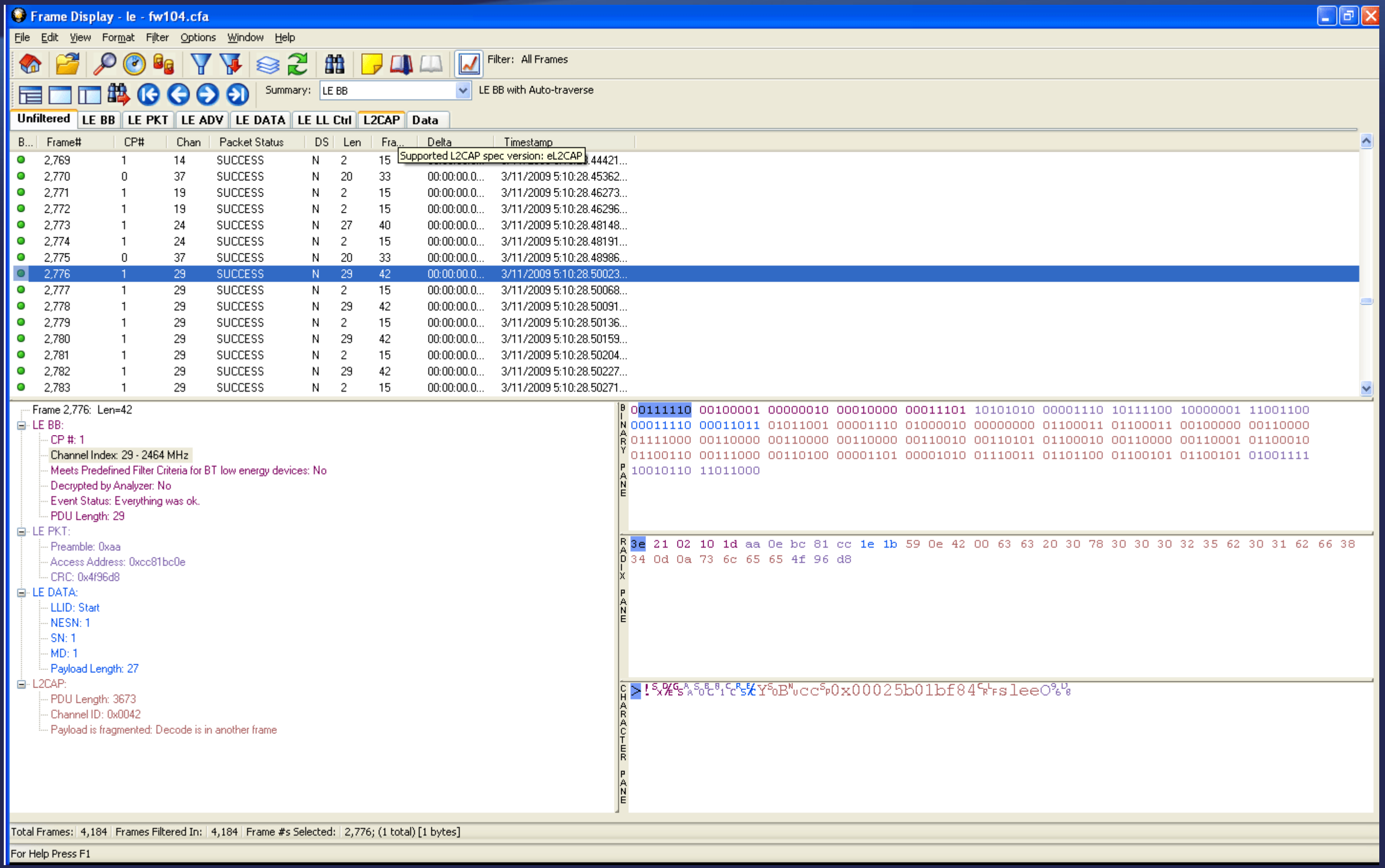
User Interface Features

- Familiar tree protocol decode display
    - single-click protocol filtering
- Decodes & displays multiple protocol layers of multiple data packets simultaneously
- Detects and displays protocol errors (in red) in real-time
- Session notes and annotated bookmarks
    - allow for quick identification of questionable packets

Additional Features

- Continuous direct logging to disk
- Counts
- Audio extraction

Frame Display



Frame Display - le - fw104.cfa
File Edit View Format Filter Options Window Help
Filter: All Frames
Summary: LE BB
LE BB with Auto-traverse
Unfiltered
LE BB
LE PKT
LE ADV
LE DATA
LE LL Ctrl
L2CAP
Data
Supported L2CAP spec version: eL2CAP

B...	Frame#	CP#	Chan	Packet Status	DS	Len	Fra...	Delta	Timestamp
●	2,769	1	14	SUCCESS	N	2	15		.44421...
●	2,770	0	37	SUCCESS	N	20	33	00:00:00.0...	3/11/2009 5:10:28.45362...
●	2,771	1	19	SUCCESS	N	2	15	00:00:00.0...	3/11/2009 5:10:28.46273...
●	2,772	1	19	SUCCESS	N	2	15	00:00:00.0...	3/11/2009 5:10:28.46296...
●	2,773	1	24	SUCCESS	N	27	40	00:00:00.0...	3/11/2009 5:10:28.48148...
●	2,774	1	24	SUCCESS	N	2	15	00:00:00.0...	3/11/2009 5:10:28.48191...
●	2,775	0	37	SUCCESS	N	20	33	00:00:00.0...	3/11/2009 5:10:28.48986...
●	2,776	1	29	SUCCESS	N	29	42	00:00:00.0...	3/11/2009 5:10:28.50023...
●	2,777	1	29	SUCCESS	N	2	15	00:00:00.0...	3/11/2009 5:10:28.50068...
●	2,778	1	29	SUCCESS	N	29	42	00:00:00.0...	3/11/2009 5:10:28.50091...
●	2,779	1	29	SUCCESS	N	2	15	00:00:00.0...	3/11/2009 5:10:28.50136...
●	2,780	1	29	SUCCESS	N	29	42	00:00:00.0...	3/11/2009 5:10:28.50159...
●	2,781	1	29	SUCCESS	N	2	15	00:00:00.0...	3/11/2009 5:10:28.50204...
●	2,782	1	29	SUCCESS	N	29	42	00:00:00.0...	3/11/2009 5:10:28.50227...
●	2,783	1	29	SUCCESS	N	2	15	00:00:00.0...	3/11/2009 5:10:28.50271...

```
Frame 2,776:  Len=42
⊟ LE BB:
    CP #: 1
    Channel Index: 29 - 2464 MHz
    Meets Predefined Filter Criteria for BT low energy devices: No
    Decrypted by Analyzer: No
    Event Status: Everything was ok.
    PDU Length: 29
⊟ LE PKT:
    Preamble: 0xaa
    Access Address: 0xcc81bc0e
    CRC: 0x4f96d8
⊟ LE DATA:
    LLID: Start
    NESN: 1
    SN: 1
    MD: 1
    Payload Length: 27
⊟ L2CAP:
    PDU Length: 3673
    Channel ID: 0x0042
    Payload is fragmented: Decode is in another frame
```

BINARY PANE

```
00111110 00100001 00000010 00010000 00011101 10101010 00001110 10111100 10000001 11001100
00011110 00011011 01011001 00001110 01000010 00000000 01100011 01100011 00100000 00110000
01111000 00110000 00110000 00110000 00110010 00110101 01100010 00110000 00110001 01100010
01100110 00111000 00110100 00001101 00001010 01110011 01101100 01100101 01100101 01001111
10010110 11011000
```

RADIX PANE

```
3e 21 02 10 1d aa 0e bc 81 cc 1e 1b 59 0e 42 00 63 63 20 30 78 30 30 30 32 35 62 30 31 62 66 38
34 0d 0a 73 6c 65 65 4f 96 d8
```

CHARACTER PANE

```
>!Y B cc 0x00025b01bf84 sleeO
```

Total Frames: 4,184 Frames Filtered In: 4,184 Frame #s Selected: 2,776; (1 total) [1 bytes]

For Help Press F1

Panes:

