



# **Bluetooth Vanguard**

## **Advanced Wireless Protocol Analysis System**

Innovative Cutting-Edge Integrated

Sales Contact:







**Ellisys Bluetooth Vanguard**<sup>™</sup> **Advanced Wireless Protocol Analysis System** 

### **Powerful Ellisys Features**

- generic I2C, UART, SWD, and SPI, Audio I2S, and WCI-2
- insights they need
- discovery/connection traffic and complex topologies
- capture accelerated by Ellisys hardware protocol engine for best-in-class performance
- unmatched coexistence analysis capability
- Connection/Power Flexibility: Connect, control, and power the system locally or remotely Deliverv)
- Emerging Features Support: Benefit from early implementation of pre-specification feature additions
- Mesh Support: Includes full support for Bluetooth Mesh network topologies
- **Reprogrammable Bluetooth Digital Radio:** Support for new specifications without hardware changes
- Multi-Piconet Support: Visualize all topologies, including multiple piconets and scatternets
- All Protocols and Profiles: Best-of-breed protocol decoding
- I2S, within the software, in sync with all other traffic
- issues
- Free Maintenance: Free lifetime updates as well as free fully-featured viewer software with unlocked hardware that can be used on any computer

Wideband BR/EDR and Low Energy sniffer, with concurrent capture of Wi-Fi, WPAN IEEE 802.15.4, spectrum, HCI (USB, UART, SPI), Generic UART, SPI, SWD, I2C, WCI-2, logic signals, and Audio I2S

### **Innovative Tool for Demanding Users**

The most advanced, most comprehensive Bluetooth<sup>®</sup> protocol analyzer ever made. Building on a legacy of innovation, the Bluetooth Vanguard All-In-One Wireless Protocol Analysis System delivers new advances designed to ease the increasingly complex tasks of Bluetooth developers.

With its revolutionary wideband Digital Radio and integrated All-in-One hardware approach, Ellisys has changed the way Bluetooth protocol capture and analysis is done, by radically overcoming the drawbacks of legacy approaches. The Ellisys wideband capture approach robustly records any packet, at any time, from any neighboring piconet, with zero-configuration and without being intrusive.

### **Reconfigurable Bluetooth Digital Radio**

The reconfigurable radio concept for Bluetooth analyzers is another innovation from Ellisys engineering. With the Bluetooth Vanguard, this cost-saving feature remains a core user benefit. Reconfigurability means that the analyzer can be updated by software to support new features, without any change to the hardware. For instance, this flexibility allowed for the addition of Bluetooth features such as enhanced AES Security, Connectionless Broadcast, and more recent features, like Coded PHY and the 2Mbps BLE speed enhancement many months before these features were released in an updated specification.

Additionally, Ellisys analyzers come with free lifetime **software updates** and no restrictions on sharing the application software with co-workers, so our customers can benefit from these great additions hassle-free.



### **Industry's First Bluetooth** Wideband Capture

Bluetooth wireless technology was originally designed to be robustly impervious to interference on the much-used 2.4 GHz ISM band. It was also designed to be difficult to sniff, for security reasons. To meet these criteria, a Bluetooth radio uses from 40 to 79 channels pseudo-randomly according to a hopping sequence defined at the piconet's connection time.

A hopping sniffer tries to actively synchronize on a specific hopping sequence, and captures the packets only after a successful synchronization. This kind of sniffer has several inherent limitations, making it more difficult to use, less reliable, and usable only in a limited set of scenarios.

Ellisys created the industry's first wideband sniffer in 2010, which overcame these drawbacks, adding revolutionary features which opened new horizons for Bluetooth debugging and interoperability testing. The wideband capture approach is as simple as it is powerful: instead of listening to just a few channels, the sniffer captures all channels concurrently. The sniffer thus does not need to synchronize to a piconet; it will listen passively to all nearby Bluetooth piconets, scatternets, and other topologies without any required configuration.

### The All-in-One Sniffer Concept -**Another Ellisys Innovation**

Capturing wireless traffic is a very important aspect of Bluetooth debugging, but other information is equally important for understanding the big picture. This is another aspect where Ellisys sniffers excel.

The Bluetooth Vanguard supports one-click concurrent and tightly synchronized capture of:

### Wireless Capture

- Bluetooth Low Energy
- Bluetooth Classic (BR/EDR)
- Wi-Fi IEEE 802.11a/b/g/n/ac/ax/6e [ENT/OPT]
- WPAN IEEE 802.15.4 [ENT]
- 2.4 GHz Raw Spectrum Energy [PRO]

### Wired Capture

- Bluetooth HCI (UART x2, USB x1, SPI x2) [PRO]
- General Purpose Logic Signals [PRO]
- Audio I2S [PRO]
- Wireless Coexistence Interface 2 [PRO]
- Generic Communications -UART, SPI, I2C, SWD [PRO]



• All-in-One: Fully hardware-integrated, time-synchronized, and truly one-click concurrent capture of BR/EDR, Bluetooth Low Energy, Wi-Fi, WPAN (IEEE 802.15.4), raw RF spectrum, HCI, logic/GPIO,

 Widely Acclaimed Software: The Ellisys software application provides intuitive understandings of complex protocol and RF behaviors, and flexible configuration and control to give engineers the

Bluetooth Wideband Capture: Easy and rock-solid capture of any traffic on all channels, including

• WiFi 802.11 a/b/g/n/ac/ax/6e Capture: Extremely accurate and perfectly synchronized Wi-Fi

