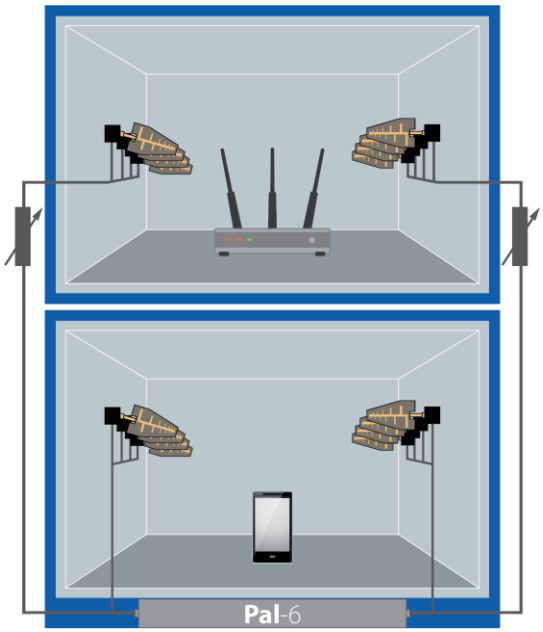
The Pal-6 Wi-Fi 6 (11ax) smartBox subsystem



octoScope's Pal-6 is a Wi-Fi 6 (IEEE 802.11ax) test instrument built into an octoBox® chamber, making that chamber a smartBox™. The Pal-6 functions as a traffic partner, an expert analyzer, virtual station emulator and a load generator for testing throughput, capacity, roaming, band steering and more.

The Pal-6 can be extended with a Bluetooth (BT) plug-in module to integrate BT test capabilities.

The smartBox's integrated dual-band Pal-6 instrument is based on one of the most advanced Wi-Fi 6 chipsets on the market supporting all the Wi-Fi protocols, IEEE 802.11a/b/g/n/ac/ax. With access to the chipset's driver and firmware via the octoScope API, you can configure the smartBox's built-in Pal-6 as a real device or as a test instrument. As a real device, the Pal-6 acts as a traffic partner running the standard station and AP (access point) drivers. As an instrument, it can emulate virtual stations for testing APs under heavy traffic load from multiple stations, act as multiple APs to a station under test, perform expert monitoring and analysis, replay captured traffic or operate as a sniffer.

FEATURES

- 802.11ax up to 8x8 MIMO-OTA transmission
- 2.4 and 5 GHz 802.11a/b/g/n/ac/ax radios and two BT5/BLE/BLE 2 GHz EDR radios
- BT profiles: A2DP, OPP, HFP, HID, BLE HID
- Wireshark synchroSniffer™ with a sniffer probe on each of the 4 radios for simultaneous Wi-Fi and Bluetooth sniffing
- Up to 64 virtual Wi-Fi stations, vSTAs
- Expert analysis of PCAP captures
- Interference generation
- Complete isolation from outside interference
- Powerful test automation API
- Seamless integration with the octoBox personal testbed; field upgradeable into any octoBox model chamber

BENEFITS

- Quickly and easily verify emerging 802.11ax and legacy Wi-Fi devices in the ideal 8x8 MIMO-OTA environment
- Using the octoBox personal testbed, perform key tests including throughput vs. range vs. orientation, roaming, band steering, coexistence, WFA certification and more
- Test BT/Wi-Fi coexistence
- Test BT pairing with BT 5, BLE, EDR and legacy devices
- Perform root cause analysis of poor performance or protocol issues using built-in multi-probe multi-channel expert analysis
- Test capacity of APs with up to 128 concurrent virtual stations; application layer traffic

www.octoscope.com
+1.978.222.3114

PAL-6 ARCHITECTURE

Based on the latest 802.11ax chipset and with fine controls at the firmware and driver level, the Pal-6 can function as a real device or as a precision test instrument. For example, to test band steering, the Pal-6 can function at a set data rate, bandwidth and number of streams. To test receiver sensitivity, the Pal-6 can operate at a fixed modulation coding scheme (MCS).