- Summary
- Detail
- Radix
- Protocol Filter tabs

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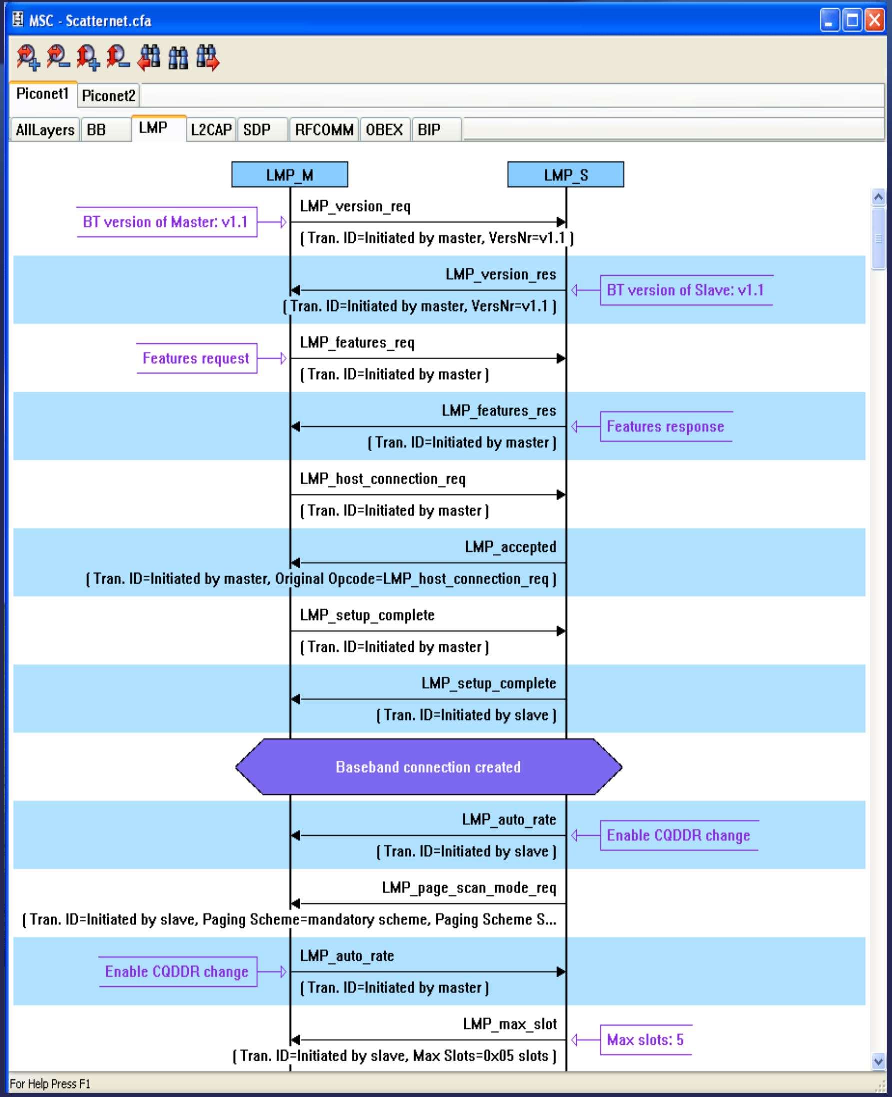
MSC: Message Sequence Chart



BT version of Master: v1.1 → LMP_version_req (Tran. ID=Initiated by master, VersNr=v1.1)

LMP_version_res (Tran. ID=Initiated by master, VersNr=v1.1) ← BT version of Slave: v1.1

Features request → LMP_features_req (Tran. ID=Initiated by master)

LMP_features_res (Tran. ID=Initiated by master) ← Features response

LMP_host_connection_req (Tran. ID=Initiated by master)

LMP_accepted (Tran. ID=Initiated by master, Original Opcode=LMP_host_connection_req)

LMP_setup_complete (Tran. ID=Initiated by master)

LMP_setup_complete (Tran. ID=Initiated by slave)

Baseband connection created

LMP_auto_rate (Tran. ID=Initiated by slave) ← Enable CQDDR change

LMP_page_scan_mode_req (Tran. ID=Initiated by slave, Paging Scheme=mandatory scheme, Paging Scheme S...

Enable CQDDR change → LMP_auto_rate (Tran. ID=Initiated by master)

LMP_max_slot (Tran. ID=Initiated by slave, Max Slots=0x05 slots) ← Max slots: 5

- All in simple terms and easy to understand
- MSC makes it easy to see
  - Physical link activities
  - Logical links activities
  - Protocol level activities
  - Profile level activities

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Supported profiles & 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
- CMTP
- 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

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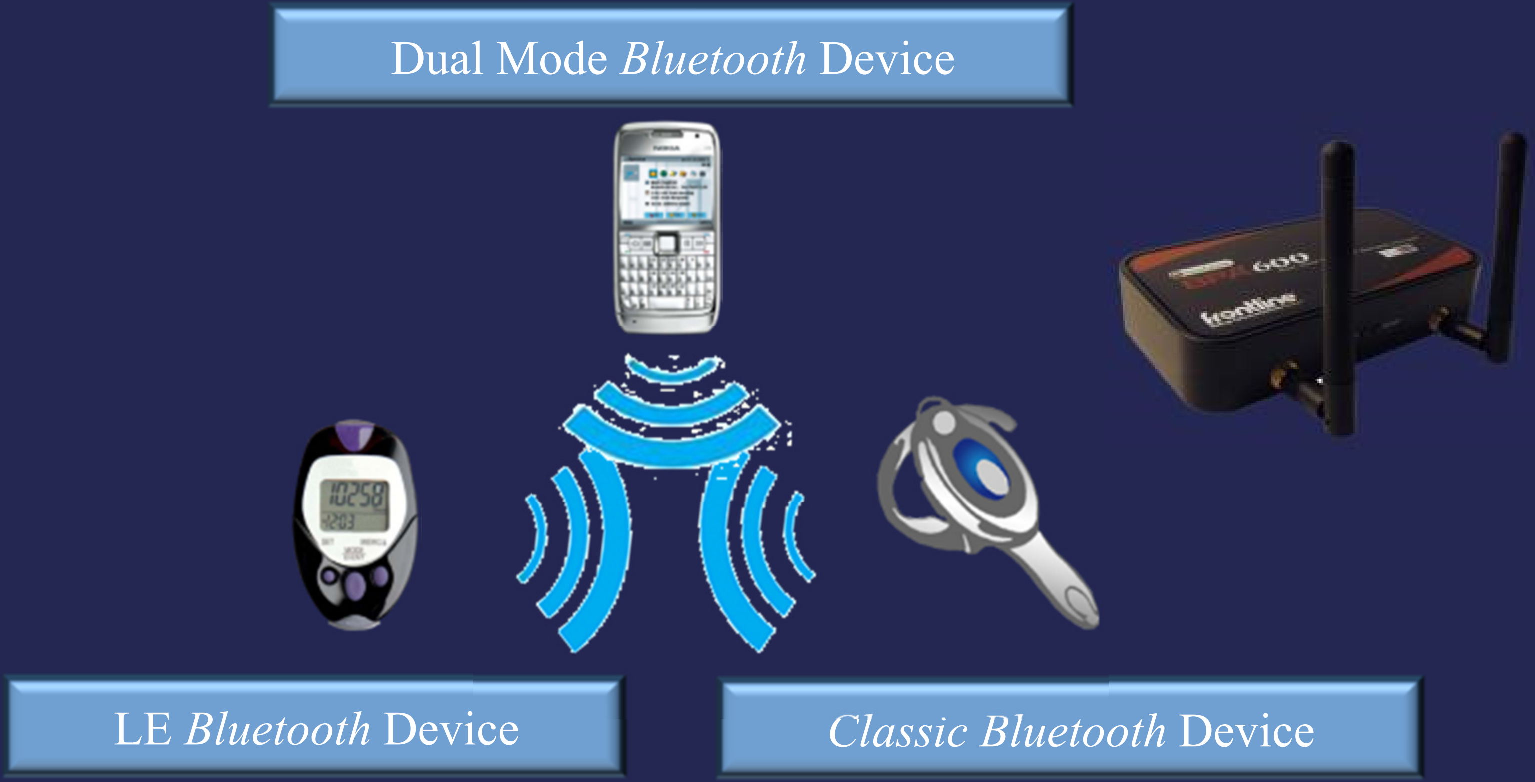
Sniffs Air – Dual Mode

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


Dual Mode *Bluetooth* Device

LE *Bluetooth* Device

Classic Bluetooth Device

BPA 600 Addons

- **802.11 ComProbe Addon**

  802.11 ComProbe with antennas to monitor Bluetooth packets across a WiFi transport

- **USB ComProbe Addon**

  USB HCI sniffer hardware using the USB ComProbe II.

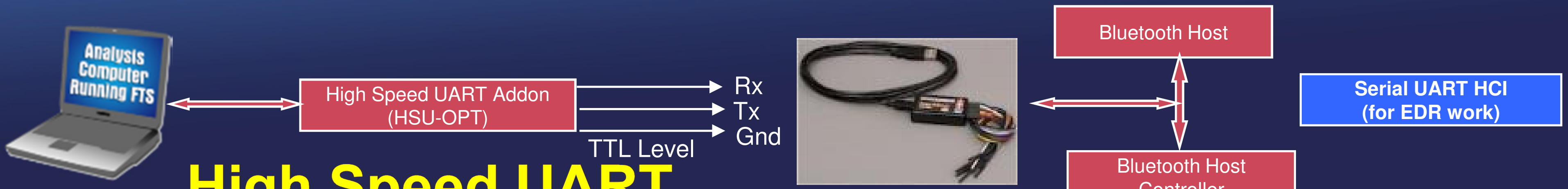
- **SDIO ComProbe Addon**

  SDIO sniffer hardware using the SDIO ComProbe

- **High Speed UART Addon**

  UART HCI sniffer hardware

HCI Sniffing – Add-ons Summary



Analysis Computer Running FTS

High Speed UART Addon
(HSU-OPT)