• WPAN 802.15.4 Wideband Capture: Concurrent capture of all 16 WPAN 2.4 GHz channels for an

via networkable GbE (with Power-over-Ethernet/PoE) or USB 3.1 over Type-C<sup>®</sup> (with USB Power

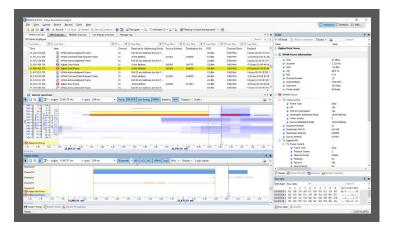
Integrated Audio Analysis: Listen to captured over-the-air audio, including audio over HCI and

• Raw RF Spectrum Display: Characterize the raw wireless environment and visualize coexistence

### All-Channels 802.15.4 WPAN

IEEE 802.15.4 is a technical standard that provides lower-layer support for higher-layer network specifications like Thread and Zigbee. Increasingly, this Low-Rate Wireless Personal Area Network (LR-WPAN) technology is being used on devices, modules, and SoC's that also employ Bluetooth and/or Wi-Fi communications, and in environments like Smart Home, smart cities, and industrial applications where Bluetooth and Wi-Fi are also present.

These circumstances present coexistence challenges. **Bluetooth Vanguard uses an innovative wideband approach to capture all 16 WPAN channels** that are used in the 2.4GHz band, including associated RF characteristics, in precise synchronization with all other traffic streams captured by the analyzer.



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### **Ellisys Bluetooth Vanguard**<sup>™</sup> Advanced Wireless Protocol Analysis System

### **Automated Error Detections**

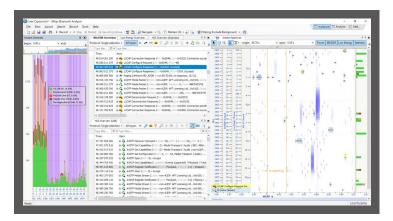
The analyzer software alerts the user to a variety of errors detected for both wired and wireless captures. Physical, protocol, and profile layer errors, including packet and transactional errors, are **automatically highlighted without any need to search through the capture.** 

Errors are highlighted on a color-coded system to indicate the relative severity of the errors, summarized in a dedicated status column in each protocol overview, and described in the Details view or with pop-up messages on fly-over in the Overviews. Incomplete payloads, missing or incorrect field values, center frequency violations, timing violations, missing responses, and CRC errors are among the errors indicated.

### **Visualizing Coexistence Issues**

In addition to Bluetooth Classic and Bluetooth Low Energy, Vanguard supports capture of Wi-Fi 802.11a/b/g/n/AC 3x3, WPAN 802.15.4, and raw RF spectrum - **in precise synchronization with each other and all supported wired transmissions.** These technologies are frequently sources of interference and contention with Bluetooth communications, as they share the 2.4 GHz ISM spectrum used by Bluetooth. Increasingly, these technologies are co-resident on the same SoC.

To fully characterize coexistence issues, Vanguard delivers a variety of features that make this task easier. The user is provided a precise understanding of RF signatures, sources, and power, various timings, device performance indications, and other related metrics.



### Wi-Fi Capture - Accelerated

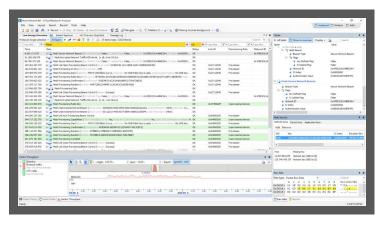
With Vanguard, **Wi-Fi traffic is captured using an innovative, Ellisys-designed hardware-accelerated protocol engine.** With lower-performance Wi-Fi capture tools that use a software-based capture approach, the capture process is done with a processor involved. This approach can limit the speed and timing accuracy of the capture – packets can be missed when the processor is outmatched by the incoming streams.

With Vanguard's specially designed protocol engine, the Wi-Fi capture is driven directly and without processor dependence to guarantee throughput and minimize latency. Importantly, the Wi-Fi traffic is captured concurrently and in precise synchronization with all other supported wired and wireless capture streams.

### **Bluetooth Mesh Networking**

The Bluetooth Mesh Networking specifications define a broad spectrum of device and system requirements for a large-scale many-to-many network using Bluetooth Low Energy wireless technology. Bluetooth mesh networks can greatly increase the range of Bluetooth communications by using a message relay approach and are inherently uncomplicated and inexpensive to deploy, as there are no requirements for a central router or computer.

Bluetooth Vanguard provides **comprehensive support for capture of mesh network protocol,** related packet and transactional decodes, encryption and key management features, and error detections. Mesh traffic is captured concurrently and in precise synchronization with all other supported traffic streams.



### **Instant Timing**

Timing is everything as they say, and with Bluetooth, it's always an important focus. Multitudes of timing parameters defined by the Bluetooth specification are system-critical. It is understandably important to characterize these timings efficiently and accurately. Hardware and software timing issues are often the source of interoperability and performance issues that can challenge Bluetooth engineers.

The Instant Timing view displays various information along a common timestamp, including visualized Bluetooth, Wi-Fi, and WPAN packets, HCI traffic (UART, SPI, and USB), generic communications (SWD, I2C, UART, and SPI), and logic signals. Data throughput and packet transmission statistics are included to complete the approach.



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### Ellisys Bluetooth Vanguard<sup>™</sup>

**Advanced Wireless Protocol Analysis System** 

### **One-Click Record**

Capture starts instantly without any configuration. Devices under test are automatically

#### **Protocol Overview**

Low-level and stack protocol elements are hierarchically displayed in easily configurable views.

