Report for: Wifi Capacity Test

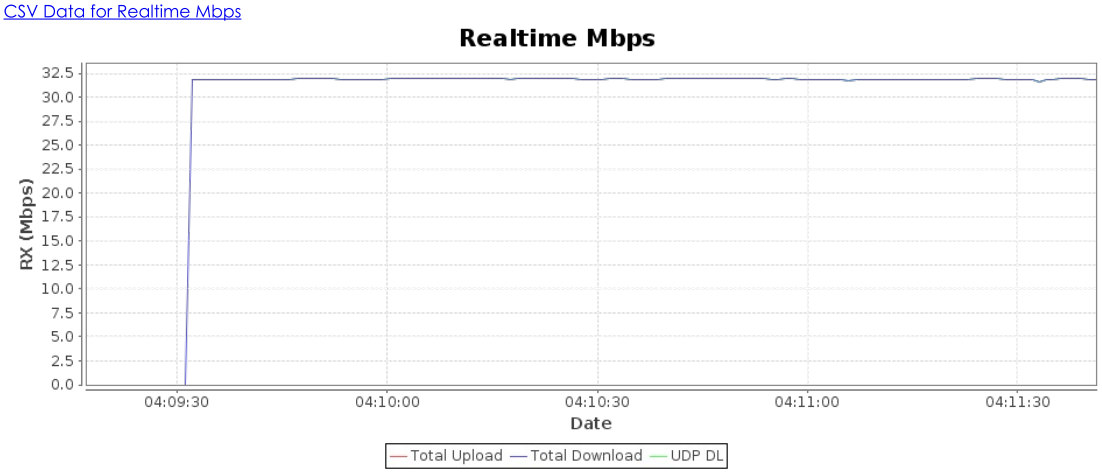
Thu Feb 17 04:11:42 PST 2022

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.

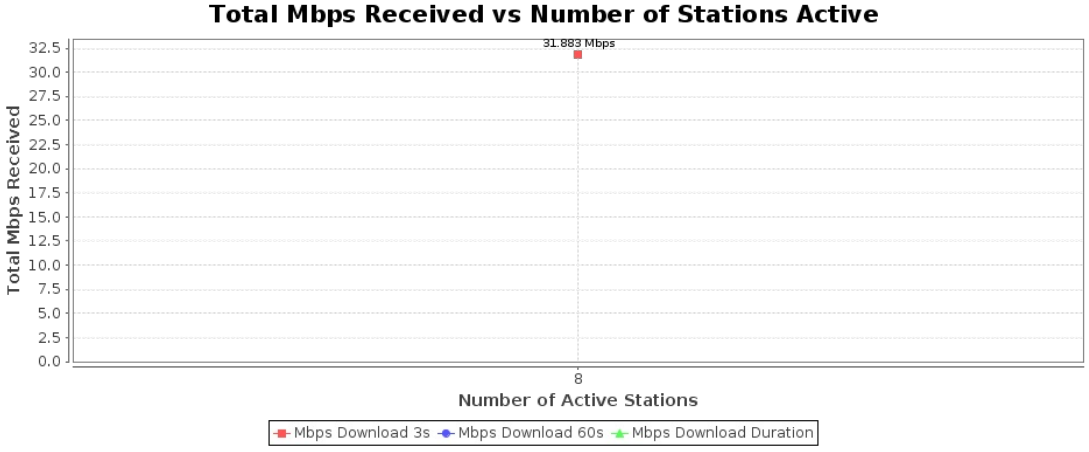
Realtime Graph shows summary download and upload RX bps of connections created by this test.