Rx
Tx
Gnd

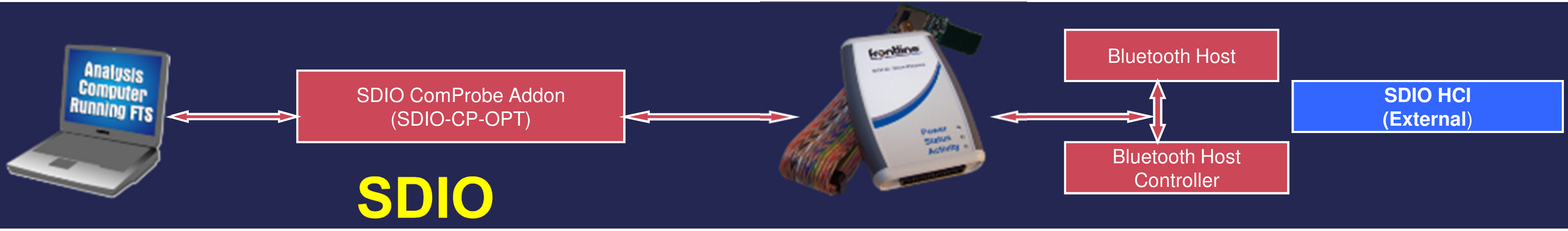
TTL Level

Bluetooth Host

Bluetooth Host
Controller

**Serial UART HCI
(for EDR work)**

High Speed UART



Analysis Computer Running FTS

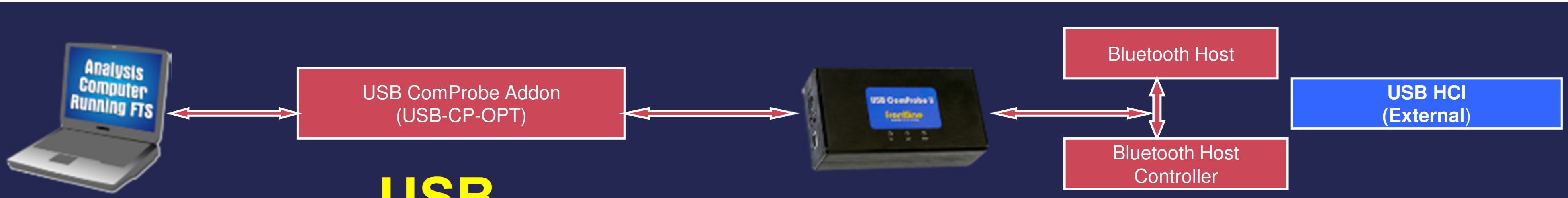
SDIO ComProbe Addon
(SDIO-CP-OPT)

Bluetooth Host

Bluetooth Host
Controller

**SDIO HCI
(External)**

SDIO



Analysis Computer Running FTS

USB ComProbe Addon
(USB-CP-OPT)

Bluetooth Host

Bluetooth Host
Controller

**USB HCI
(External)**

USB

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802.11 Sniffing Addon

- Bluetooth specification Bluetooth 4.0 +HS
- Combined Bluetooth and Wi-Fi throughput graph
- Numeric Data throughput readout for Average and Live (1 second window) payload
- Wi-Fi and Bluetooth channels identified on a single display
- Combined Bluetooth/Wi-Fi capture log
- Full, stand-alone Wi-Fi decoding and protocol analysis
- Detachable antenna to enable conductive capture of Wi-Fi data

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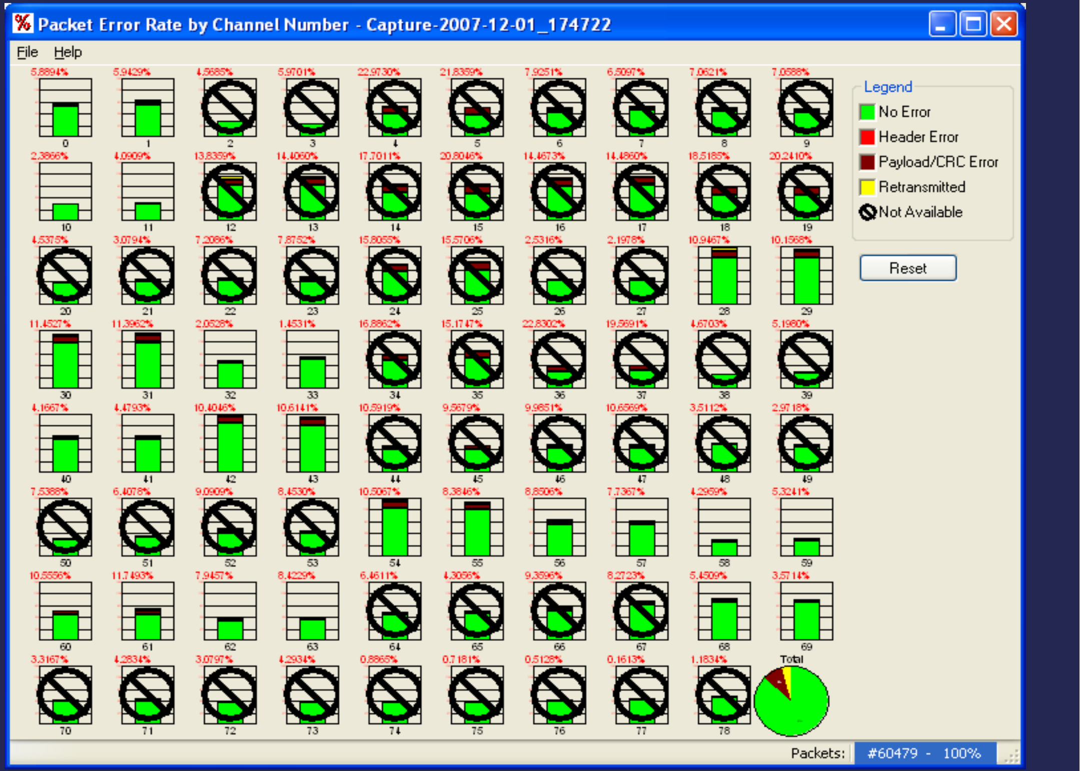
Other Useful Features

- Real-Time Packet Error Rate analysis
  - CRC and Header Errors for all 79 RF channels
  - Understands performance around other 2.4Ghz devices



Bluetooth Classic Time Line

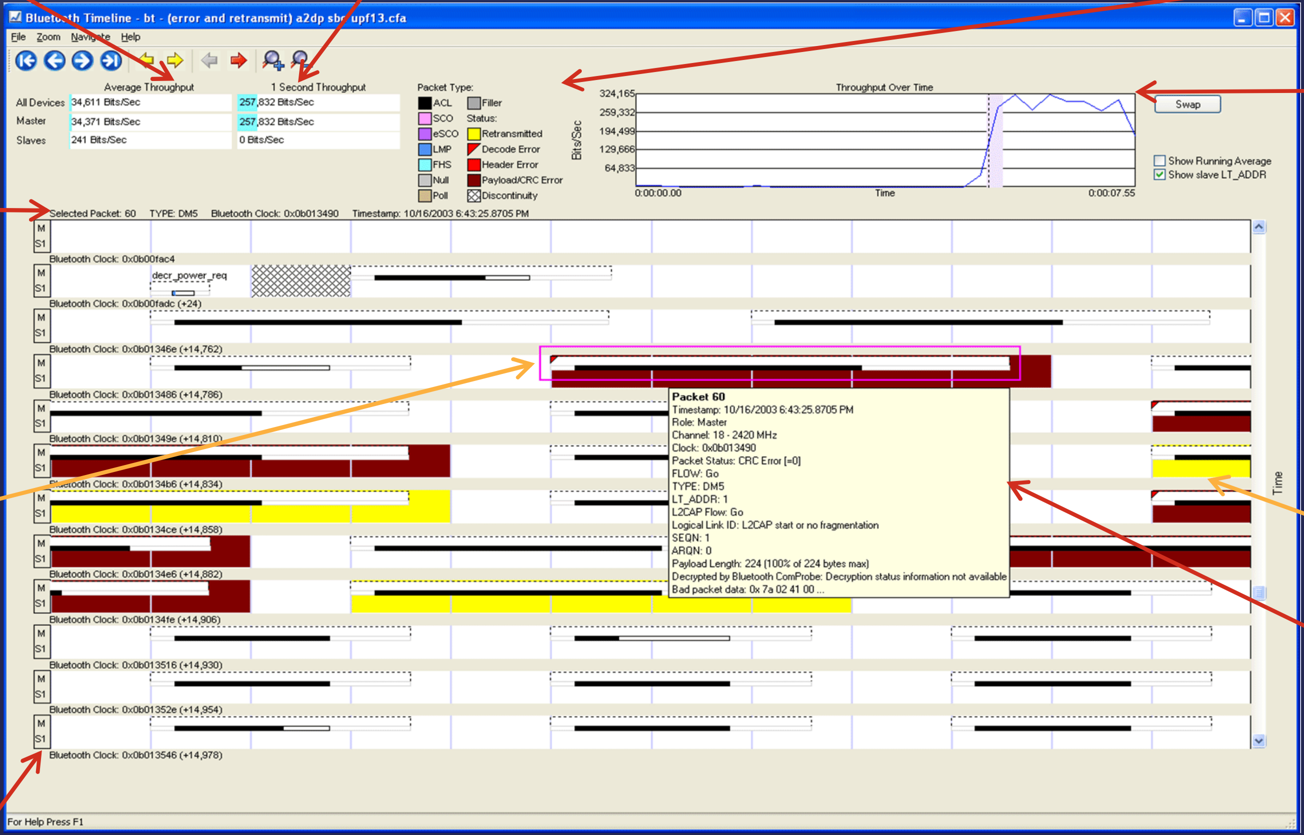
Average Throughput

One Second Throughput

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

Throughput Over Time

Summary info for selected packet



Bluetooth Timeline - bt - (error and retransmit) a2dp sbc upf13.cfa

	Average Throughput	1 Second Throughput
All Devices	34,611 Bits/Sec	257,832 Bits/Sec
Master	34,371 Bits/Sec	257,832 Bits/Sec
Slaves	241 Bits/Sec	0 Bits/Sec

