Report for: Wifi Capacity Test

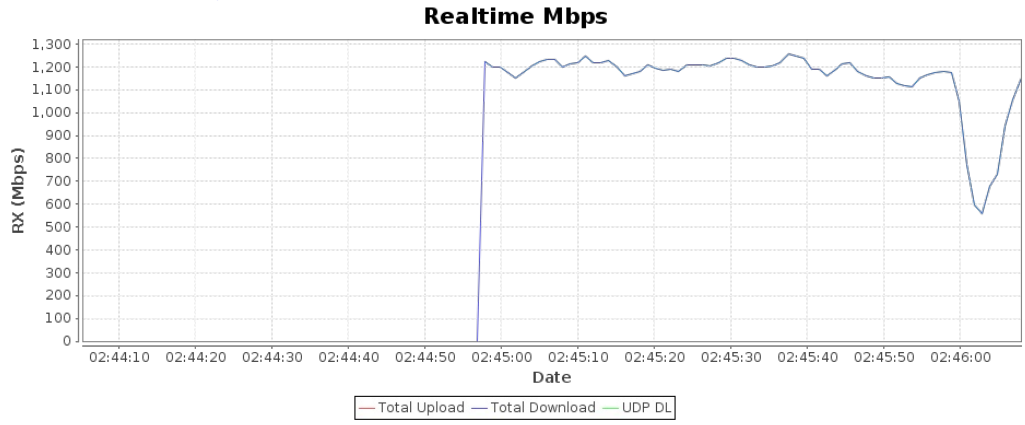
Fri Jul 22 02:47:05 PDT 2022

Objective

The Candela WiFi Capacity test is designed to measure performance of an Access Point when handling different amounts of WiFi Stations. The test allows the user to increase the number of stations in user defined steps for each test iteration and measure the per station and the overall throughput for each trial. Along with throughput other measurements made are client connection times, Fairness, % packet loss, DHCP times and more. The expected behavior is for the AP to be able to handle several stations (within the limitations of the AP specs) and make sure all stations get a fair amount of airtime both in the upstream and downstream. An AP that scales well will not show a significant over-all throughput decrease as more stations are added.

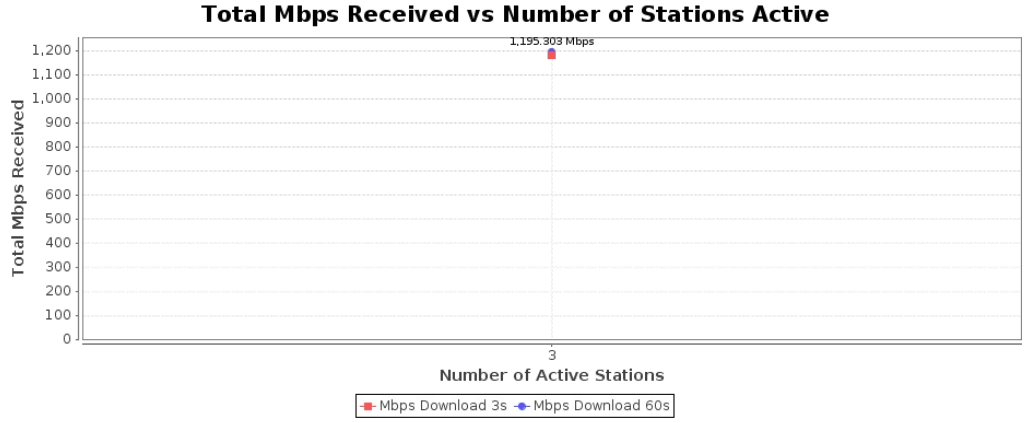
Realtime Graph shows summary download and upload RX bps of connections created by this test.