CSV Data for Realtime Mbps



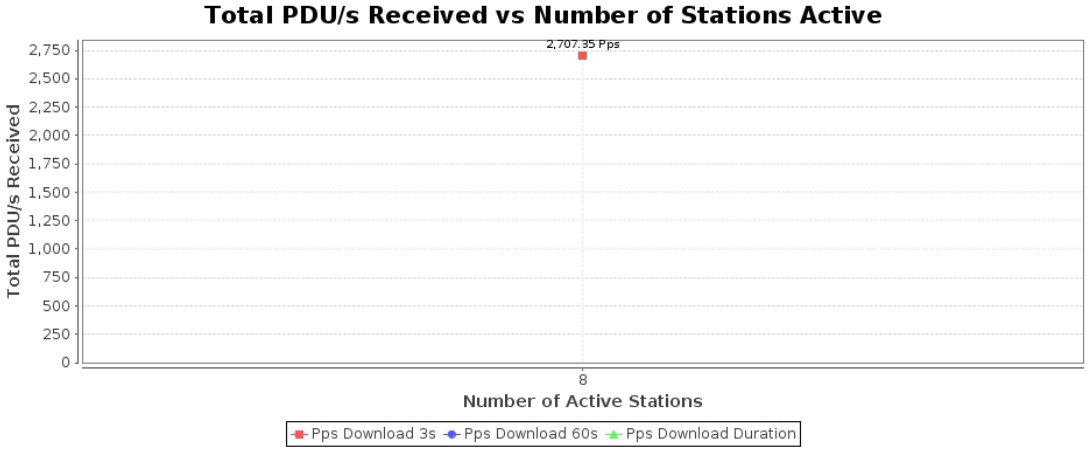
Total Megabits-per-second transferred. This only counts the protocol payload, so it will not count the Ethernet, IP, UDP, TCP or other header overhead. A well behaving system will show about the same rate as stations increase. If the rate decreases significantly as stations increase, then it is not scaling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

CSV Data for Total Mbps Received vs Number of Stations Active



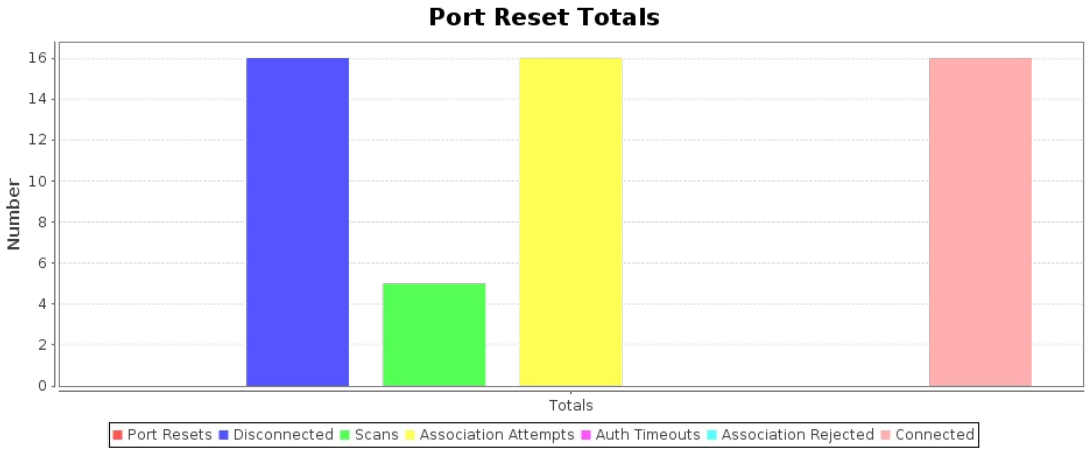
Protocol-Data-Units received. For TCP, this does not mean much, but for UDP connections, this correlates to packet size. If the PDU size is larger than what fits into a single frame, then the network stack will segment it accordingly. A well behaving system will show about the same rate as stations increase.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