The Pal-6 features two 802.11ax radios. The 5 GHz radios support up to 8x8 MIMO in channels of up to 80 MHz, or 4x4 MIMO in 80+80 or 160 MHz channels.

The Pal-6 has has an option for two BT5, BLE, EDR radios to test Bluetooth and to capture sniffer traces.

To address the high bandwidth requirements of 802.11ax, the Pal-6 features two 10 GbE ports.

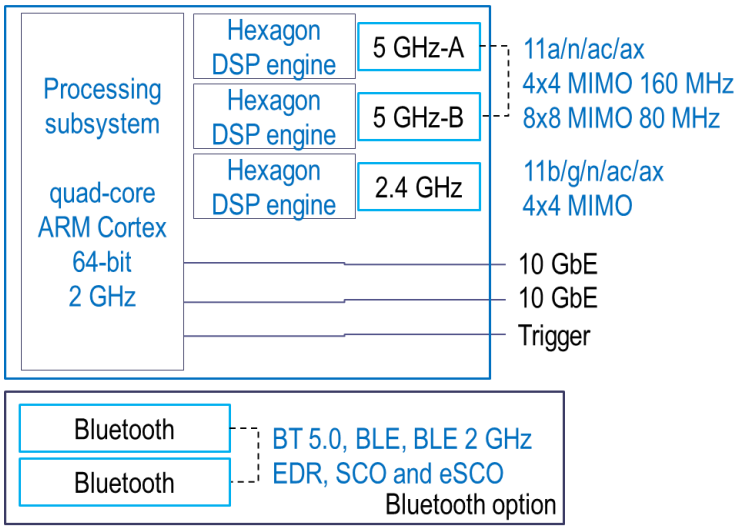
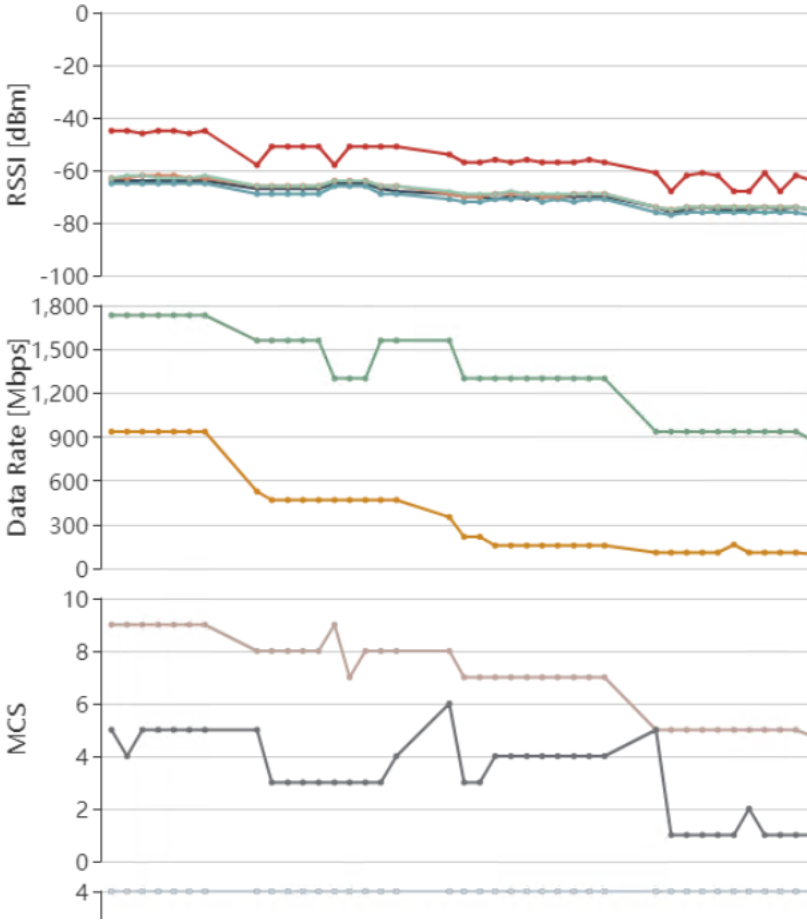


Figure 1: Pal-6 block diagram; chipsets used are Qualcomm Hawkeye QCN5054/QCN5024 and Cypress CYW20719

www.octoscope.com
+1.978.222.3114

EXPERT ANALYSIS

The Pal-6 can function as a real-time analyzer to show adaptation behavior of modern Wi-Fi systems. It can monitor and plot RSSI, data rate, number of spatial streams, channel width and other physical layer information.



