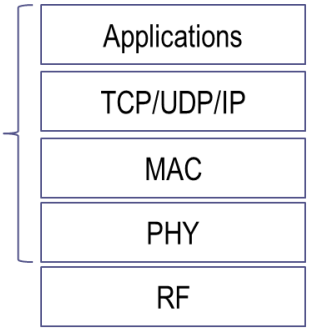
octoBox
Wireless personal testbeds

Triathlon RF/MAC/PHY Analyzer

Triathlon™ integrates the LitePoint® IQxel-MW™ into the octoBox® wireless personal testbed, adding the RF layer analysis.



Triathlon is a critically important tool for the development of the new Wi-Fi 6 (11ax) equipment, enabling engineers to observe hard-to-capture issues on the RF layer. Often performance issues are easily seen at the MAC or TCP/UDP/IP layers by common sniffers, such as Wireshark, but when the root cause of these issues is at the RF layer, engineers have trouble capturing it. Triathlon enables captures at the RF layer using event-based triggering performed by octoScope's Pal-6 at the MAC or IP layers in real-time.

FEATURES

- Programmable event-based triggering of the LitePoint IQxel-MW by the Pal
- Synchronization of PCAP captures by the Pal with packets captured by the LitePoint
- Trigger logic easily implementable by engineers using standard scripting, JavaScript
- Filtering of desired traffic implemented in the 802.11ax chipset driver for line-rate real-time processing

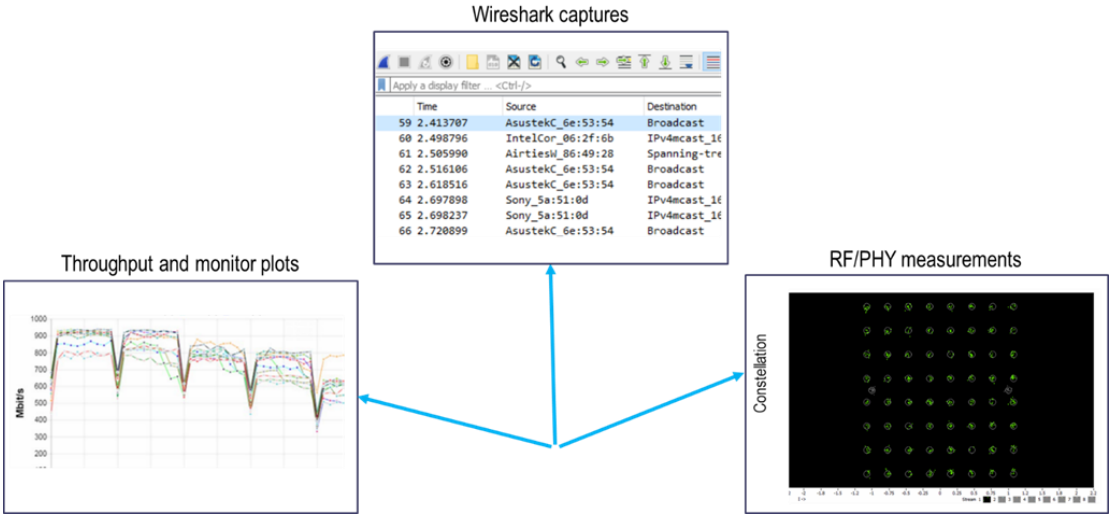
BENEFITS

- Easily capture the events of interest at the RF layer based on issues seen at the higher layers
- Minimize packet loss via fast filtering of the desired traffic in the chipset driver
- Perform root cause analysis of issues using familiar PCAP format
- Speed up development work in the completely isolated over the air (OTA) test environment of the octoBox personal testbed

Data is visualized at multiple layers synchronously. Clicking on the data from one layer (for example, the PCAP file) opens the associated data from the other layers (for example, the associated RF packets.)

Triathlon enables engineers to trigger the LitePoint IQxel-MW in real-time, synchronize the Wireshark captures with the RF measurements performed by the LitePoint PHY layer traffic analysis software and then click on problematic packets in the Wireshark captures to view the underlying RF measurements.

This new capability saves months of development and helps engineers optimize the performance of the challenging new Wi-Fi 6 OFDMA technology.



The Pal, based on an embedded Linux system and the Qualcomm 802.11 chipset, can operate in signaling mode, interacting with the DUT either as a reference AP or STA. While being precisely controllable at the driver and firmware layers (e.g. set MCS, # streams, etc.), the Pal is a real Wi-Fi device that can be a reference partner for testing at Layer 2 and above.

REAL-TIME TRIGGERING

The RF instrument captures the DUT transmissions in the form of IQ samples and cannot perform any real-time processing or triggering on packets since packets are unavailable until the IQ stream is postprocessed. The Pal, on the other hand, can process packets in real-time and perform triggering.