Packet Type:

- ■ ACL
- ■ SCO
- ■ eSCO
- ■ LMP
- ■ FHS
- ■ Null
- ■ Poll
- ■ Filler

Status:

- ■ Retransmitted
- ◤ Decode Error
- ■ Header Error
- ■ Payload/CRC Error
- ☒ Discontinuity

□ Show Running Average
☑ Show slave LT_ADDR

Selected Packet: 60 TYPE: DM5 Bluetooth Clock: 0x0b013490 Timestamp: 10/16/2003 6:43:25.8705 PM

Bluetooth Clock: 0x0b00fac4

Bluetooth Clock: 0x0b00fadc (+24)

Bluetooth Clock: 0x0b01346e (+14,762)

Bluetooth Clock: 0x0b013486 (+14,786)

Bluetooth Clock: 0x0b01349e (+14,810)

Bluetooth Clock: 0x0b0134b6 (+14,834)

Bluetooth Clock: 0x0b0134ce (+14,858)

Bluetooth Clock: 0x0b0134e6 (+14,882)

Bluetooth Clock: 0x0b0134fe (+14,906)

Bluetooth Clock: 0x0b013516 (+14,930)

Bluetooth Clock: 0x0b01352e (+14,954)

Bluetooth Clock: 0x0b013546 (+14,978)

Packet 60
Timestamp: 10/16/2003 6:43:25.8705 PM
Role: Master
Channel: 18 - 2420 MHz
Clock: 0x0b013490
Packet Status: CRC Error [=0]
FLOW: Go
TYPE: DM5
LT_ADDR: 1
L2CAP Flow: Go
Logical Link ID: L2CAP start or no fragmentation
SEQN: 1
ARQN: 0
Payload Length: 224 (100% of 224 bytes max)
Decrypted by Bluetooth ComProbe: Decryption status information not available
Bad packet data: 0x 7a 02 41 00 ...

For Help Press F1

Packet

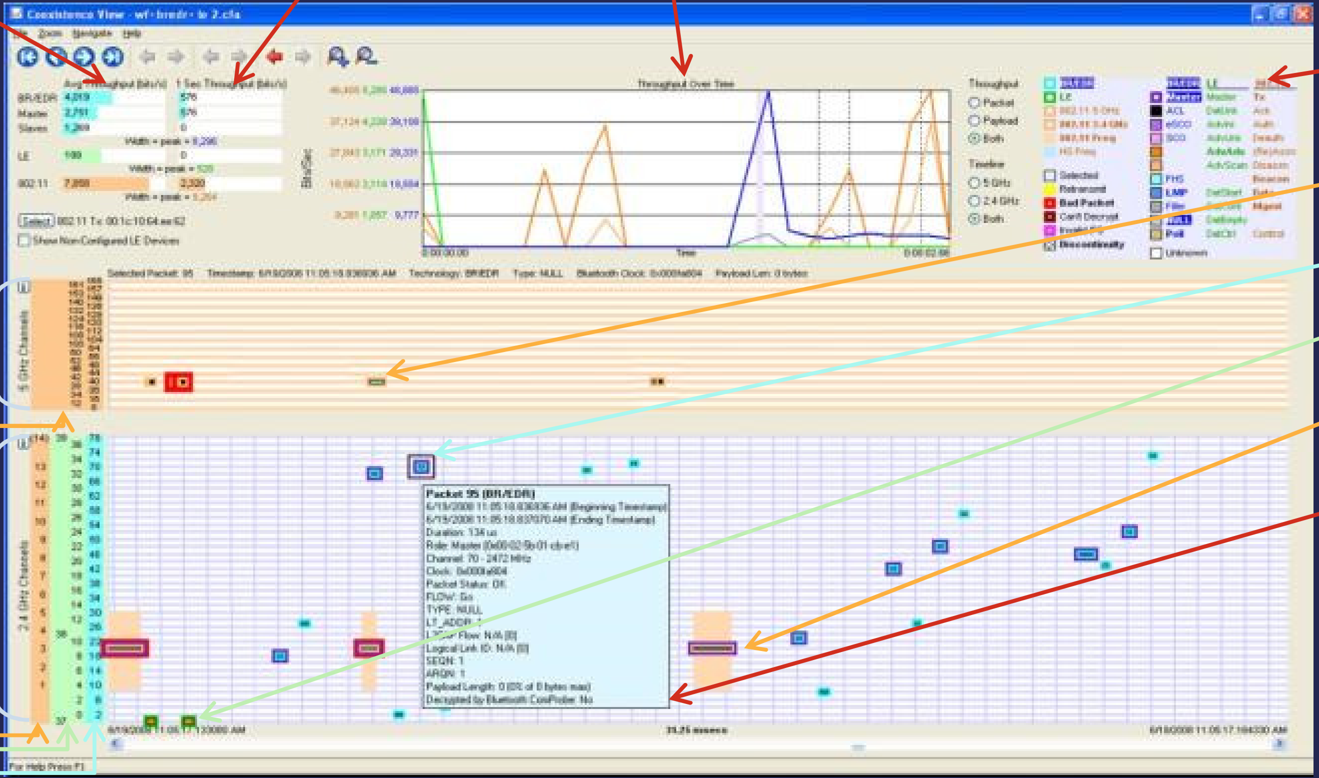
Retransmit Packet

Tooltip – Detailed Information about packet on mouse over

Master / Slave

Time flows left to right and down

Bluetooth Classic, 802.11, LE Coexistence Timeline



Coexistence View - wf-bredr- le 2.cfa

Selected Packet: 95 Timestamp: 6/19/2008 11:05:18.836836 AM Technology: BR/EDR Type: NULL Bluetooth Clock: 0x0008a604 Payload Len: 0 bytes

Packet 95 (BR/EDR)
6/19/2008 11:05:18.836836 AM (Beginning Timestamp)
6/19/2008 11:05:18.837070 AM (Ending Timestamp)
Duration: 134 us
Role: Master (0x00:02:5b:01:cb:e1)
Channel: 70 - 2472 MHz
Clock: 0x0008a604
Packet Status: OK
FLOW: Go
TYPE: NULL
LT_ADDR: 1
L2CAP Flow: N/A (0)
Logical Link ID: N/A (0)
SEQN: 1
ARQN: 1
Payload Length: 0 (0% of 0 bytes max)
Decrypted by Bluetooth ComProbe: No

Average Throughput

One Second Throughput

Throughput Over Time

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

802.11 Packet – 5 GHz range

Classic Packet

Low energy Packet

802.11 Packet – 2.4 GHz range

Tooltip – Detailed Information about packet on mouse over

5GHz Channels

802.11 (only)

2.4GHz Channels

802.11

Low energy

Classic (BR/EDR)