AP TESTING

To test access point (AP) performance or to emulate a realistic network with multi-station traffic, the Pal-6 can emulate up to 64 vSTAs (virtual stations) per-radio, up to 128 virtual stations per Pal-6.

Real-life traffic can be bridged from the Ethernet interface via each vSTA to test video, voice and data performance with different priority and security settings.

STATION TESTING

To test a station device, configure the Pal-6 radios as APs so they can be traffic partners to the station under test. The radios can also be sniffers or expert analyzers. Station tests include throught vs. range vs. orientation, RX sensitivity, data rate adaptaiton performance, roaming, band steering, and more.

SYNCHROSNIFFER™

Pal-6 can capture and stream packets in the PCAP format to the Wireshark in real-time. Each radio on the Pal-6 can be synchronized with the radios on the same or other Pals via the Precision Time Protocol (PTP). The captures from each radio in the octoBox testbed are combined in a common PCAP file viewable in the octoScope-customized Wireshark for easy analysis. In this custom Wireshark application, you can identify captures by probe (i.e. Pal radio). Such a common view of the different points in the testbed helps analyze complex band steering, roaming and mesh behavior in the presence of motion, interference, path loss, multipath and variable orientaiton of the DUT.

synchroSniffer capability is particularly helpful when testing OFDMA links with multiple stations operating on different resource units (RUs) because a single sniffer can only monitor a single RU. For an OFDMA link with 4 stations, you would need 4 sniffer probes, one on each station. When placed inside a smartBox, each of the OFDMA stations can be monitored by a dedicated built-in Pal-6. The sniffer captures from each smartBox are then aggregated via the synchroSniffer software for powerful analysis of the entire complex OFDMA link.

www.octoscope.com
+1.978.222.3114

BLUETOOTH TESTING

Bluetooth testing includes:

- Pairing test of BT5, BLE, EDR and legacy BT devices
- Master and Slave modes for pairing and traffic testing
- BT sniffer on 2 BT radios simultaneously, synchronized with captures from Bluetooth or Wi-Fi radios on any octoScope Pals
- BT traffic partner to the DUT
- HID latency
- AFH map
- Configurable packet size
- Simultaneous BT and Wi-Fi traffic
- Powerful test automation API

PAL-6 IN AN OCTOBOX PERSONAL TESTBED

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
- Addition of Triathlon™ to sniff down to the RF layer