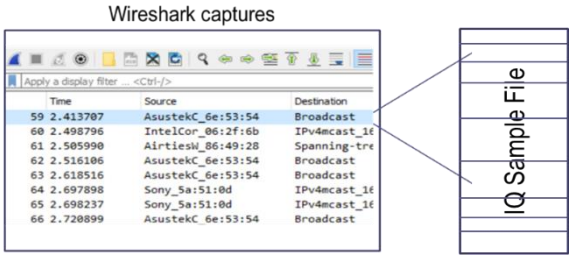
Triggering the captures is implemented in the Pal. The Pal-generated trigger can either stop or start the captures. The trigger conditions include:

- Association, Authentication
- Probe request, Probe response
- Trigger frame
- RTS, CTS
- Beacon

CROSS-PROBING

In order to extract the above measurements per packet, Triathlon software incorporates a customized version of Wireshark that supports clicking on any packet in the captured PCAP file and then locating the clicked packet's corresponding IQ samples in the saved IQ sample file.

A full set of plots for the clicked packet can then be produced.



Synchronized captures on the Pal and RF Tool
Triggering performed in real-time by the Pal

EXAMPLE OCTOBOX TESTBEDS WITH TRIATHLON INTERCONNECTIONS

The Pal-6 enables compact yet powerful octoBox personal testbeds with a range of automated tests.

A block diagram of the simplest octoBox testbed, STACK-MIN, with one smartBox and one regular octoBox is shown in Figure 3. This testbed is capable of the following tests:

- RvR
- RvR with rotation if a turntable is included
- RvRvO or RvOvR if a turntable is included
- Band steering
- Packet capture
- Synchronized captures between Pal-6 and the LitePoint

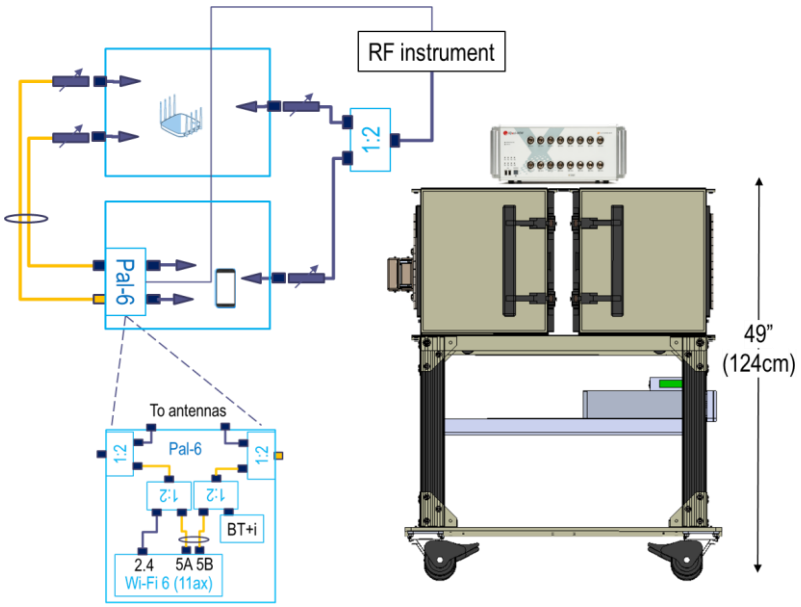


Figure 3: STACK-MIN with embedded Pal-6 and Triathlon connection

DETAILED RF VISIBILITY

With RF instrument integration, Triathlon provides a detailed set of RF measurements, including:

General:		OFDM:	DSSS:
• Spectrum • Spectrum Mask Margins • Power vs. Time • I/Q vs. Time • CCDF **Info:** • # of Streams • MCS • Coding Type • Coding Rate • HE-SIG-B CRC • Data Rate (Mbps) • Modulation Type • PSDU Length (Bytes) • PSDU CRC • Packet Type • Packet Format • Channel BW • # of Space-Time Streams • A-Factor • Guard Interval	**TXQuality:** • Power • Phase Error • Frequency Error • Symbol Clock Error • LO Leakage • Amplitude Imbalance • Phase Imbalance **EVM:** • EVM • EVM (%) • EVM Data • EVM Pilot • Constellation	**Info** • # of Users • # of Symbols • # of Tones • HE-SIG CRC • L-SIG Parity • L STF Periods • HE LTF Size • RU Index • RU Size **TXQuality:** • Channel Phase vs. subcarrier • Channel Relative Magnitude vs. Subcarrier • Phase Error vs. Symbol • Amplitude vs. Symbol • Spectral Flatness • Preamble frequency error vs. Time • PSD of Phase Error vs. Symbol **EVM:** • EVM vs. Subcarrier • EVM vs. Symbol • EVM vs. User	• EVM vs. Time DSSS • Frequency Error vs. Time DSSS • Eye Diagram DSSS • Ramp Off Power DSSS • Ramp On Power DSSS

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