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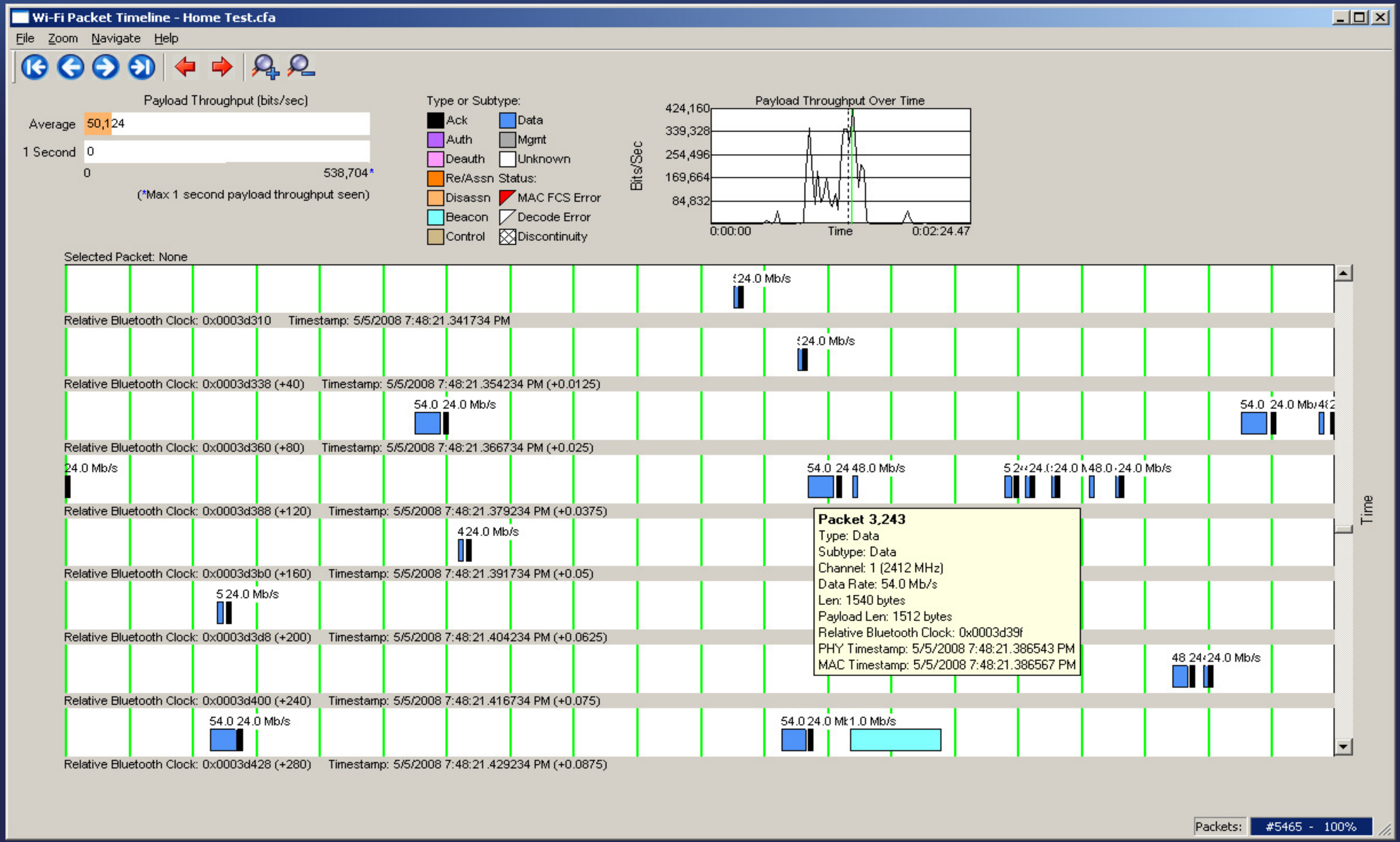
Bluetooth/Wi-Fi compatibility Time Line.



Wi-Fi Packet Timeline - Home Test.cfa

Payload Throughput (bits/sec)

Average 50,124

1 Second 0

0 538,704*

(*Max 1 second payload throughput seen)

Type or Subtype:

■ Ack ■ Data
■ Auth ■ Mgmt
■ Deauth □ Unknown
■ Re/Assn Status:
■ Disassn ◤ MAC FCS Error
■ Beacon ◸ Decode Error
■ Control ☒ Discontinuity

Payload Throughput Over Time

Selected Packet: None

Relative Bluetooth Clock: 0x0003d310 Timestamp: 5/5/2008 7:48:21.341734 PM

Relative Bluetooth Clock: 0x0003d338 (+40) Timestamp: 5/5/2008 7:48:21.354234 PM (+0.0125)

Relative Bluetooth Clock: 0x0003d360 (+80) Timestamp: 5/5/2008 7:48:21.366734 PM (+0.025)

Relative Bluetooth Clock: 0x0003d388 (+120) Timestamp: 5/5/2008 7:48:21.379234 PM (+0.0375)

Relative Bluetooth Clock: 0x0003d3b0 (+160) Timestamp: 5/5/2008 7:48:21.391734 PM (+0.05)

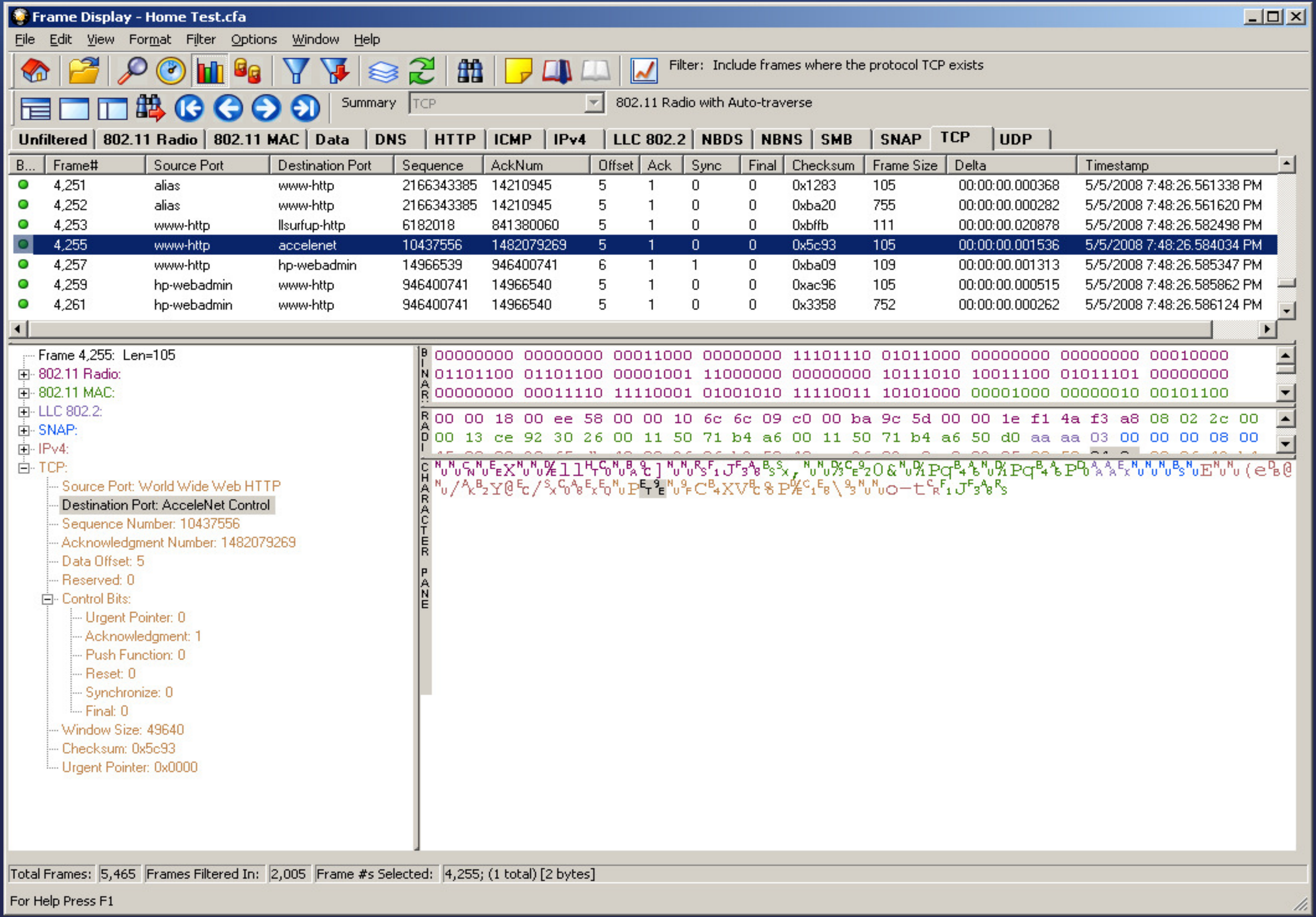
Relative Bluetooth Clock: 0x0003d3d8 (+200) Timestamp: 5/5/2008 7:48:21.404234 PM (+0.0625)

Relative Bluetooth Clock: 0x0003d400 (+240) Timestamp: 5/5/2008 7:48:21.416734 PM (+0.075)

Relative Bluetooth Clock: 0x0003d428 (+280) Timestamp: 5/5/2008 7:48:21.429234 PM (+0.0875)

Packet 3,243
Type: Data
Subtype: Data
Channel: 1 (2412 MHz)
Data Rate: 54.0 Mb/s
Len: 1540 bytes
Payload Len: 1512 bytes
Relative Bluetooth Clock: 0x0003d39f
PHY Timestamp: 5/5/2008 7:48:21.386543 PM
MAC Timestamp: 5/5/2008 7:48:21.386567 PM

Wi-Fi Frame display



Frame Display - Home Test.cfa
File Edit View Format Filter Options Window Help
Summary
802.11 Radio with Auto-traverse
Unfiltered | 802.11 Radio | 802.11 MAC | Data | DNS | HTTP | ICMP | IPv4 | LLC 802.2 | NBDS | NBNS | SMB | SNAP | TCP | UDP
For Help Press F1