#### **Instant Spectrum**

Visualize hopping sequences, AFH dynamics, statistical per-channel error characteristics,

#### **In-Depth Data Mining**

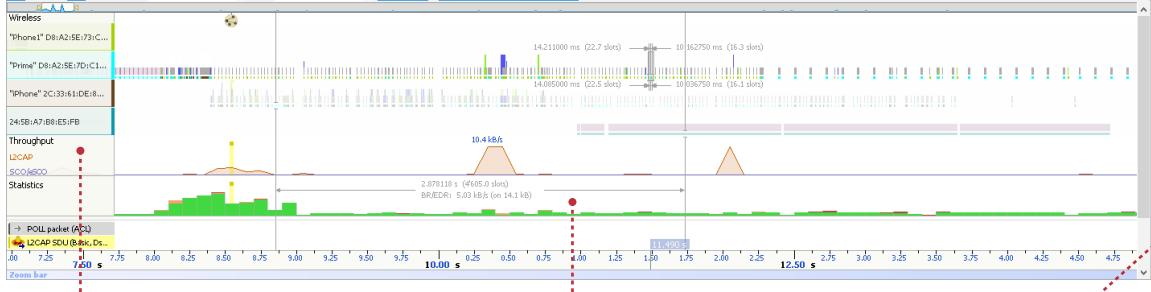
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#### timings, and RF characteristics. detected. item in the overview. <u>File View</u> Layout Search Record Tools Help 🕨 Record 🗸 🗉 Stop 🔄 Restart 🖷 Save & Continue | 👹 🎆 🖉 Navigate 🔹 🖾 | 🗁 Markers 🗸 💷 🧠 | 🏹 Filtering: Exclude Background 🔹 | 🛅 💕 🔛 R **A**A ᢙ Welcome 4 Þ 🗙 BR/EDR Overview HCI Overview (Injection) Message Log HCI Overview (Serial) 拱 Instant Spectrum 🔍 🔲 🚡 - origin: 8,544.24 ms Power BR/EDR Protocol: Single selection 👻 All layers - + + 📾 🎃 💡 🔎 🖶 🖄 🕒 🗰 🖾 🛍 🎯 4 🔟 🎬 🕥 📩 🎬 span: 7.18 ms Type filter Type filter. Type filter 3 Time ~ 2405 — Item Communication 6 8,407 372 500 Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 2411 1q-8.412 372 500 E de L2CAP Information (Fixed Channels Supported > ATT) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 8.447 372 500 🗄 🔶 L2CAP SDU (Basic, Dst=Fixed 0x0030) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 2 -18 ------0 8.448 622 500 E de L2CAP Connection (Src=0x0204, PSM=SDP > Dst=0x8707) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 3 — 2423 — 8.452 996 875 E de L2CAP Information (Extended Features Supported) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 2426 — 4 ---11 — 12 — 13 — 8.459 247 000 E L2CAP Information (Fixed Channels Supported > ATT) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 2429 -----30 — 8.460 496 875 🗄 📥 L2CAP Configure (Dst=0x0204, MTU=256 > Src=0x8707, MTU=256) Master: "Phone" 2C:33:61:DE:8C:3E <-> Sla 5g-14 — . 15 — . 5 16 — 2435 - 233 - 2438 - 2438 - 236 8.467 372 500 E 🚣 L2CAP Configure (Dst=0x8707, MTU=128 > Src=0x0204, MTU=128) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 8.472 996 875 Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla ₩2441 ----8.541 122 500 🗄 🛖 L2CAP SDU (Basic, Dst=Fixed 0x0030) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 2444 d 42 ----2447 - 2447 -8.542 372 500 B 2 SDP Service Search Attribute Transaction (PnP Information) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 48 — 8.544 246 875 Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 22 23 24 25 26 27 28 -9g 2453 — 51-----8.629 872 500 碱 🔎 SDP Service Search Attribute Transaction (Hands-Free Audio Gateway) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 10 -8.667 372 500 🗄 🛖 L2CAP SDU (Basic, Dst=Fixed 0x0030) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 57 - 🗄 ■ 2 SDP Service Search Attribute Transaction (Audio Source: L2CAP AVDTP V1.3) 11 -8.669 872 625 Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 29 — 30 — 31 — 63 — 2465 — \_\_\_\_\_2,998375 ms 8.707 372 625 🖳 🚇 SDP Service Search Attribute Transfer (A/V Remote Control Target) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 12 -2468 — 66 — 32 — 33 — 34 — 8.722 372 500 B DP Service Search Attribute Transaction (iAP: L2CAP RECOMM Ch 1) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 13 g ⊞ LMP Authentication Transaction (02 00 00 00 13 00 00 00 02 00 00 03 00 . 2474 — 8,904 872 500 Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 35 -2477 — 8.912 372 625 ⊞ ■ LMP Encryption Mode (Encryption > Accepted) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 📤 L2CAP SDU (Basic, Dst=Fixed 0. 8,915 496 750 ⊞ ■ LMP Encryption Key Size (16 bytes > Accepted) Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla ➔ POLL packet (ACL) 8,916 746 750 Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 7.00 2.00 6.00 ⊞ 🖼 LMP Start Encryption Request (58 D9 FF 87 40 FE 6F 1A 34 2A B7 A9 D2 5B 4... Master: "iPhone" 2C:33:61:DE:8C:3E <-> Sla 8.921 746 750 8,55<mark>0.00</mark> ms Zoom ba Instant Timing 👠 🖑 🔍 🔳 🚡 - 🛛 origin: 7.72 s ▼ Bluetooth ▼ WiFi HCI WCI Logic Misc ▼ Display ▼ Logic inputs • span: 7.18 s



#### Innovative Data Groups

Relationships between packets are made clear, by assembling data per piconet's master device, slave, channel and more.