CSV Data for Realtime Mbps



Total Megabits-per-second transferred. This only counts the protocol payload, so it will not count the Ethernet, IP, UDP, TCP or other header overhead. A well behaving system will show about the same rate as stations increase. If the rate decreases significantly as stations increase, then it is not scaling we

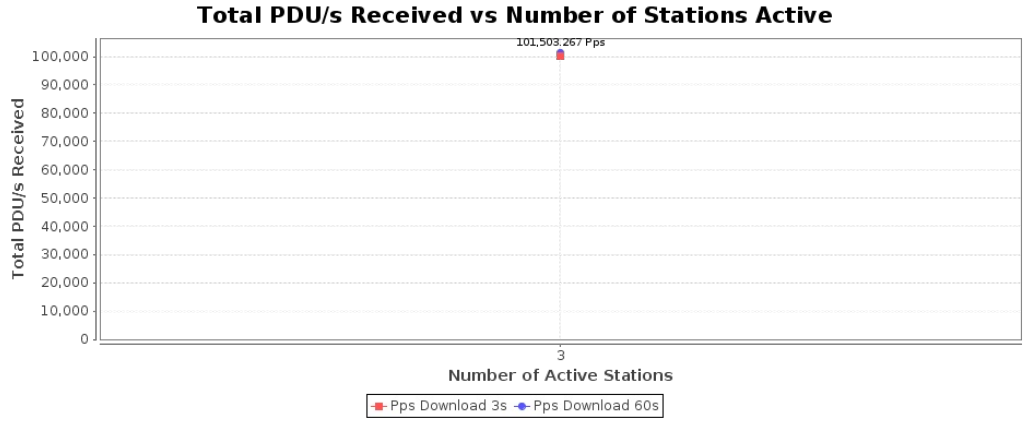
CSV Data for Total Mbps Received vs Number of Stations Active



Protocol-Data-Units received. For TCP, this does not mean much, but for UDP connections, this correlates to packet size. If the PDU size is larger than what fits into a single frame, then the network stack will segment it accordingly. A well behaving system will show about the same rate as stations increase. If the

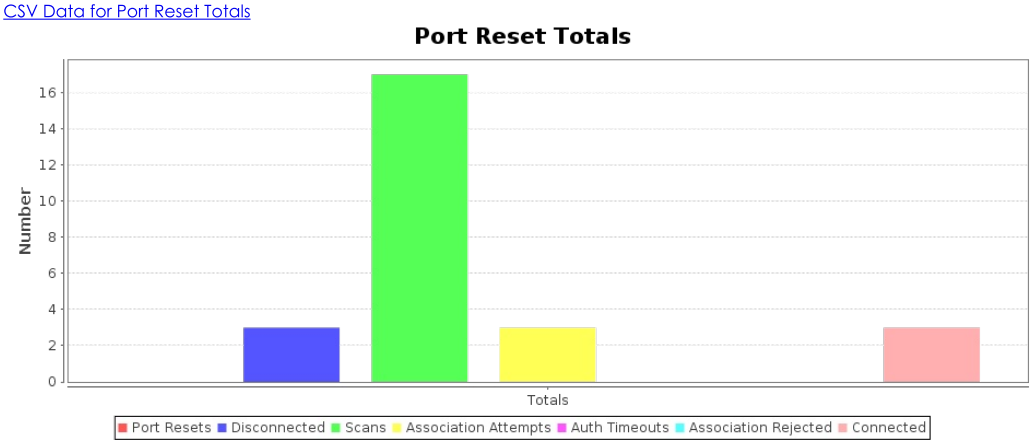
rate decreases significantly as stations increase, then it is not scaling well.

CSV Data for Total PDU/s Received vs Number of Stations Active



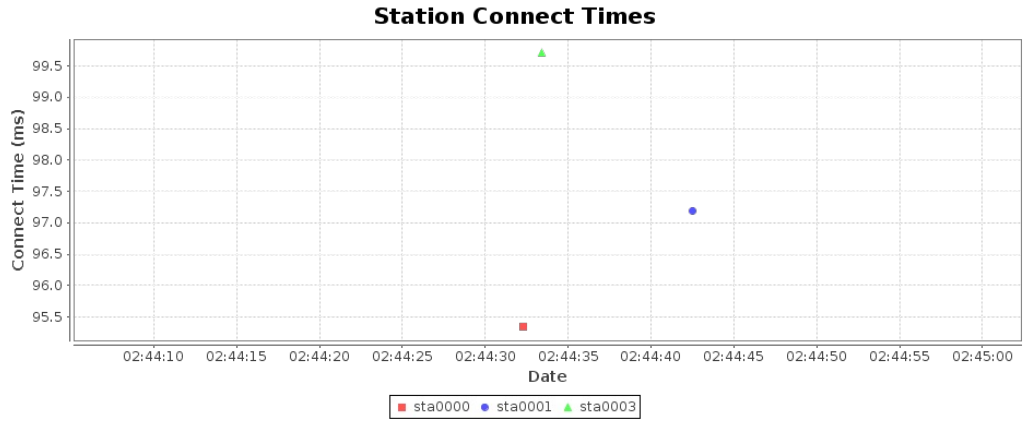
Station disconnect stats. These will be only for the last iteration. If the 'Clear Reset Counters' option is selected, the stats are cleared after the initial association. Any re-connects reported indicate a potential stability issue. Can be used for long-term stability testing in cases where you bring up all stations in one iteration and then run the test for a longer duration.