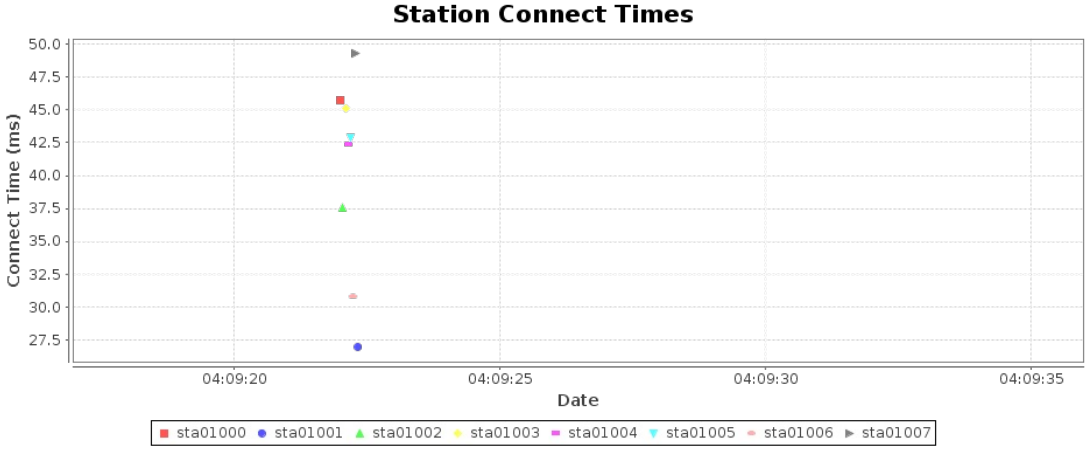
Station disconnect stats. These will be only for the last iteration. If the 'Clear Reset Counters' option is selected, the stats are cleared after the initial association. Any re-connects reported indicate a potential stability issue. Can be used for long-term stability testing in cases where you bring 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:	8
Loop Iterations:	Single (1)
Duration:	2 min (2 m)
Protocol:	UDP-IPv4
Layer 4-7 Endpoint:	NONE
Payload Size:	AUTO
MSS	AUTO
Per-Station Download Rate:	4Mbps
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	/home/lanforge/report-data/wifi-cap-csv-data-2022-02-17_04.09
Build Date	Thu 13 Jan 2022 01:27:32 PM PST
Build Version	5.4.4
Git Version	c419229103db6f1917b40d5169b2c9926b273e51
Ports	1.1.eth2 1.1.sta01000 1.1.sta01001 1.1.sta01002 1.1.sta01003 1.1.sta01004 1.1.sta01005 1.1.sta01006 1.1.sta01007
Firmware	10.4b-ct-9984-xtH-13-b1b524c8e5 0x80000aef, 1.1876.0
Machines	ct523c-3011

```
Requested Parameters:
Download Rate: Per station:   4000000 (   4 Mbps)  All:     32000000 (  32 Mbps)
Upload Rate:   Per station:         0 (    0 bps)  All:            0 (    0 bps)
                                                Total:      32000000 (  32 Mbps)
Station count: 8   Connections per station: 1   Payload (PDU) sizes: AUTO (AUTO)

Observed Rate:
Download Rate:     Cx Min:       3 Mbps  Cx Ave:       3 Mbps  Cx Max:       3 Mbps  All Cx:      31 Mbps
Upload Rate:       Cx Min:        0 bps  Cx Ave:        0 bps  Cx Max:        0 bps  All Cx:        0 bps
                                                                                      Total:       31 bps
Aggregated Rate:   Min:          3 Mbps  Avg:          3 Mbps  Max:          3 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.
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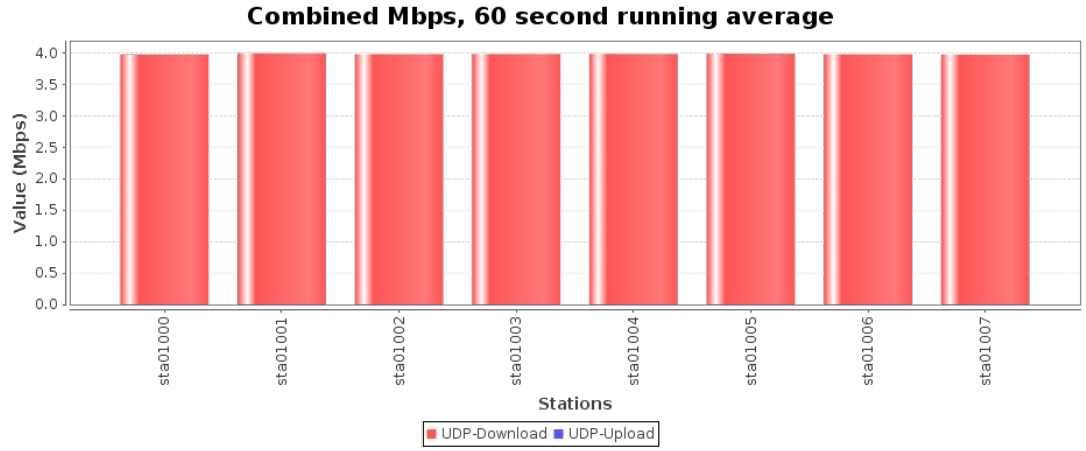
CSV Data for Combined Mbps, 60 second running average