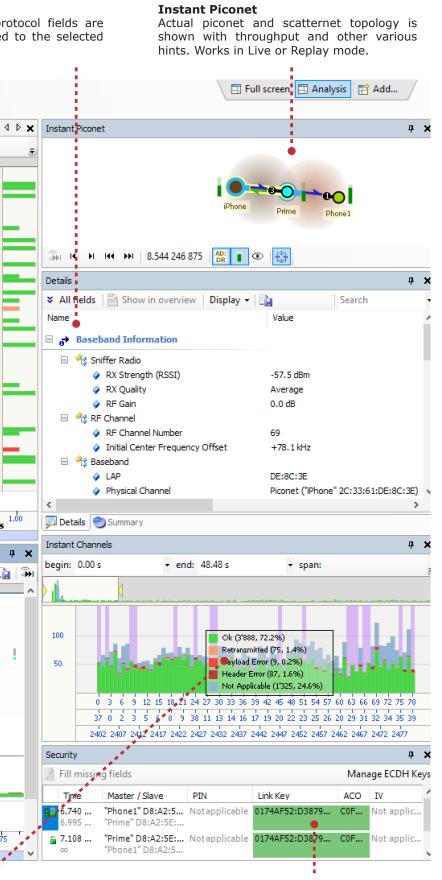
#### Instant Timing

Time-ordered, color-coded display of air and HCI traffic, statistics, data throughput and logic signals, with precision timing measurements.

#### **Instant Channels**

Understand per-channel transmission quality with a variety of statistics, over a user-specified time range.





### Security Management

Manage addition of link keys here. See when a Start Encryption exchange happens and navigate there with a single click.

### Protocol & Profiles Analysis

Bluetooth protocols and profiles are displayed in an **easy-to-understand, high-level procedures-oriented chronological format** in the Overview windows and fully detailed to the lowest bit/byte level in the linked Details view. All supported traffic streams are displayed in designated Overviews real-time, as the capture progresses.

The user is provided various controls to easily customize any Overview, including powerful filtering and coloring capabilities designed to quickly isolate specific protocols, profiles, or communications of interest. Traffic can be presented at the highest level of abstraction and the user can drill down to show all intermediate levels, down to the most basic elements, such as packet-only views.

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100.519 412 500 🛞 🚓 L2CAP Information (Extended Features Supported + BRTM ( PCS)	🗟 💣 Retransmission Information			00 09 00 01	
100.523 162 500 🔹 📽 UMP Extended Features Exchange (SSP Host + SSP Host, LE Host)	Data Retries			35 03 19 10 00 09 00 04	
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101,299 339 000 + Ha LMP Features Exchange (SD Features - 40 Features)	Protocol 1	LICAP		00 09 01 00	
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131.605 013 750 🛞 🛖 L2CAP Deconnection (V0x0030, Dst-0x0046)	Protocol	L2CAP		76 69 63 65 73 00 09 01	
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105.709 917 000 · Paging Daknown 8D, ACOR > "MyDevice" 0C/88/FD/04/83/88, responded, 3.72 ()	E 🍕 Language Base Attribute ID List			00 09 02 01	
105.005 825 625 (k 0) Inquiry (11 responders, 20 s)	Ø Element 1	25'966		00 00 00 40	
106.576 012 875 a 😘 UMP Features Exchange (50 Features - 51 Features)	Element 2	206		OE 35 90 09 00 00 04 00	
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ellisys

### **Ellisys Bluetooth Vanguard**<sup>™</sup> Advanced Wireless Protocol Analysis System

### **Topology Analysis**

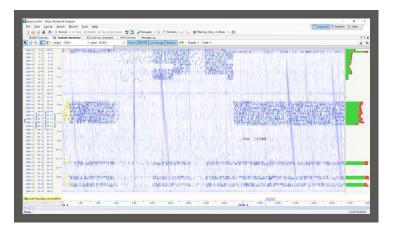
Bluetooth technology has become very popular among consumers and continues to evolve into new applications and markets, leading to more complex use cases. The only way to support these new use cases is to create more complex topologies, for example, Mesh Networking.

Debugging complex topologies has always been a difficult task, but Bluetooth Vanguard is up to the task with its **powerful wideband radio capable of capturing any traffic from any device,** including the most complex topologies. The Instant Piconet view helps developers visualize their topologies live while capturing, and also provides a play-back feature showing step-by-step evolution of topology changes.

### **Spectrum Analysis**

The Instant Spectrum feature displays packets by channel, over time and can also **synchronously display raw RF spectrum information in the busy and unlicensed 2.4GHz ISM band** in which Bluetooth operates. Other users of this band include Wi-Fi, LTE, ZigBee, ANT, microwave ovens, and other products and technologies. These users can and do interfere with each other, and it is often necessary to gain a precise understanding of the wireless environment.

The signal strength of all emitters (RSSI) is displayed. Adaptive Frequency Hopping (AFH) behaviors are overlaid, enabling a keen understanding of the complexities of the dynamic RF challenges encountered by any given Bluetooth link.



### **Logic Analysis**

The logic analysis feature allows for synchronous capture of external logic signals. Any digital signal is supported, including general-purpose inputs/outputs (GPIOs) or dedicated pins such as TX/RX Active, CTS, RTS, etc. A convenient color-coded probe is supplied.