CSV Data for Port Reset Totals



Station connect time is calculated from the initial Authenticate message through the completion of Open or RSN association/authentication.

CSV Data for Station Connect Times



Wifi-Capacity Test requested values

Station Increment:	3
Loop Iterations:	Single (1)

Duration:	1 min (1 m)
Protocol:	UDP-IPv4
Layer 4-7 Endpoint:	NONE
Payload Size:	AUTO
MSS	AUTO
Total Download Rate:	OC48 (2.488 Gbps)
Total Upload Rate:	Zero (0 bps)
Percentage TCP Rate:	10% (10%)
Set Bursty Minimum Speed:	Burst Mode Disabled (-1)
Randomize Rates	true
Leave Ports Up	false
Socket buffer size:	OS Default
Settle Time:	5 sec (5 s)
Rpt Timer:	fast (1 s)
IP ToS:	Best Effort (0)
Multi-Conn:	AUTO
Show-Per-Iteration-Charts	true
Show-Per-Loop-Totals	true
Hunt-Lower-Rates	false
Show Events	true
Clear Reset Counters	false
CSV Reporting Dir	- not selected -
Build Date	Fri 20 May 2022 09:36:36 PM PDT
Build Version	5.4.5
Git Version	b98d1c2ca17aea46b035480e1fafa9ec0f1fed1d
Ports	1.1.sta0000 1.1.sta0001 1.1.sta0003 1.1.eth3
Firmware	0x80000aef, 1.1876.0
Machines	ct523c-c3d8

Requested Parameters:

Download Rate:	Per station:	829333333 (829.333 Mbps)	All:	2488000000 (2.488 Gbps)
Upload Rate:	Per station:	0 (0 bps)	All:	0 (0 bps)
Total:				2488000000 (2.488 Gbps)

Station count:	3
Connections per station:	1
Payload (PDU) sizes:	AUTO (AUTO)

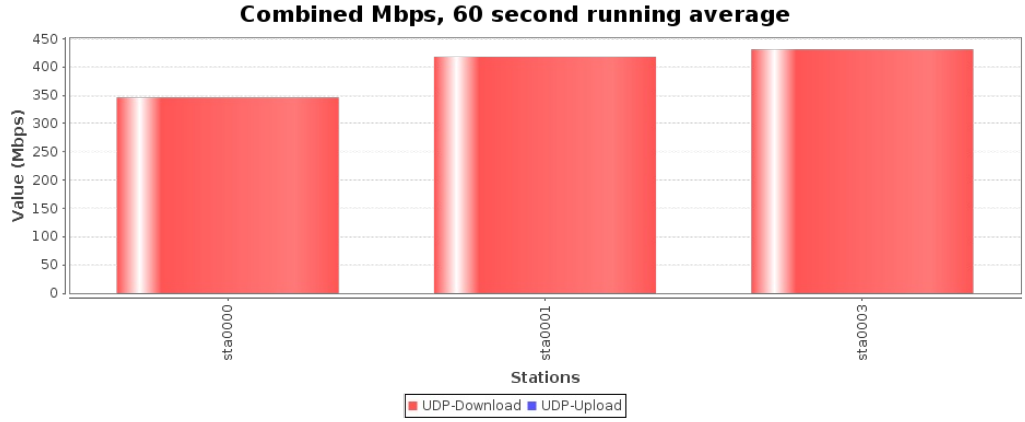
Observed Rate:

Download Rate:	Cx Min:	346.11 Mbps	Cx Ave:	398.434 Mbps	Cx Max:	431.228 Mbps	All Cx:	1.195 Gbps

Upload Rate:	Cx Min:	0 bps	Cx Ave:	0 bps	Cx Max:	0 bps	All Cx:	0 bps
Total:								1.195 Gbps
Aggregated Rate:	Min:	346.11 Mbps	Avg:	398.434 Mbps	Max:	431.228 Mbps		

This graph shows fairness. On a fair system, each station should get about the same throughput. In the download direction, it is mostly the device-under-test that is responsible for this behavior, but in the upload direction, LANforge itself would be the source of most fairness issues unless the device-under-test takes specific actions to ensure fairness.

CSV Data for Combined Mbps, 60 second running average



Requested Parameters:

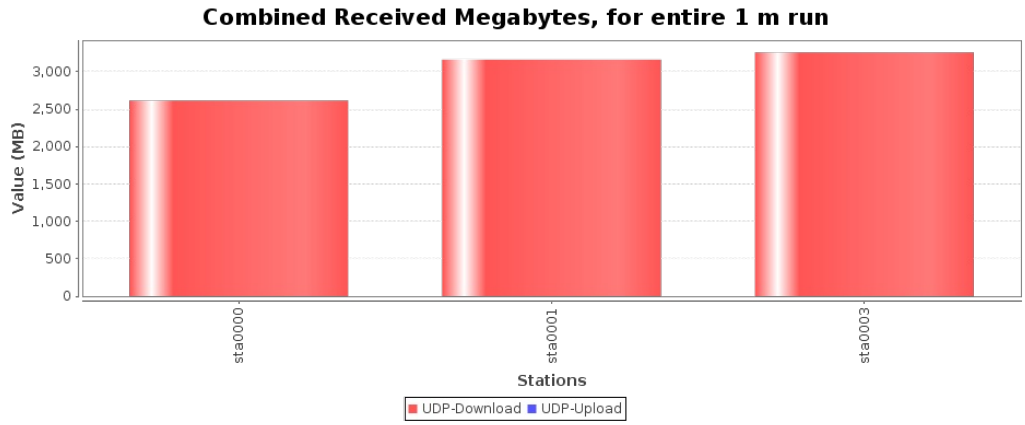
Download Rate:	Per station:	829333333 (829.333 Mbps)	All:	2488000000 (2.488 Gbps)
Upload Rate:	Per station:	0 (0 bps)	All:	0 (0 bps)
Total:				2488000000 (2.488 Gbps)
Station count:				3
Connections per station:				1
Payload (PDU) sizes:				AUTO (AUTO)

Observed Amount:

Download Amount:	Cx Min:	2.437 GB	Cx Ave:	2.807 GB	Cx Max:	3.037 GB	All Cx:	8.42 GB
Upload Amount:	Cx Min:	0 B	Cx Ave:	0 B	Cx Max:	0 B	All Cx:	0 B
Total:								8.42 GB

This graph shows fairness. On a fair system, each station should get about the same throughput. In the download direction, it is mostly the device-under-test that is responsible for this behavior, but in the upload direction, LANforge itself would be the source of most fairness issues unless the device-under-test takes specific actions to ensure fairness.