Filter: Include frames where the protocol TCP exists

Summary: TCP

B...	Frame#	Source Port	Destination Port	Sequence	AckNum	Offset	Ack	Sync	Final	Checksum	Frame Size	Delta	Timestamp
●	4,251	alias	www-http	2166343385	14210945	5	1	0	0	0x1283	105	00:00:00.000368	5/5/2008 7:48:26.561338 PM
●	4,252	alias	www-http	2166343385	14210945	5	1	0	0	0xba20	755	00:00:00.000282	5/5/2008 7:48:26.561620 PM
●	4,253	www-http	llsurfup-http	6182018	841380060	5	1	0	0	0xbffb	111	00:00:00.020878	5/5/2008 7:48:26.582498 PM
●	4,255	www-http	accelenet	10437556	1482079269	5	1	0	0	0x5c93	105	00:00:00.001536	5/5/2008 7:48:26.584034 PM
●	4,257	www-http	hp-webadmin	14966539	946400741	6	1	1	0	0xba09	109	00:00:00.001313	5/5/2008 7:48:26.585347 PM
●	4,259	hp-webadmin	www-http	946400741	14966540	5	1	0	0	0xac96	105	00:00:00.000515	5/5/2008 7:48:26.585862 PM
●	4,261	hp-webadmin	www-http	946400741	14966540	5	1	0	0	0x3358	752	00:00:00.000262	5/5/2008 7:48:26.586124 PM

```
Frame 4,255:  Len=105
⊞ 802.11 Radio:
⊞ 802.11 MAC:
⊞ LLC 802.2:
⊞ SNAP:
⊞ IPv4:
⊟ TCP:
    Source Port: World Wide Web HTTP
    Destination Port: AcceleNet Control
    Sequence Number: 10437556
    Acknowledgment Number: 1482079269
    Data Offset: 5
    Reserved: 0
    Control Bits:
        Urgent Pointer: 0
        Acknowledgment: 1
        Push Function: 0
        Reset: 0
        Synchronize: 0
        Final: 0
    Window Size: 49640
    Checksum: 0x5c93
    Urgent Pointer: 0x0000
```

BINARY

```
00000000 00000000 00011000 00000000 11101110 01011000 00000000 00000000 00010000
01101100 01101100 00001001 11000000 00000000 10111010 10011100 01011101 00000000
00000000 00011110 11110001 01001010 11110011 10101000 00001000 00000010 00101100
```

RADIX

```
00 00 18 00 ee 58 00 00 10 6c 6c 09 c0 00 ba 9c 5d 00 00 1e f1 4a f3 a8 08 02 2c 00
00 13 ce 92 30 26 00 11 50 71 b4 a6 00 11 50 71 b4 a6 50 d0 aa aa 03 00 00 00 08 00
```

CHARACTER PANE

Total Frames:	5,465	Frames Filtered In:	2,005	Frame #s Selected:	4,255; (1 total) [2 bytes]

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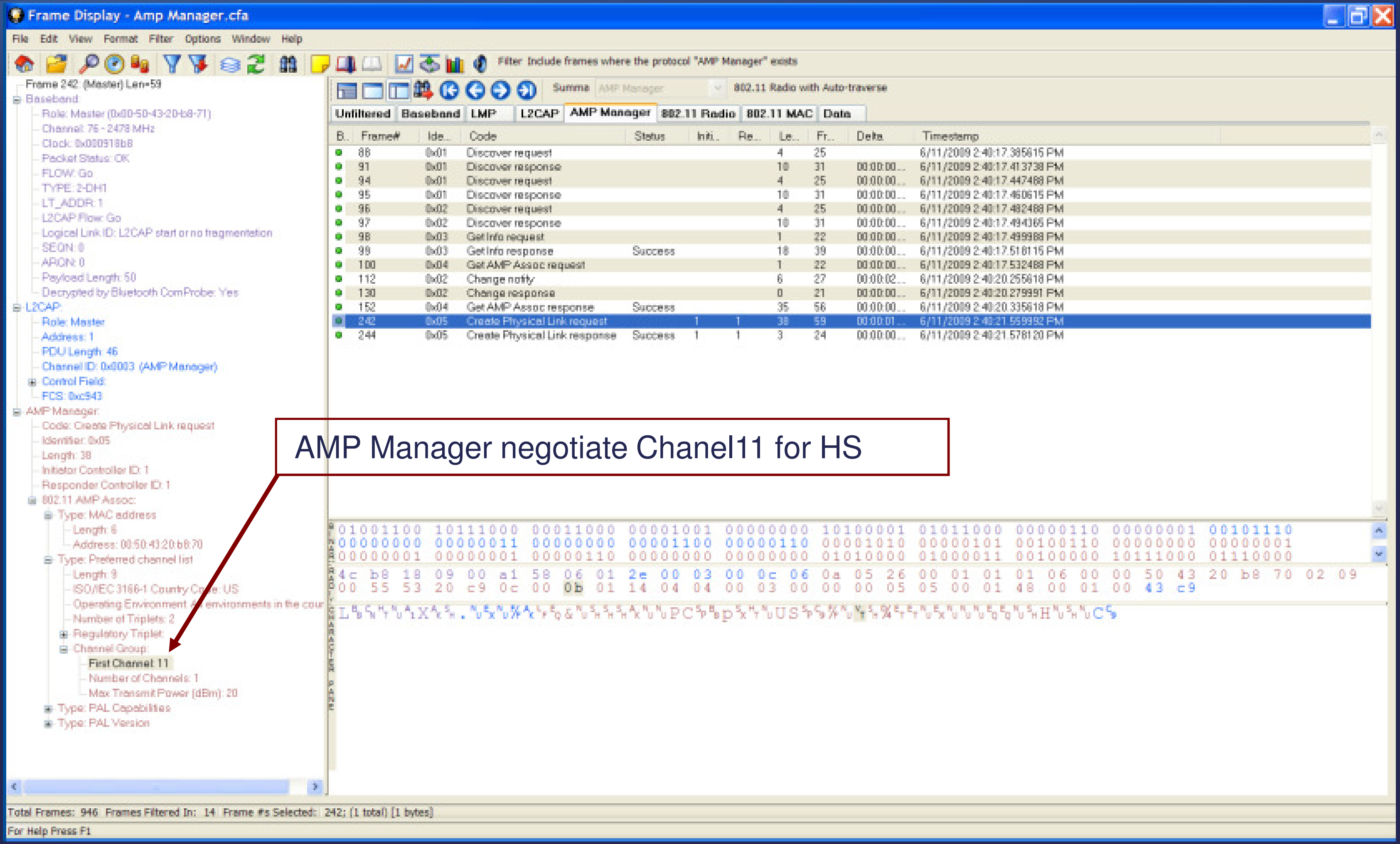
Bluetooth/Wi-Fi Coexistence view


Frame Display - Amp Manager.cfa
File Edit View Format Filter Options Window Help
Summa
AMP Manager
Unfiltered
Baseband
LMP
L2CAP
AMP Manager
802.11 Radio
802.11 MAC
Data

Filter: Include frames where the protocol "AMP Manager" exists

802.11 Radio with Auto-traverse

```
Frame 242: (Master) Len=59
⊟ Baseband:
   Role: Master (0x00-50-43-20-b8-71)
   Channel: 76 - 2478 MHz
   Clock: 0x000918b8
   Packet Status: OK
   FLOW: Go
   TYPE: 2-DH1
   LT_ADDR: 1
   L2CAP Flow: Go
   Logical Link ID: L2CAP start or no fragmentation
   SEQN: 0
   ARQN: 0
   Payload Length: 50
   Decrypted by Bluetooth ComProbe: Yes
⊟ L2CAP:
   Role: Master
   Address: 1
   PDU Length: 46
   Channel ID: 0x0003 (AMP Manager)
 ⊞ Control Field:
   FCS: 0xc943
⊟ AMP Manager:
   Code: Create Physical Link request
   Identifier: 0x05
   Length: 38
   Initiator Controller ID: 1
   Responder Controller ID: 1
 ⊟ 802.11 AMP Assoc:
   ⊟ Type: MAC address
       Length: 6
       Address: 00:50:43:20:b8:70
   ⊟ Type: Preferred channel list
       Length: 9
       ISO/IEC 3166-1 Country Code: US
       Operating Environment: All environments in the cour
       Number of Triplets: 2
     ⊞ Regulatory Triplet:
     ⊟ Channel Group:
         First Channel: 11
         Number of Channels: 1
         Max Transmit Power (dBm): 20
   ⊞ Type: PAL Capabilities
   ⊞ Type: PAL Version
```