### These signals are visualized with 5-nanosecond precision

and displayed in the Instant Timing view with all over-the-air and wired traffic streams. Signals can be assigned custom names and colors for easy identification. Custom signal groups can be created and displayed as buses, in addition to the display of discrete signals. Users can create simple external comparators and observe thresholds being crossed for various metrics, such a power consumption.

### **Integrated Audio Analysis**

The Ellisys analysis software includes integrated Audio analysis. **Any captured audio stream can be quickly and easily played back, even live, during capture.** Finding the packet carrying a specific audio portion or seeing event and topology changes at specific audio positions becomes child's play.

Audio captured over HCI or from an Audio I2S input [PRO] can be played back as well. This enables characterization of the complete audio chain, from the uncompressed audio provided to the source radio chip, to the audio transmitted wirelessly, and the decoded audio received by the receiver radio chip. The various audio streams are exportable to WAV format.

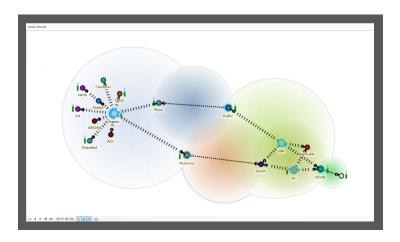
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### **HCI Analysis**

Wireless traffic is the primary element of debug information for Bluetooth engineers, but Host Controller Interface (HCI) traffic can be an equally important complement of information for getting a clear and complete picture of a given situation. Bluetooth Vanguard supports capture of HCI transports over USB, UART, and SPI.

HCI traffic is captured concurrently with the wireless traffic and other wired streams using the same precision clock for perfect synchronization and timing analysis and is decoded and displayed in various formats. Conveniently, the Ellisys software **automatically extracts any Link Key exchanged over HCI** and uses it to decrypt the wireless traffic, all without any user interaction.