```
Requested Parameters:
Download Rate: Per station:   4000000 (   4 Mbps)  All:     32000000 (  32 Mbps)
Upload Rate:   Per station:         0 (    0 bps)  All:            0 (    0 bps)
                                              Total:      32000000 (  32 Mbps)
Station count: 8   Connections per station: 1   Payload (PDU) sizes: AUTO (AUTO)

Observed Amount:
Download Amount:   Cx Min:         59 B  Cx Ave:         60 B  Cx Max:         60 B  All Cx:        480 B
Upload Amount:     Cx Min:          0 B  Cx Ave:          0 B  Cx Max:          0 B  All Cx:          0 B
                                                                                    Total:         480 B

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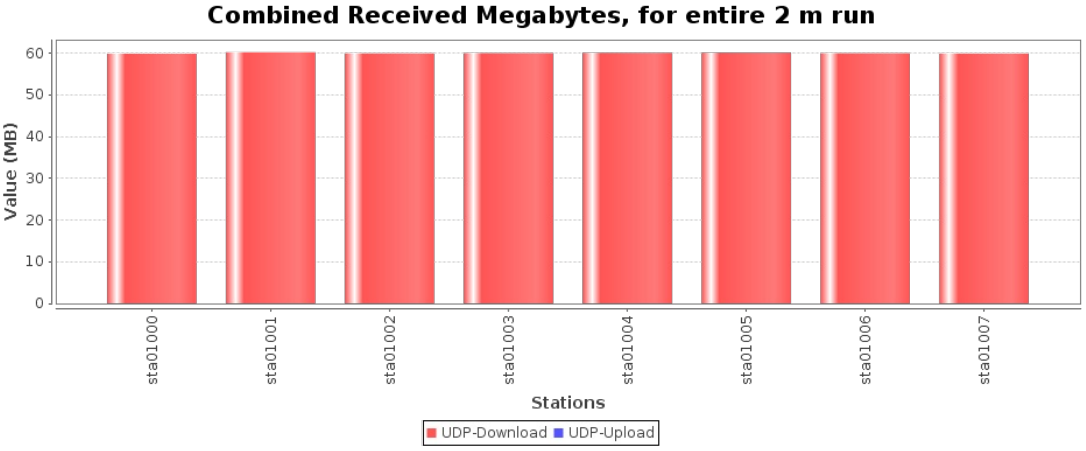
unless the device-under-test takes specific actions to ensure fairness.
```

CSV Data for Combined Received Megabytes, for entire 2 m run

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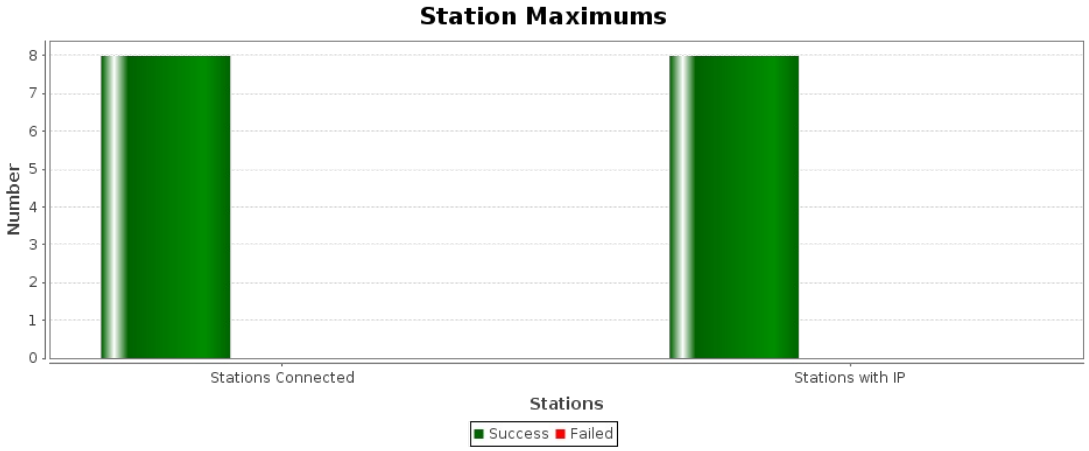
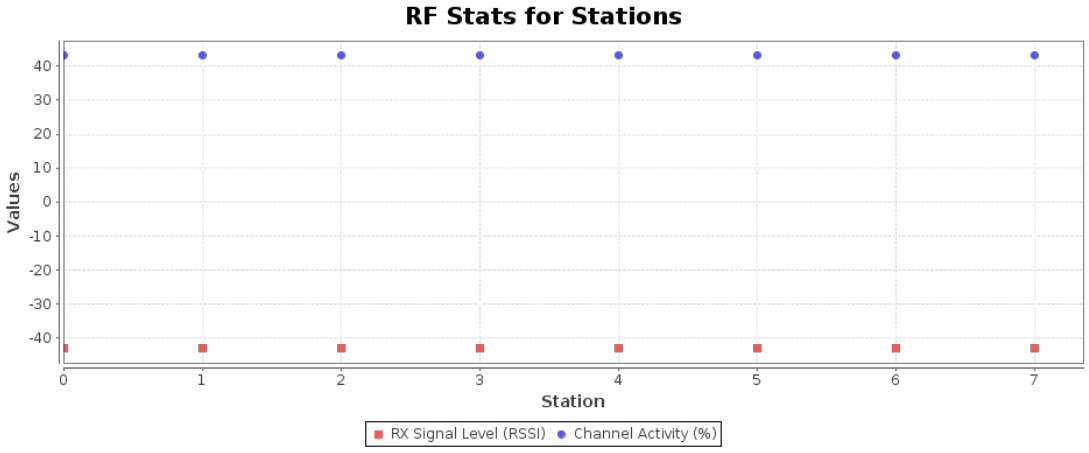
Maximum Stations Connected: 8
Stations NOT connected at this time: 0
Maximum Stations with IP Address: 8
Stations without IP at this time: 0
```