CSV Data for Combined Received Megabytes, for entire 1 m run

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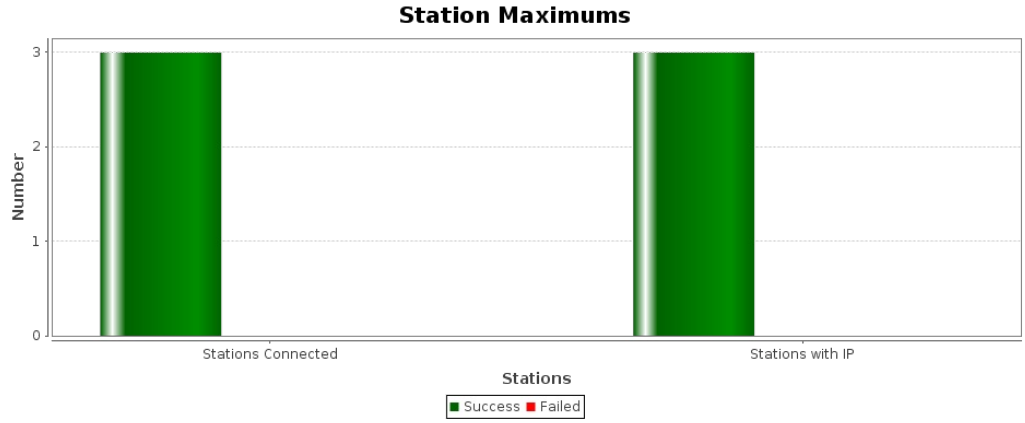
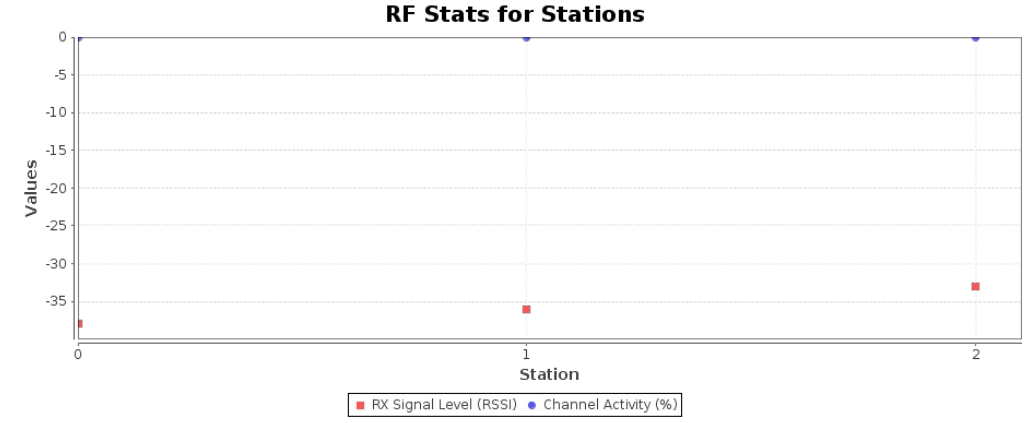
Maximum Stations Connected: 3
Stations NOT connected at this time: 0
Maximum Stations with IP Address: 3
Stations without IP at this time: 0
```

CSV Data for Station Maximums



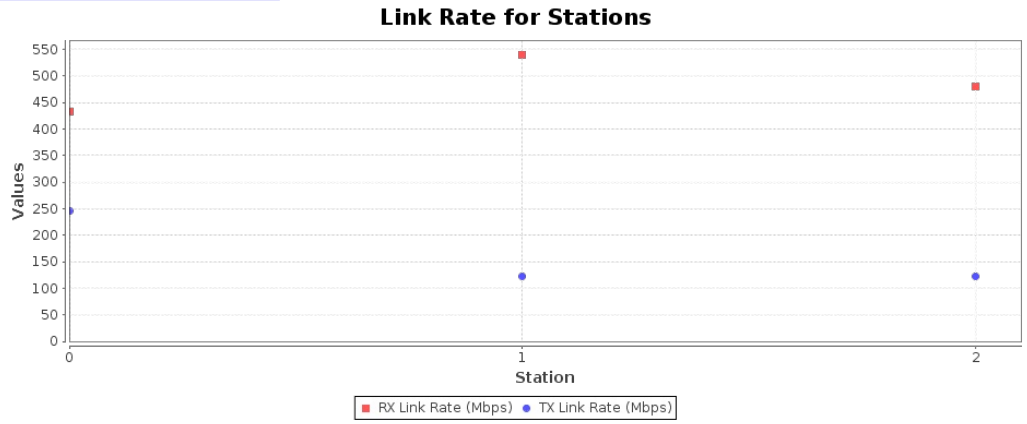
RF stats give an indication of how well how congested is the RF environment. Channel activity is what the wifi radio reports as the busy-time for the RF environment. It is expected that this be near 100% when LANforge is running at max speed, but at lower speeds, this should be a lower percentage unless the RF environment is busy with other systems.

CSV Data for RF Stats for Stations



Link rate stats give an indication of how well the rate-control is working. For rate-control, the 'RX' link rate corresponds to what the device-under-test is transmitting. If all of the stations are on the same radio, then the TX and RX encoding rates should be similar for all stations. If there is a definite pattern where some stations do not get good RX rate, then probably the device-under-test has rate-control problems. The TX rate is what LANforge is transmitting at.

CSV Data for Link Rate for Stations



Key Performance Indicators CSV

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Scan Results for SSIDs used in this test.

BSS 04:42:1a:5d:5d:58(on sta0000) -- associated
        last seen: 3135.331s [boottime]
        TSF: 134324155 usec (0d, 00:02:14)
        freq: 6135
        beacon interval: 100 TUs
        capability: ESS Privacy RadioMeasure (0x1011)
        signal: -44.00 dBm
        last seen: 85 ms ago
        Information elements from Probe Response frame:
        SSID: ASUS_6G
        Supported rates: 6.0* 9.0 12.0 18.0 24.0* 36.0 48.0 54.0
        Country: US     Environment: bogus
                Extension ID: 254 Regulatory Class: 131 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 132 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 133 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 134 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 136 Coverage class: 0 (up to 0m)
        TPC report: TX power: 17 dBm
        Extended supported rates: 61.5*
        RSN:     * Version: 1
                 * Group cipher: CCMP
                 * Pairwise ciphers: CCMP
                 * Authentication suites: SAE
                 * Capabilities: 16-PTKSA-RC 1-GTKSA-RC MFP-required MFP-capable (0x00cc)
        BSS Load:
                 * station count: 2
                 * channel utilisation: 5/255
                 * available admission capacity: 0 [*32us]
        RM enabled capabilities:
                Capabilities: 0x30 0x00 0x00 0x00 0x00
                        Beacon Passive Measurement
                        Beacon Active Measurement
                Nonoperating Channel Max Measurement Duration: 0
                Measurement Pilot Capability: 0
        Extended capabilities:
                 * Extended Channel Switching
                 * BSS Transition
                 * Multiple BSSID
                 * Interworking
                 * QoS Map
                 * Operating Mode Notification
                 * Reserved Reserved Channel Schedule Management
                 * Reserved Channel Schedule Management
                 * 0
        Transmit Power Envelope:
        Transmit Power Envelope:
        Transmit Power Envelope:
        HE capabilities:
                HE MAC Capabilities (0x000112081000):
                        +HTC HE Supported
                        BSR
                        OM Control