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37,840 685 000 R 📩 L2C8P Canfoure (1)(1-0x0044 + (1)(1-0x0048)	ox	Hester: Lentes <>> Sk	17.458	634.820		DP Service Search Attribute Transaction (L2CAP) Audio Sink L2CAP AVOTP V1.	509	CK.	28 bytes
27.851 936 250 R 44 L3CAP Connection (Tro-0x0044, PSH-AVCTP + Dxt-0x0045)	OK .	Hester: Laptao <-> Si				ZP Service Search Attribute Transaction (PhP Information: PhP Information V.		OK .	28 bytes
37,882 562 250 W 4 L3CAP Configure Chill-0x0044, http://2017 + Src-0x0045)	ox	Master: Lapteo <-> Si	37.572	447 400	-	2CAP Connection (Inc -0x0041, PDH-HED Control + DH-0x0042)	LICAP	OK	16 bytes
37.863 186 375 🛞 🧙 L2CAP Configure (Dist-0x0045 + Src=0x0044)	OK.	Haster: Laptop <-> Sk	37.574	170 410	8 🔹 L	2CAP Configure (Dist-Du0041, HTU+1017 + Sec-Du0042, HTU-672)	LICAP	OK	20 bytes
37,964 436 000 (# 1/# UNP Unanff (Accepted)	OK	Mester: Lapton <-> Sk	37.574	800 620	a 🗟 t	CI White Link Supervision Timeout (Connection - 0x0049, Timeout - 10 s) + Co.	. HCI	OK .	7 bytes
37.983 \$86 875 . AUOTP Discover Command + Used-Ne, ACP-1	OK	Master: Laptao <-> Sk	37.580	015 035	8 🚓 L	2CAP Configure (Dst-0x0042, HTU-672 + Sto-0x0041, HTU-672)	LICAP	OK	20 bytes
38.033 686 625 · AUOTP Get Capabilities (I/CP-1) + Media Transport   Audio   SBC: 4864z	OK.	Haster: Laptop <-> Si	37.500	698 750	8 <b>4</b> L	2CAP Connection (Frc -0x0042, PSH -HED Interrupt + Dol -0x0040)	LICAP	OK .	35 bytes
38.040 687 250 🔹 🖧 AVOTP Set Configuration (ACP-1, TVE-52, Media Transport   Audio   SBC: Joint	OK	Master: Laptop <> Sk	37.590	143 295	8+4 H	CI Link Supervision Timeout Changed (Connection - \$x0049), Timeout -2 s)	HCL	OK .	6 bytes
38.070 688 000 🔹 🦓 AUOTP Open (UCP - 1) + Accept	OK.	Master: Laptap <-> Sk	37.990	530 920	8 🥠 L	2CAP Configure (Dot-Ox0042, MTU + Y017, Ox5-Best Effort + Soc-Ox0043, M	LICAP	OK	44 byte
38.100 687 750 (# 🎪 L2CAP Connection (Scorebx0045, PDH - AV07P + Dot - 0x0046)	OK	Master: Laptop <-> Sk	37.596	266 385	a 🛖 L	2CAP Configure (Dist=0x0043, HTU+672 + Src=0x0042, HTU+672)	LICAP	OK	20 byte
38.130 065 000 🗉 🛶 L2CAP Configure (1st-0x0045, https://000 + fre-0x0046)	OK.	Mester: Leptop <-> Sk	37.599	302 585	8.4 1	CI Shiff Mode (Connection-Ox0049, Non-7.5 ms, Non-5 ms, Attempt - 3.75 .	- HCI	OK	13 byte
38.131 938 250 (# 🎪 L3CAP Configure (Dist-Ox0046 + Src-Ox0045)	ox	Haster: Laptop <-> Sk	37.601	055 580	8.41	CI Read Scan Enable + Both	HCI	OK	3 bytes
38.517 567 750 R Pg UMP Preferred Rate (FEC, 171 - No preference, 1022 - Use 3 Mbps packets, Pref - N		Master: Laptop <>> Sk	37.603	468 6 20	8.¢H	CI Write Scan Enable (Initial-Page)	HCL	OK	4bytes
40.003 197 625 · O Inquiry (no responders, 20 s)	OK	Master: Inquirer <-> 5	37.604	066 975	B. 2 H	KI Read Class of Device + Headset	HCI	OK	3 bytes
40.099 446 250 (# 19 Dreferred Rate (IR -No preference, ICR -Use 3 Mbps packets, Prof-Use 5		Master: Laptop <-> Sk	37.605	495 900	a 🍂 H	KI Write Class of Device (Headset)	HCI	OK .	6 bytes
44.204 464 000 R R LMP Name Transaction ("Nox Gamepad Controller 281878FA51D9")	OK.	Masteri Laptap <-> Si	37.606	204 900	a 🗄 H	00 Set Idle (Cate-Infinite)	HID	OK .	20 byte
55.142 012 625 🔹 🚖 L2CAP Signaling Reserved (0x00) (15 bytes (EC 86 F0 D8 24/E3 40 5E 0F 22 98 D	Warning	Master: Laptop <-> Si	37.794	949 380	8421	2CAP Disconnection (Src=0x0040, Cst=0x0041)	LOCAP	OK.	35 byte
56.521 396 000 🛞 📲 UMP Preferred Rate (III -No preference, IDR -Use 2 Mbps packets, Pref-No pre		Haster: Laptop <> Sk	37,825	949 210	8 🐽 L	2CAP Connection (Inc - 0x0043, PDH - AV07P + Dxt - 0x0044)	LICAP	OK	15 byte
60.003 284 125 · O Inquiry (2 responders, 20 s)	OK	Master: Inquirer <-> 5	37.933	338 255	8 🤹 L	2CAP Configure (1st -0x0043, MILL-1017 + Src-0x0044)	L2CAP	OK .	20 byte
64.531 432 875 · · · · · · · · · · · · · · · · · · ·		Master: Laptop <-> Sk	37.041	211 920	a 🍁 L	2CAP Configure (Ditt-Dir0044 + Src=0x0043)	LICAP	OK	35 byte
78-296 146 125 (ii) Paging (Urknown BD_ADDR > coc/FE/CB/CE, no response, 20.6 s)	ox	Master: Unknown 80	37.853	450 130	8441	2CAP Connection (Inc - 0x0044, PSH - AVCTP + Dxt - 0x0045)	L2CAP	OK.	15 byte
80.003 373 125 (a) OD Inquiry (2 responders, 19.3 s)	OK .	Meeter: Inquirer <-> S	37.854		n 🍂 L	2CAP Configure (100-0x0044, 1011-1017 + 00-0x0045)	LICAP	OK .	20 byte
55.477 449 500 (a > Paging (Unknown BD_ADDR > coorFE:CB:CE, no response, 3.44 s)	ox	Master: Unknown 80 /	37,863	712 835	8 🍁 L	2CAP Configure (Det=0x0045 + Sec=0x0044)	LICAP	ox	35 byte
105.818 488 000 🛞 🦓 AUDTP Start (+01+1) > Accept	OK	Hester: Laptop <-> Sk	37.983	630 080	82.4	HOTP Decever Command + Used-No, ACP+1	A/V	OK.	20 byte
185.847 241 500 🐨 🖧 AVDTP Hedia Stream (Color-SBC: Joint Stereo, 44, Skitz, Loudness, 8 Subbands, 1	OK	Master: Laptop <-> Sk	38.011	138 015	a 4 A	UDTP Get Capabilities (407-1) • Media Transport   Audio   SBC: 48kHz	A/V	OK	11 byte
196.828 494 500 🛞 🖧 AUOTP Media Stream (Union-SBC: Joint Stereo, 44.5Hz, Loudness, 8 Subbands, 1	OK	Mester: Laptap <> Sk	38.043	114 770	8.0.4	UDTP Set Configuration (HCP+1, INT+52, Media Transport   Audio   SBC: Jol.	AN	OK	22 byte
107.717 247 625 🔹 🦓 AUDTP Hedia Stream (Coder - SBC: Joint Stereo, 44. Lists, Loudness, 8 Subbands, 1	OK .	Master: Laptop <-> Si	38.071	140 500	3 A A	UDTP Open (ACP = 1) + Accept	A/V	OK .	11 byte
108, 229 740 250 🔹 🐴 AVOTP Hedia Stream (Codec - 58C: Joint Stereo, 44, SHz, Loudness, 8 Subbands, 1		Master: Laptop <> Sk				2CAP Connection (Inc-0x0045, PSH-AV079 + Dat-0x0046)	L2CAP	OK .	15 byte
199, 209 753 250 🛞 🐴 AVOTP Hedia Stream (Under-SBC: Joint Stereo, 44, SHiz, Loudness, 8 Subbands, 1	OK	Haster: Laptop <-> Sk	38.103	961 200	8 🏟 L	2CAP Configure (011-0x0045, HTU+2000 + (rc=0x0046)	LOCAP	OK	20 byte
110.215 508 000 🛞 🐴 AVOTP Media Stream (Codec-SBC: Joint Stareo, 44. Siriz, Loudness, 8 Subbands, 1		Master: Laptop <-> Sk				2CAP Configure (Dist-Ox0046 + Src=Ox0045)	LOCAP	OK	35 byte
111.238 514 500 🛞 🖧 AxOTP Hedia Stream (Color-SBC: Joint Stereo, 44.3Hz, Loudress, 8 Subbands, 1	OK	Mesteri Laptop <-> Sk	38.163	299 065	8+4 H	CI Number Of Completed Packets (Connection -0x0049, Packets - 1)	HCI	OK	7 bytes
112.243 519 375 🛞 🐴 AxOTP Media Stream (Codec-SBC: Joint Stareo, 44.5Hz, Loudness, 8 Subbands, 1	OK	Master: Laptop <-> Sk	\$3.253	297 510	30	JART Sleep Hessage	Uart	OK .	
113.258 521 125 🔹 🐴 AxOTP Media Stream (Codec-58C: Joint Stereo, 44.5Hz, Loudness, 8 Subbands, 1		Master: Laptop <> Sk		5-089		JART Wakeup Message	Uet	OK	
114.382 276 125 🛞 🐴 AVOTP Media Stream (Contro-SBC: Joint Stereo, 44.18Hz, Loudness, 8 Subbands, 1	ox	Master: Laptop <-> Sk		9 368		JART Makeup Message	Uat	OK	
115 089 780 750 a PL AUTO Horis Group (Contra SNC) Sort Street, 44 Set, Loudons, 8 Subbards, 1	OK .	Mester: Lavine <-> 50 V	105.61	4 140	4.0	ULT Unlern Minstone	1947	CK .	
¢ dr		)	<						0.6710.36763