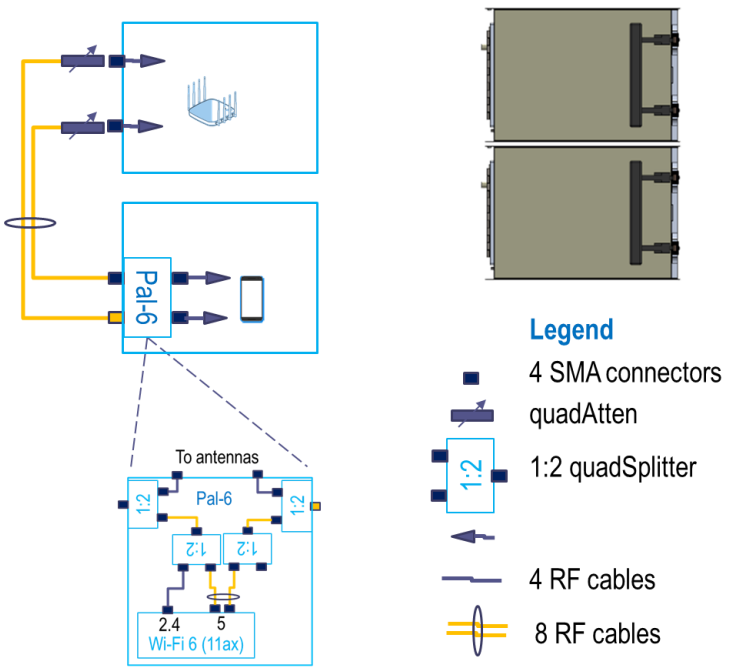


Figure 3: STACK-MIN with embedded Pal-6

www.octoscope.com
+1.978.222.3114

Figure 4 shows octoScope's complete testbed, STACK-MAX, supporting the following tests:

- 4 STA to 1 AP OFDMA throughput (RvR, RvR with rotation, RvRvO, RvOvR)
- 8x8 MIMO with multipath
- OFDMA sniffing with a synchroSniffer probe on each of the STAs and on the AP rendering complete distributed monitoring of an OFDMA link
- 3-node mesh testing (self-forming, self-healing, throughput vs. hops)
- Roaming
- Band steering
- Packet capture
- Addition of Triathlon™ to sniff down to the RF layer