                        Maximum A-MPDU Length Exponent: 2
                        OM Control UL MU Data Disable RX
                HE PHY Capabilities: (0x442002c002439500008c00):
                        HE40/HE80/5GHz
                        242 tone RUs/5GHz
                        LDPC Coding in Payload
                        NDP with 4x HE-LTF and 3.2us GI
                        Rx HE MU PPDU from Non-AP STA
                        SU Beamformer
                        MU Beamformer
                        Sounding Dimensions <= 80Mhz: 3
                        Ng = 16 SU Feedback
                        Codebook Size SU Feedback
                        Triggered SU Beamforming Feedback
                        Triggered CQI Feedback
                        PPE Threshold Present
                        TX 1024-QAM
                        RX 1024-QAM
                HE RX MCS and NSS set <= 80 MHz
                        1 streams: MCS 0-11
                        2 streams: MCS 0-11
                        3 streams: MCS 0-11
                        4 streams: MCS 0-11
```

```
                        5 streams: not supported
                        6 streams: not supported
                        7 streams: not supported
                        8 streams: not supported
                HE TX MCS and NSS set <= 80 MHz
                        1 streams: MCS 0-11
                        2 streams: MCS 0-11
                        3 streams: MCS 0-11
                        4 streams: MCS 0-11
                        5 streams: not supported
                        6 streams: not supported
                        7 streams: not supported
                        8 streams: not supported
                PPE Threshold 0x7b 0x1c 0xc7 0x71 0x1c 0xc7 0x71 0x1c 0xc7 0x71 0x1c 0xc7 0x71
        WMM:     * Parameter version 1
                 * u-APSD
                 * BE: CW 15-1023, AIFSN 3
                 * BK: CW 15-1023, AIFSN 7
                 * VI: CW 7-15, AIFSN 2, TXOP 3008 usec
                 * VO: CW 3-7, AIFSN 2, TXOP 1504 usec
        802.11u Advertisement:
                Query Response Info: 0x7f
                        Query Response Length Limit: 127
                        ANQP


BSS 04:42:1a:5d:5d:58(on sta0001) -- associated
        last seen: 3135.637s [boottime]
        TSF: 222807905 usec (0d, 00:03:42)
        freq: 6135
        beacon interval: 100 TUs
        capability: ESS Privacy RadioMeasure (0x1011)
        signal: -43.00 dBm
        last seen: 85 ms ago
        Information elements from Probe Response frame:
        SSID: ASUS_6G
        Supported rates: 6.0* 9.0 12.0 18.0 24.0* 36.0 48.0 54.0
        Country: US     Environment: bogus
                Extension ID: 254 Regulatory Class: 131 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 132 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 133 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 134 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 136 Coverage class: 0 (up to 0m)
        TPC report: TX power: 17 dBm
        Extended supported rates: 61.5*
        RSN:     * Version: 1
                 * Group cipher: CCMP
                 * Pairwise ciphers: CCMP
                 * Authentication suites: SAE
                 * Capabilities: 16-PTKSA-RC 1-GTKSA-RC MFP-required MFP-capable (0x00cc)
        BSS Load:
                 * station count: 3
                 * channel utilisation: 185/255
                 * available admission capacity: 0 [*32us]
        RM enabled capabilities:
                Capabilities: 0x30 0x00 0x00 0x00 0x00
                        Beacon Passive Measurement
                        Beacon Active Measurement
                Nonoperating Channel Max Measurement Duration: 0