### **Instant Channels**

The Instant Channels feature provides **easy-to-understand visual and statistical analyses on various per-channel transmission characteristics,** including packet retransmissions, header errors, and payload errors. This information can be useful in understanding where in the Bluetooth spectrum all devices, or specific devices, are communicating and the spectral areas (channels) they are avoiding, generally due to external interferences.

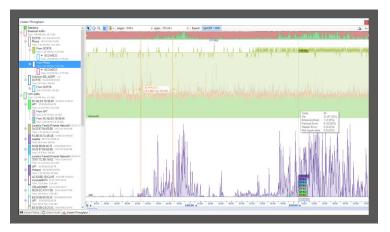
Visual cues are provided to give the user an understanding of the propensity of a given device, or aggregate devices, to avoid particular channels. This information is provided for the duration of an entire capture and can be configured to characterize all devices in the vicinity or specific devices.



### **Instant Throughput**

Understanding device data throughout performance is a common task for wireless engineers. These metrics are the domain of the Instant Throughput view, which **provides throughput by device and by L2CAP or SCO/eSCO channel and Wi-Fi communications.** A convenient statistical overlay provides information on how various transmission inefficiencies may be affecting throughput, such as packet retransmissions.

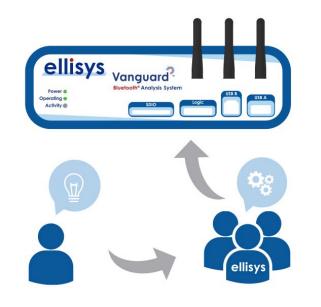
Each device and channel is color-coded and can be shown or not shown as the user may prefer. A navigation bar is provided to allow the user to select a time range to pan through the entire capture to see trends, as well as high and low peaks on data throughput.



### **Emerging Features Support**

All Ellisys Bluetooth analyzer systems are reconfigurable with software updates – another Ellisys innovation. Ellisys maintains close relationships with radio developers worldwide and with various technical groups involved in outlining new Bluetooth specifications.

This approach allows new features to be added even in the conceptual stages, long before they become standardized in a public release of the Bluetooth specification. This is a huge advantage to Bluetooth radio developers, and to the Bluetooth developer ecosystem in general, as radio developers can test new features well before they are committed to silicon, greatly reducing chances of re-spins or discoveries of issues in the marketplace, post-spin.





**Ellisys Bluetooth Vanguard**<sup>™</sup> Advanced Wireless Protocol Analysis System

### **Configurations and Purchase Information**

Radio Configuration	
BR/EDR Capture	
Low Energy Capture	
Editions	
Wideband Bluetooth Capture	
HCI Capture	
Logic Capture	
I2C, UART, SPI, SWD Capture	
Spectrum Capture	
Audio I2S Capture	
WCI-2 Capture	
Wi-Fi 802.11 a/b/g/n/ac/ax/6e Capture	
WPAN 15.4 Capture	
Warranty	

### Description

Ellisys Bluetooth Vanguard Standard BR/EDR Ellisys Bluetooth Vanguard Standard Low Energy Ellisys Bluetooth Vanguard Standard Dual Mode Ellisys Bluetooth Vanguard Pro BR/EDR Ellisys Bluetooth Vanguard Pro Low Energy Ellisys Bluetooth Vanguard Pro Dual Mode Ellisys Bluetooth Vanguard Enterprise BR/EDR Ellisys Bluetooth Vanguard Enterprise Low Energy Ellisys Bluetooth Vanguard Pro Upgrade Ellisys Bluetooth Vanguard Pro Upgrade Ellisys Bluetooth Vanguard Enterprise Upgrade Ellisys Bluetooth Vanguard Dual Mode Upgrade Ellisys Bluetooth Vanguard WiFi 6E Option



EDR	LE	DUAL
x		x
	x	x

Standard	Pro	Enterprise
x	x	x
	x	x
	x	x
	x	x
	x	x
	x	x
	x	x
		x
		x
2 years	2 years	3 years