CSV Data for Station Maximums



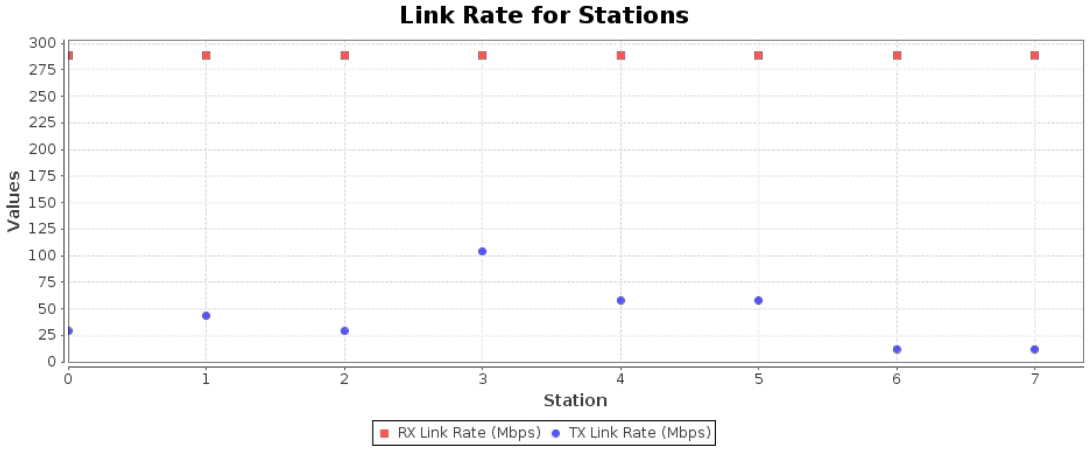
RF stats give an indication of how well how congested is the RF environment. Channel activity is what the wifi radio reports as the busy-time for the RF environment. It is expected that this be near 100% when LANforge is running at max speed, but at lower speeds, this should be a lower percentage unless 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 68:7d:b4:5f:5c:33(on sta01000) -- associated
        last seen: 604789.939s [boottime]
        TSF: 659006876612 usec (7d, 15:03:26)
        freq: 2437
        beacon interval: 100 TUs
        capability: ESS Privacy RadioMeasure (0x1011)
        signal: -33.00 dBm
        last seen: 48 ms ago
        Information elements from Probe Response frame:
        SSID: ssid_wpa2_2g
        Supported rates: 9.0 12.0* 18.0 24.0 36.0 48.0 54.0
        DS Parameter set: channel 6
        Country: US     Environment: bogus
                Channels [1 - 1] @ 21 dBm
                Channels [2 - 10] @ 23 dBm
                Channels [11 - 11] @ 19 dBm
        Power constraint: 3 dB
        TPC report: TX power: 23 dBm
        ERP: Barker_Preamble_Mode
        RSN:     * Version: 1
                 * Group cipher: CCMP
                 * Pairwise ciphers: CCMP
                 * Authentication suites: PSK
                 * Capabilities: 4-PTKSA-RC 4-GTKSA-RC (0x0028)
        BSS Load:
                 * station count: 16
                 * channel utilisation: 101/255
                 * available admission capacity: 23437 [*32us]
        RM enabled capabilities:
                Capabilities: 0x73 0xd0 0x00 0x00 0x0c
                        Link Measurement
                        Neighbor Report
                        Beacon Passive Measurement
                        Beacon Active Measurement
                        Beacon Table Measurement
                        LCI Measurement
                        Transmit Stream/Category Measurement
                        Triggered Transmit Stream/Category
                        FTM Range Report
                        Civic Location Measurement
                Nonoperating Channel Max Measurement Duration: 0
                Measurement Pilot Capability: 4
        HT capabilities:
                Capabilities: 0x9ad
                        RX LDPC
                        HT20
                        SM Power Save disabled
                        RX HT20 SGI
                        TX STBC
                        RX STBC 1-stream