B..	Frame#	Ide..	Code	Status	Initi..	Re..	Le..	Fr..	Delta	Timestamp
●	88	0x01	Discover request				4	25		6/11/2009 2:40:17.385615 PM
●	91	0x01	Discover response				10	31	00:00:00...	6/11/2009 2:40:17.413738 PM
●	94	0x01	Discover request				4	25	00:00:00...	6/11/2009 2:40:17.447488 PM
●	95	0x01	Discover response				10	31	00:00:00...	6/11/2009 2:40:17.460615 PM
●	96	0x02	Discover request				4	25	00:00:00...	6/11/2009 2:40:17.482488 PM
●	97	0x02	Discover response				10	31	00:00:00...	6/11/2009 2:40:17.494365 PM
●	98	0x03	Get Info request				1	22	00:00:00...	6/11/2009 2:40:17.499988 PM
●	99	0x03	Get Info response	Success			18	39	00:00:00...	6/11/2009 2:40:17.518115 PM
●	100	0x04	Get AMP Assoc request				1	22	00:00:00...	6/11/2009 2:40:17.532488 PM
●	112	0x02	Change notify				6	27	00:00:02...	6/11/2009 2:40:20.255618 PM
●	130	0x02	Change response				0	21	00:00:00...	6/11/2009 2:40:20.279991 PM
●	152	0x04	Get AMP Assoc response	Success			35	56	00:00:00...	6/11/2009 2:40:20.335618 PM
●	242	0x05	Create Physical Link request		1	1	38	59	00:00:01...	6/11/2009 2:40:21.559992 PM
●	244	0x05	Create Physical Link response	Success	1	1	3	24	00:00:00...	6/11/2009 2:40:21.578120 PM

```
01001100 10111000 00011000 00001001 00000000 10100001 01011000 00000110 00000001 00101110
00000000 00000011 00000000 00001100 00000110 00001010 00000101 00100110 00000000 00000001
00000001 00000001 00000110 00000000 00000000 01010000 01000011 00100000 10111000 01110000
```

```
4c b8 18 09 00 a1 58 06 01 2e 00 03 00 0c 06 0a 05 26 00 01 01 01 06 00 00 50 43 20 b8 70 02 09
00 55 53 20 c9 0c 00 0b 01 14 04 04 00 03 00 00 00 05 05 00 01 48 00 01 00 43 c9
```

Total Frames: 946 Frames Filtered In: 14 Frame #s Selected: 242; (1 total) (1 bytes)

For Help Press F1

AMP Manager negotiate Chanel11 for HS

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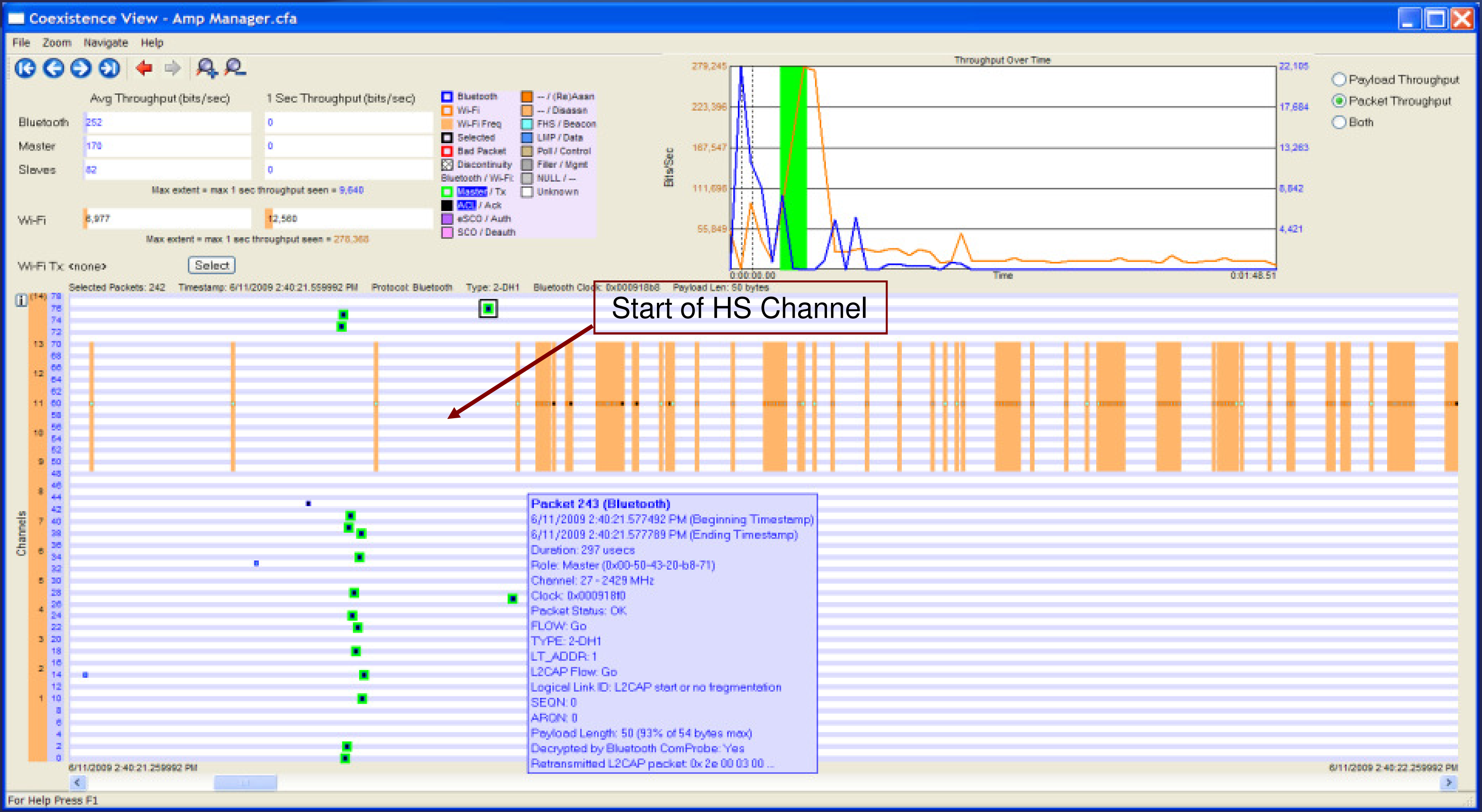
Bluetooth/Wi-Fi Coexistence view



Coexistence View - Amp Manager.cfa

File Zoom Navigate Help

	Avg Throughput (bits/sec)	1 Sec Throughput (bits/sec)
Bluetooth	252	0
Master	170	0
Slaves	82	0

Max extent = max 1 sec throughput seen = 9,640

Wi-Fi	6,977	12,560

Max extent = max 1 sec throughput seen = 278,368

Wi-Fi Tx: <none> Select

Selected Packets: 242 Timestamp: 6/11/2009 2:40:21.559992 PM Protocol: Bluetooth Type: 2-DH1 Bluetooth Clock: 0x000918b8 Payload Len: 50 bytes

○ Payload Throughput
● Packet Throughput
○ Both

Packet 243 (Bluetooth)
6/11/2009 2:40:21.577492 PM (Beginning Timestamp)
6/11/2009 2:40:21.577789 PM (Ending Timestamp)
Duration: 297 usecs
Role: Master (0x00-50-43-20-b8-71)
Channel: 27 - 2429 MHz
Clock: 0x000918f0
Packet Status: OK
FLOW: Go
TYPE: 2-DH1
LT_ADDR: 1
L2CAP Flow: Go
Logical Link ID: L2CAP start or no fragmentation
SEQN: 0
ARQN: 0
Payload Length: 50 (93% of 54 bytes max)
Decrypted by Bluetooth ComProbe: Yes
Retransmitted L2CAP packet: 0x 2e 00 03 00 ...