                Measurement Pilot Capability: 0
        Extended capabilities:
                 * Extended Channel Switching
                 * BSS Transition
                 * Multiple BSSID
                 * Interworking
                 * QoS Map
                 * Operating Mode Notification
                 * Reserved Reserved Channel Schedule Management
                 * Reserved Channel Schedule Management
                 * 0
        Transmit Power Envelope:
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        HE capabilities:
                HE MAC Capabilities (0x000112081000):
                        +HTC HE Supported
                        BSR
                        OM Control
                        Maximum A-MPDU Length Exponent: 2
                        OM Control UL MU Data Disable RX
                HE PHY Capabilities: (0x442002c002439500008c00):
                        HE40/HE80/5GHz
                        242 tone RUs/5GHz
                        LDPC Coding in Payload
                        NDP with 4x HE-LTF and 3.2us GI
                        Rx HE MU PPDU from Non-AP STA
                        SU Beamformer
                        MU Beamformer
                        Sounding Dimensions <= 80Mhz: 3
                        Ng = 16 SU Feedback
                        Codebook Size SU Feedback
                        Triggered SU Beamforming Feedback
                        Triggered CQI Feedback
                        PPE Threshold Present
                        TX 1024-QAM
                        RX 1024-QAM
                HE RX MCS and NSS set <= 80 MHz
                        1 streams: MCS 0-11
                        2 streams: MCS 0-11
                        3 streams: MCS 0-11
                        4 streams: MCS 0-11
                        5 streams: not supported
                        6 streams: not supported
                        7 streams: not supported
                        8 streams: not supported
                HE TX MCS and NSS set <= 80 MHz
                        1 streams: MCS 0-11
                        2 streams: MCS 0-11
                        3 streams: MCS 0-11
                        4 streams: MCS 0-11
                        5 streams: not supported
```

```
                        6 streams: not supported
                        7 streams: not supported
                        8 streams: not supported
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        WMM:     * Parameter version 1
                 * u-APSD
                 * BE: CW 15-1023, AIFSN 3
                 * BK: CW 15-1023, AIFSN 7
                 * VI: CW 7-15, AIFSN 2, TXOP 3008 usec
                 * VO: CW 3-7, AIFSN 2, TXOP 1504 usec
        802.11u Advertisement:
                Query Response Info: 0x7f
                        Query Response Length Limit: 127
                        ANQP


BSS 04:42:1a:5d:5d:58(on sta0003) -- associated
        last seen: 3135.637s [boottime]
        TSF: 222807905 usec (0d, 00:03:42)
        freq: 6135
        beacon interval: 100 TUs
        capability: ESS Privacy RadioMeasure (0x1011)
        signal: -39.00 dBm
        last seen: 85 ms ago
        Information elements from Probe Response frame:
        SSID: ASUS_6G
        Supported rates: 6.0* 9.0 12.0 18.0 24.0* 36.0 48.0 54.0
        Country: US     Environment: bogus
                Extension ID: 254 Regulatory Class: 131 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 132 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 133 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 134 Coverage class: 0 (up to 0m)
                Extension ID: 254 Regulatory Class: 136 Coverage class: 0 (up to 0m)