Code
BV1-STD-EDR
BV1-STD-LE
BV1-STD-DUAL
BV1-PRO-EDR
BV1-PRO-LE
BV1-PRO-DUAL
BV1-ENT-EDR
BV1-ENT-LE
<b>BV1-ENT-DUAL</b>
BV1-PRO/UPG
BV1-ENT/UPG
BV1-DUAL/UPG
BV1-ENT/OPT-W

### **Ellisys Bluetooth Vanguard**<sup>™</sup>

**Advanced Wireless Protocol Analysis System** 

### ellisys Better Anglysis

### **Technical Specifications**

#### **Bluetooth Capture Characteristics**

- Ellisys Rainbow<sup>™</sup>: Industry's first wideband concurrent capture of all Bluetooth channels.
- Frequency band: 2.402-2.480 GHz
- Sensitivity range: From -90 to +15 dBm
- Gain: Programmable from -30 to +30 dB
- Modulations: All BR/EDR/LE modulations (GFSK 1/2Mbps, p/4-DQPSK, 8-DPSK)
- Baseband: Support of Bluetooth 5.x, upgradeable by software. Preliminary support of non-released specifications available.

### **Wi-Fi Capture Characteristics**

- IEEE 802.11 a/b/g/n/ac/ax/6e
- Channel width 2.4GHz: 20MHz, 40MHz
- Channel width 5GHz: 20MHz, 40MHz, 80MHz
- 11n MCS: 0 to 23 (up to 3 streams)
- 11ac MCS: 0 to 9 (up to 3 streams)
- Guard Interval: 800ns (long) and 400ns (short) GI
- Frame encoding: BCC, LDPC, STBC, Greenfield
- Max AMPDU size: 65,535 bytes
- Timing accuracy: 125 ns

#### WPAN Capture Characteristics

- IEEE 802.15.4-2011
- Channels: All 16 2.4 GHz channels (11 to 26)
- Data rate: 250 Kbps
- Modulation: O-QPSK
- Timing accuracy: 125 ns

### **Logic Capture Characteristics**

- Maximum bandwidth: 20 MHz
- Sampling precision: 5 ns
- Supported input voltage: 1.8 to 3.3V

#### **HCI Capture Characteristics**

- USB transport: Low, Full, and High Speed, with automatic detection
- UART transport: Up to 8 Mbit/s, automatic detection of all parameters
- SPI transport: Up to 8 Mbit/s, automatic detection of all parameters

### **Embedded Memory**

- 512 MB of FIFO memory
- Data is stored in highly optimized format
- Analyzed data is uploaded in real time

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#### Low-speed Serial Capture Characteristics

- UART: Up to 8 Mbit/s automatic detection of all parameters
- SPI: Up to 8 Mbit/s, automatic detection of all parameters
- I2C: Up to 1 Mb/s
- SWD: Up to 8 Mb/s

#### Timing

- Clock: ±10ppm frequency accuracy over -10 to +60 degrees Celsius range
- BR/EDR/LE timestamp accuracy: ±125ns
- Wi-Fi timestamp accuracy: ±125ns
- WPAN timestamp accuracy: ±125ns
- USB HCI timestamp accuracy: ±16.7ns
- Logic timestamp accuracy: ±5ns

#### **Power Adapter**

- Input: 100-240 VAC
- Output: 24 VDC
- Power: 40 W
- Plug: 5.5 x 2.1 x 12 mm barrel straight
- Safety: CB, TUV, UL, CCC, PSE
- EMI: CE, FCC, VCCI, RCM

#### **Front-Panel Indicators**

- Power: unit powered on
- Operating: unit performing requested task
- Activity: blinks when wireless or wired activity detected

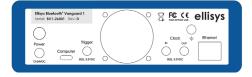
#### **Front-Panel Connectors**

- RF (x3): Shared between Bluetooth, Wi-Fi and WPAN
- USB HCI: USB 2.0 Standard-A and Standard-B
- Logic: Supports UART/SPI HCI, WCI-2, generic I2C/UART/SPI/SWD and logic analysis
- SDIO: Optional, for external trace storage and unit recovery



### **Rear-Panel Connectors**

- Computer: USB 3.1 Gen 1 Type-C
- Ethernet: 1GbE, PoE+
- Power: 12-24 VDC, max 36W
- Trigger: SMA in and out, 50  $\Omega,$  3.3VDC
- Clock IN: SMA, 50 Ω, 3.3VDC, 10MHz
- Clock OUT: SMA, 50 Ω, 3.3VDC, 10MHz
- Earth: Optional, to ground the unit



### **Power Inputs**

- DC input (12-24 V)
- USB Type-C Power Delivery
- Power-over-Ethernet (PoE+)
- Backup Battery (22 Wh)

#### Enclosure

- 180 x 170 x 58 mm (7.1 x 6.7 x 2.3")
- 1.5 kg (3.3 lbs)

### **Hardware Upgrade**

 The Ellisys Rainbow<sup>™</sup> engine is automatically updated with each software release (no user intervention required)

#### **Maintenance and Licensing**

- Free lifetime software updates
   no maintenance fees
- Free full-featured viewer software

   easily share annotated traces between computers and colleagues
- Use Ellisys hardware on any computer
   no additional licenses needed

#### Warranty

- Two-year limited warranty [STD and PRO]
- Three-year limited warranty [ENT]

### **Minimum Requirements**

- Intel Core, 2 GHz or compatible processor
- 4 GBytes of RAM

Email:

Phone:

 1280 x 1024 display resolution with at least 65,536 colors

Abe Technologies Shanghai ltd.

Website: www.abe-tech.com

abe@abe-tech.com

+86 21 3122 5020

- USB 2.0 EHCI host controller
- Windows® 7 or higher