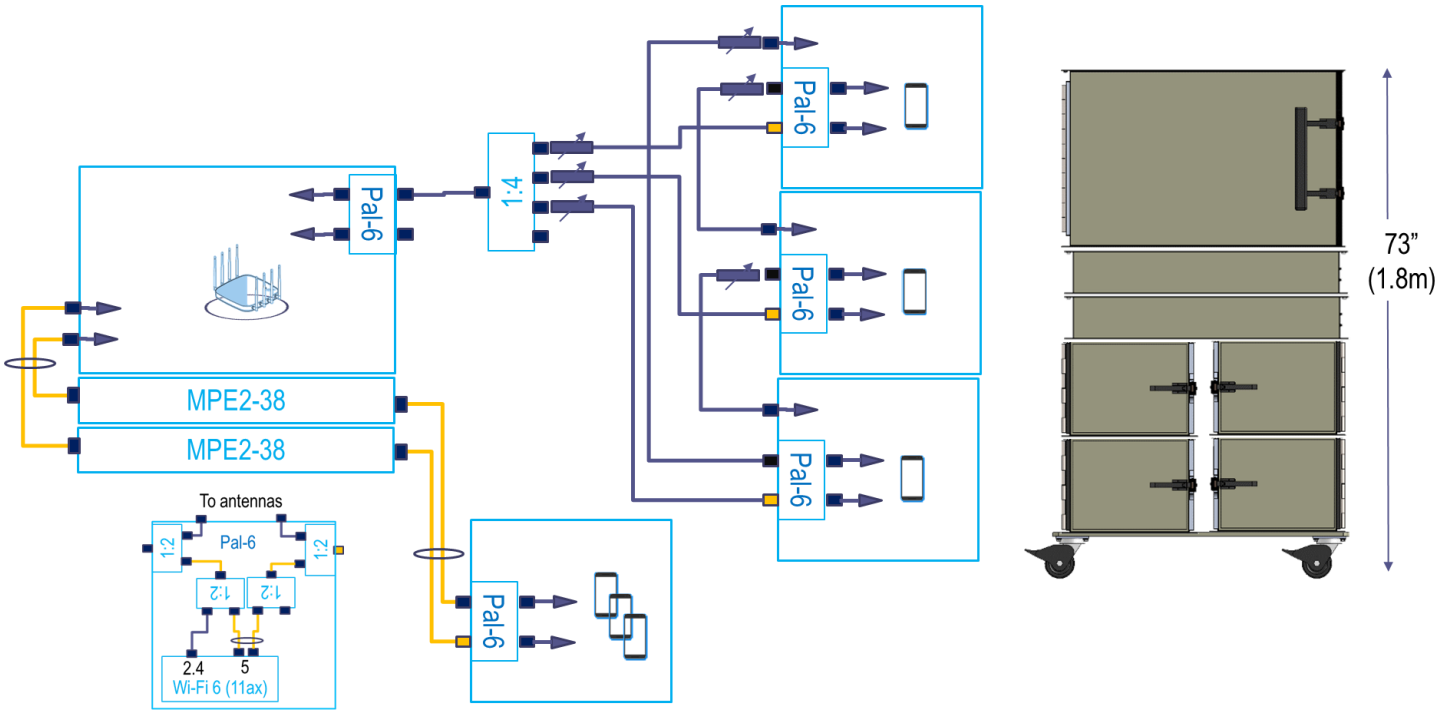


Figure 4: STACK-MAX testbed supporting 8x8 MIMO and OFDMA with packet analysis, mesh, roaming, band steering and BT testing

www.octoscope.com
+1.978.222.3114

PAL-6 SPECIFICATIONS

Wi-Fi	
Channels	2.4 GHz and 5 GHz; tri-band
Bandwidth	20, 40, 80, 80+80, 160 MHz
Standards	801.11a, 802.11b, 802.11g, 802.11n, 802.11ac (wave 2), 802.11ax
Virtual stations	64 per-radio, 64 total
Traffic replay	From PCAP file
Monitor	Detailed statistics from the Wi-Fi chipset
Sniffer	Wireshark captures
802.11ax PHY	Downlink OFDMA Uplink OFDMA Single user MIMO with > 1 spatial stream Downlink multiuser MIMO DL and UL single user transmit beamforming DL OFDMA + transmit beamforming
802.11ax MAC	Trigger frame support Non-trigger based and trigger-based sounding for beamforming Multi-user RTS and CTS Buffer status report UL-OFDMA Random Access Multiple BSSID Bandwidth query report
Bluetooth	
Protocols	Bluetooth 5, BLE, BLE 2 Mbps, EDR, SCO and eSCO
Test features	BT Master and Slave modes for pairing and traffic testing, HID latency, AFH map, configurable packet size, simultaneous BT and Wi-Fi traffic
Sniffer	Wireshark captures via synchroSniffer on the same time base as Wi-Fi radios in the same or disparate Pal-6s or Pals in the testbed; simultaneous capture on both BT radios
Interference	
Channels	2.4 and 5 GHz
Bandwidth	20, 40, 80, 80+80, 160 MHz
	Replay traffic captures (PCAP files) with configurable traffic load and priority
	Programmable MCS (modulation coding scheme), WMM (wireless multi media) priority and other settings

General	
Traffic endpoints	multiPerf®, iperf3
	Trigger out connector for triggering external RF instruments
Control	Ethernet
Power	Power adapter
Dimensions	23” x 10.4” x 1.4” (58 x 26 x 3.5cm)
TX power	MCS, # stream, frequency and channel width dependent
Processor subsystem	quad-core, ARM Cortex 64-bit, 2 GHz

PAL-6 HARDWARE AND SOFTWARE OPTIONS

Option	Description
OBS-50	Pal-6 smartBox subsystem, AP and STA partner
OBS-51	Bluetooth module for the Pal-6 smartBox subsystem; A2DP, OPP, HFP, BLE, HID, AFH
SW-SNIFFER	Streaming sniffer captures
SW-VSTA	64 vSTAs (virtual stations)
SW-BRIDGE	Bridging capability for each of the vSTAs to run application layer traffic
SW-TRIATHLON	Trigger an RF instrument (e.g. LitePoint) to cross-probe plots, PCAP captures and RF measurements
SW-SPIN	Replay as captured

Glossary

BT = Bluetooth
BLE = Bluetooth low energy
A2DP = advanced audio distribution profile
OPP = object push profile
HFP = hands free profile
HID = human interface device profile
AFH = adaptive frequency hopping

CONTACT

octoScope
305 Foster Street
Littleton, MA 01460
Tel: +1.978.222.3114
sales@octoscope.com

octoScope
780 Montague Expressway
Building 1
San Jose, CA
Tel: +1.408.888.0478