                        Max AMSDU length: 7935 bytes
                        No DSSS/CCK HT40
                Maximum RX AMPDU length 65535 bytes (exponent: 0x003)
                Minimum RX AMPDU time spacing: No restriction (0x00)
                HT TX/RX MCS rate indexes supported: 0-31
        HT operation:
                 * primary channel: 6
                 * secondary channel offset: no secondary
                 * STA channel width: 20 MHz
                 * RIFS: 0
                 * HT protection: no
                 * non-GF present: 1
                 * OBSS non-GF present: 0
                 * dual beacon: 0
                 * dual CTS protection: 0
                 * STBC beacon: 0
                 * L-SIG TXOP Prot: 0
                 * PCO active: 0
                 * PCO phase: 0
        Extended capabilities:
                 * Extended Channel Switching
                 * BSS Transition
                 * Operating Mode Notification
        HE capabilities:
                HE MAC Capabilities (0x01099a081040):
                        +HTC HE Supported
                        Dynamic BA Fragementation Level: 1
                        Minimum Payload size of 128 bytes: 1
                        BSR
                        OM Control
                        Maximum A-MPDU Length Exponent: 3
                        RX Control Frame to MultiBSS
                        A-MSDU in A-MPDU
                        OM Control UL MU Data Disable RX
                HE PHY Capabilities: (0x006048881f43811c010800):
                        LDPC Coding in Payload
                        HE SU PPDU with 1x HE-LTF and 0.8us GI
                        STBC Rx <= 80MHz
                        Full Bandwidth UL MU-MIMO
                        DCM Max Constellation Rx: 1
                        SU Beamformer
                        SU Beamformee
                        MU Beamformer
                        Beamformee STS <= 80Mhz: 7
                        Sounding Dimensions <= 80Mhz: 3
                        Ng = 16 SU Feedback
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                Codebook Size SU Feedback
                PPE Threshold Present
                HE SU PPDU & HE PPDU 4x HE-LTF 0.8us GI
                Max NC: 3
                HE ER SU PPDU 4x HE-LTF 0.8us GI
                RX 1024-QAM
        PPE Threshold 0xaa 0xff 0xaa 0xff 0x1b 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
```

Auxiliary files: wifi-cap-csv-data

META Information for Report for: Wifi Capacity Test