        TPC report: TX power: 17 dBm
        Extended supported rates: 61.5*
        RSN:     * Version: 1
                 * Group cipher: CCMP
                 * Pairwise ciphers: CCMP
                 * Authentication suites: SAE
                 * Capabilities: 16-PTKSA-RC 1-GTKSA-RC MFP-required MFP-capable (0x00cc)
        BSS Load:
                 * station count: 3
                 * channel utilisation: 185/255
                 * available admission capacity: 0 [*32us]
        RM enabled capabilities:
                Capabilities: 0x30 0x00 0x00 0x00 0x00
                        Beacon Passive Measurement
                        Beacon Active Measurement
                Nonoperating Channel Max Measurement Duration: 0
                Measurement Pilot Capability: 0
        Extended capabilities:
                 * Extended Channel Switching
                 * BSS Transition
                 * Multiple BSSID
                 * Interworking
                 * QoS Map
                 * Operating Mode Notification
                 * Reserved Reserved Channel Schedule Management
                 * Reserved Channel Schedule Management
                 * 0
        Transmit Power Envelope:
        Transmit Power Envelope:
        Transmit Power Envelope:
        HE capabilities:
                HE MAC Capabilities (0x000112081000):
                        +HTC HE Supported
                        BSR
                        OM Control
                        Maximum A-MPDU Length Exponent: 2
                        OM Control UL MU Data Disable RX
                HE PHY Capabilities: (0x442002c002439500008c00):
                        HE40/HE80/5GHz
                        242 tone RUs/5GHz
                        LDPC Coding in Payload
                        NDP with 4x HE-LTF and 3.2us GI
                        Rx HE MU PPDU from Non-AP STA
                        SU Beamformer
                        MU Beamformer
                        Sounding Dimensions <= 80Mhz: 3
                        Ng = 16 SU Feedback
                        Codebook Size SU Feedback
                        Triggered SU Beamforming Feedback
                        Triggered CQI Feedback
                        PPE Threshold Present
                        TX 1024-QAM
                        RX 1024-QAM
                HE RX MCS and NSS set <= 80 MHz
                        1 streams: MCS 0-11
                        2 streams: MCS 0-11
                        3 streams: MCS 0-11
                        4 streams: MCS 0-11
                        5 streams: not supported
                        6 streams: not supported
                        7 streams: not supported
                        8 streams: not supported
                HE TX MCS and NSS set <= 80 MHz
                        1 streams: MCS 0-11
                        2 streams: MCS 0-11
                        3 streams: MCS 0-11
                        4 streams: MCS 0-11
                        5 streams: not supported
                        6 streams: not supported
                        7 streams: not supported
                        8 streams: not supported
                PPE Threshold 0x7b 0x1c 0xc7 0x71 0x1c 0xc7 0x71 0x1c 0xc7 0x71 0x1c 0xc7 0x71
        WMM:     * Parameter version 1
                 * u-APSD
                 * BE: CW 15-1023, AIFSN 3
                 * BK: CW 15-1023, AIFSN 7
                 * VI: CW 7-15, AIFSN 2, TXOP 3008 usec
                 * VO: CW 3-7, AIFSN 2, TXOP 1504 usec
```

```
802.11u Advertisement:
        Query Response Info: 0x7f
                Query Response Length Limit: 127
                ANQP
```

META Information for Report for: Wifi Capacity Test