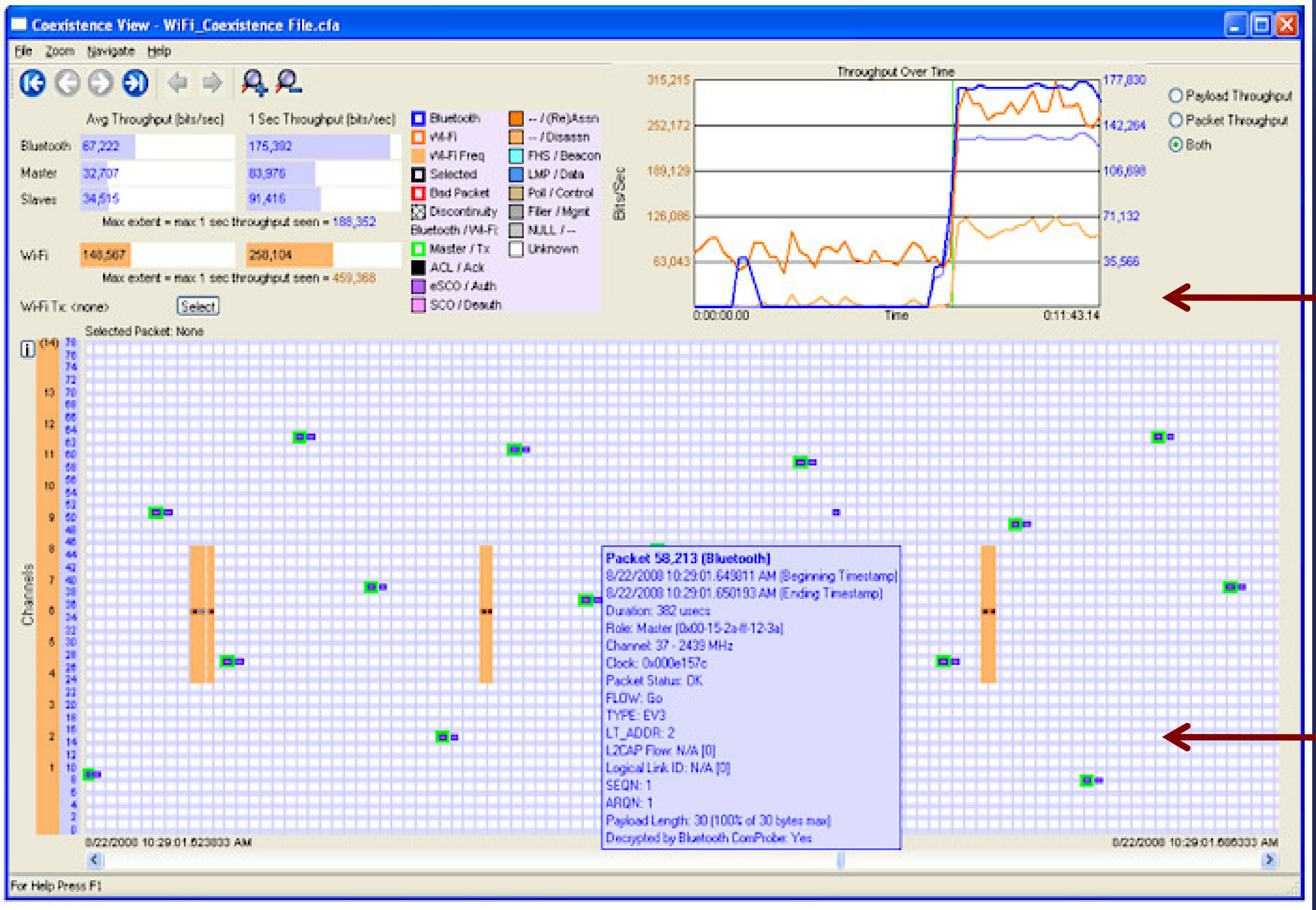
6/11/2009 2:40:21.259992 PM

6/11/2009 2:40:22.259992 PM

For Help Press F1

Start of HS Channel

Bluetooth/Wi-Fi Coexistence



Coexistence View - WiFi_Coexistence File.cfa

	Avg Throughput (bits/sec)	1 Sec Throughput (bits/sec)
Bluetooth	67,222	175,392
Master	32,707	83,976
Slaves	34,515	91,416

Max extent = max 1 sec throughput seen = 188,352

WiFi	148,567	258,104

Max extent = max 1 sec throughput seen = 459,368

WiFi Tx: <none> Select

Selected Packet: None

Packet 58,213 (Bluetooth)
8/22/2008 10:29:01.649811 AM (Beginning Timestamp)
8/22/2008 10:29:01.650193 AM (Ending Timestamp)
Duration: 382 usecs
Role: Master (0x00-15-2a-ff-12-3a)
Channel: 37 - 2439 MHz
Clock: 0x000e157c
Packet Status: OK
FLOW: Go
TYPE: EV3
LT_ADDR: 2
L2CAP Flow: N/A (0)
Logical Link ID: N/A (0)
SEQN: 1
ARQN: 1
Payload Length: 30 (100% of 30 bytes max)
Decrypted by Bluetooth ComProbe: Yes

For Help Press F1

Measure and compare Data Throughphut for Bluetooth and Wi-Fi.
Data Throughput stats enable you to monitor Data Throughput activity (average or instantaneous) on Bluetooth and Wi-Fi simultaneously.

Analyze *Bluetooth/Wi-Fi* payload efficiency at a glance.
Bluetooth and Wi-Fi data is displayed in a common graph to assure that your application is operating at its intended efficiency.

Scatternet Support

- Low cost solution with multiple Bluetooth ComProbes
- No restriction on sniffing additional Piconets
- Scatternet support

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Frontline Future Roadmap

- Further development for CPAS software.
- New and more Hardware interfaces.
- Support WBS and Aptx audio extraction.
- Exceed customers expectations.

Further development for CPAS

- Continued improved development of CPAS
- Speed
- Stability
- Larger File Limits
- Cross-platform
- Better UI
- Easier to Extend

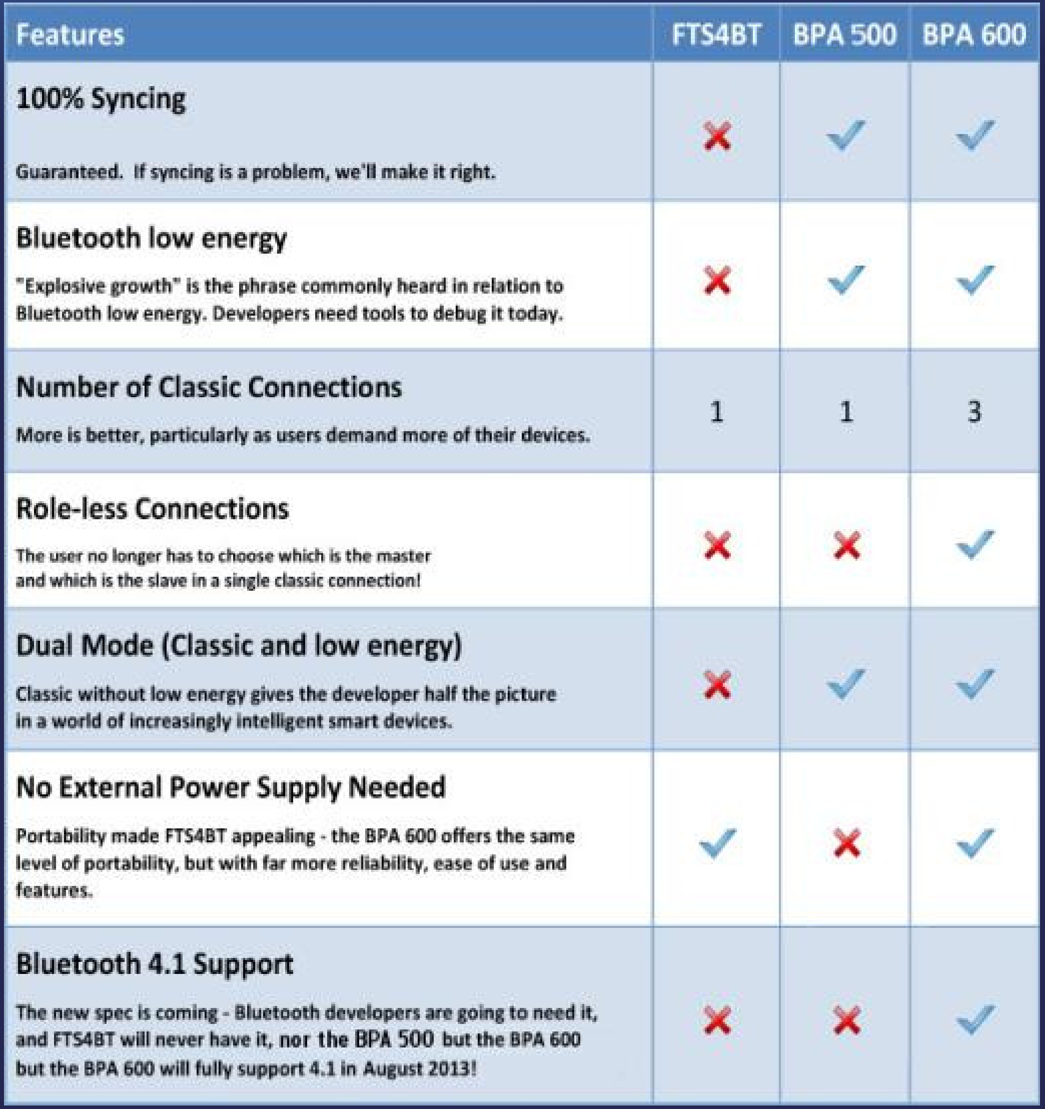
BPA 600 versus BPA 500

The BPA 600 replace the BPA 500

- Smaller Form Factor…Thinner
- 7 Radios so it can handle more scenarios
  - Example: LE and 2 classic connections at same time
  - Radios are Symmetrical.
- Can use USB Power or External Power Supply

  (On USB Power fewer radios will be enabled)
- Multi Connection decoding support with one BPA 500

Comparaison



Features	FTS4BT	BPA 500	BPA 600
100% Syncing Guaranteed. If syncing is a problem, we'll make it right.	✗	✓	✓
Bluetooth low energy "Explosive growth" is the phrase commonly heard in relation to Bluetooth low energy. Developers need tools to debug it today.	✗	✓	✓
Number of Classic Connections More is better, particularly as users demand more of their devices.	1	1	3
Role-less Connections The user no longer has to choose which is the master and which is the slave in a single classic connection!	✗	✗	✓
Dual Mode (Classic and low energy) Classic without low energy gives the developer half the picture in a world of increasingly intelligent smart devices.	✗	✓	✓
No External Power Supply Needed Portability made FTS4BT appealing - the BPA 600 offers the same level of portability, but with far more reliability, ease of use and features.	✓	✗	✓
Bluetooth 4.1 Support The new spec is coming - Bluetooth developers are going to need it, and FTS4BT will never have it, nor the BPA 500 but the BPA 600 but the BPA 600 will fully support 4.1 in August 2013!	✗	✗	✓

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The Frontline Edge

- Outstanding Technical Support
- Trusted Bluetooth Expertise

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Why use Frontline?

- You need to know your device will work with other devices – we have a comprehensive, in house, current, and ever expanding device library. 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 North America – 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?

- You want to improve your “out of box” experience – we use pre-defined and customized test plans that will thoroughly test your devices so that your 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 and cars used in mass produced vehicles.
- 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.

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