Novus Labs

SiWx917 Wireless Interoperability & Power Consumption Study

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Rev 3.0

Summary

Widespread adoption of Smart IoT devices such as smart locks, video door bells, battery powered cameras & sensors rely on device vendors meeting two key challenges unique to these devices – staying connected securely to their Wi-Fi Access Point (AP) and cloud while adhering to ultra-low power budgets that are much more stringent than a smartphone. Connectivity and power consumption of an always-ON connection measured under ideal conditions with only a few APs doesn't show the complete picture. Wireless channel congestion, AP make and model can affect interoperability and power consumption.

Given the importance of the interoperability and "connected power" metric for IoT devices – SiLabs commissioned Novus Labs to evaluate interoperability and power consumption of their silicon by connecting securely across various popular wireless APs. For each AP a 25-minute test was conducted to check robustness and measure the power consumption under varying levels of network congestion (0%, 20%, 40%, 70%, 90% - 5min each). The end-results have been tabulated by Novus Labs and can be used by device vendors looking at using SiLabs Wireless chips as a measure of robustness to compute battery life under various real-life conditions and predict variations across APs in their use case. A total of 3 different set of tests were performed by Novus Labs for this study.

1. Power Consumption: Standby Associated MQTT (100 APs)
2. Power Consumption: Standby Associated MQTT TWT (10 APs)
3. Throughput: BLE / Wi-Fi Coex TCP TX Throughput (10 APs)

KEY HIGHLIGHTS

Below were the key highlights from the testing conducted on SiWx917:

1. Robust secure connectivity and interoperability observed during the whole test for all 100 APs with:
    a. Zero Wi-Fi disconnects
    b. 100% reception of application messages
2. Ultra-Low power consumption
    a. With a 'clean channel', an average of only 89uA across all 100 APs
    b. With 'close to saturation' channel utilization of 90%, the average power consumption only increased to 217uA averaged across all 100 APs
3. Extended battery life with Target Wake Time (TWT):
    a. With a TWT enabled AP, an even lower power consumption of 49uA was recorded averaged across 10 APs
4. BLE / Wi-Fi Coexistence:
    a. With a smartphone connected via BLE to the SiWx917, a max TCP TX throughput of 35Mbps was achieved with a 'clean channel'
    b. With 'close to saturation' channel utilization of 90%, the SiWx917 was able to maintain 6Mbps

Test Setup

Silabs's newest generation SiWx917 chip includes an optimized network processor and radio functions to enable a secure ultra-low-power connection to the internet. The SiWx917 is an IoT wireless connectivity SoC that provides Wi-Fi, BLE, embedded protocol stacks and network stacks.

Wireless APs:

Different wireless APs have different protocol implementations in hardware and firmware that affect how long a sleeping Wi-Fi client device must stay awake to receive beacons and buffered frames at the AP. It is important to select a large number of APs covering various brands, chipsets and popularity to weed out all issues that device makers may face in the field. 100 retail wireless APs were selected using the above criteria - see test case 1 below for a full list of wireless APs used for the tests. All testing was done using Out-Of-Box configuration of the AP (except WLAN channel, SSID, password).

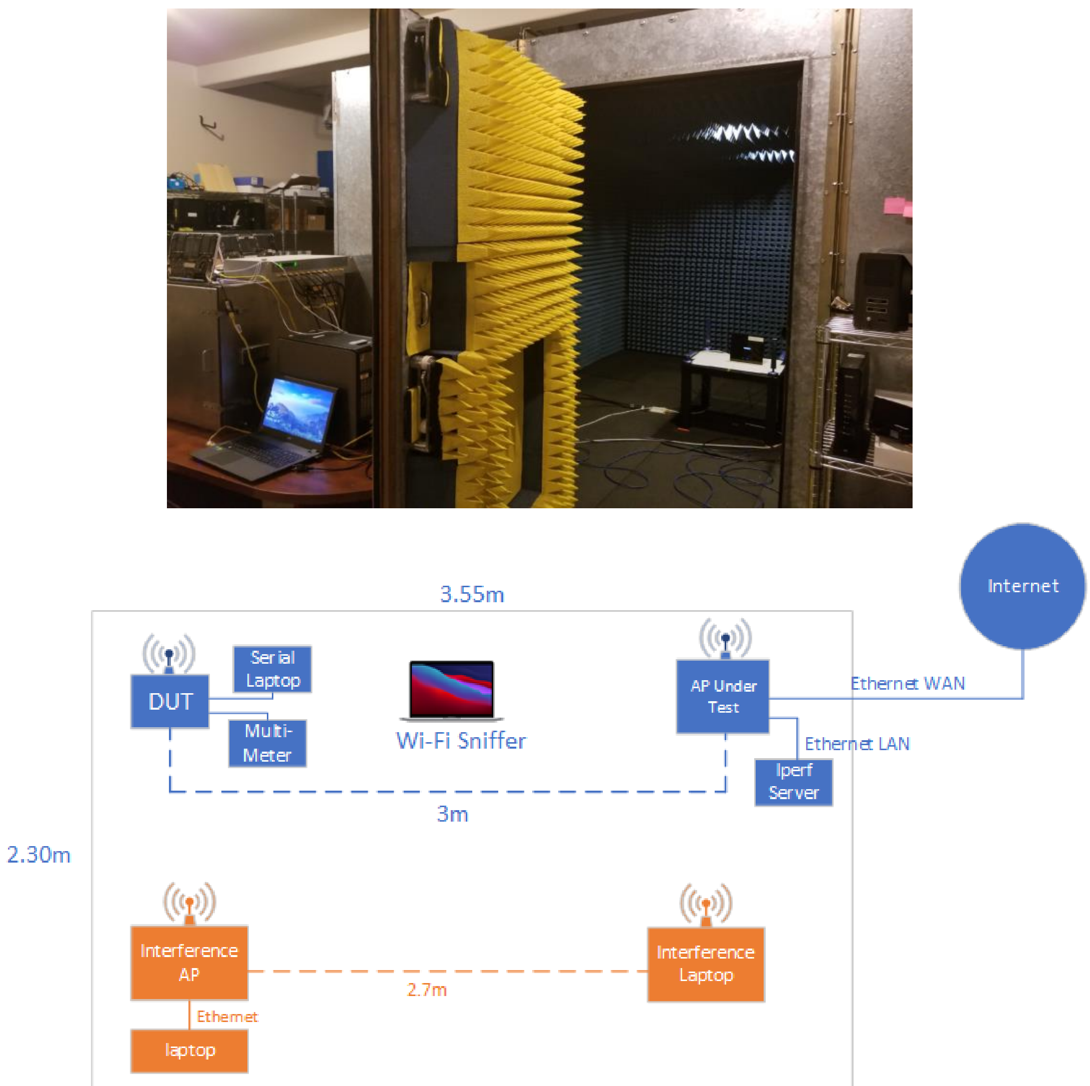


Figure 1 – Test Setup

Test Procedure

The Device-Under-Test (DUT) was configured to establish a WPA2-PSK secure connection with the AP. Once securely associated with the AP and having established the connection to the internet, the application on the Wireless MCU would periodically send keep alive packets to the server. Power consumption was measured for 5 minutes for each of the 5 channel congestion scenarios while the DUT sent application messages to the server. The 5 interference scenarios included, baseline (no congestion), 20%, 40%, 70% and 90% channel congestion. The average power consumption was recorded for each RF congestion level. Sniffer traces were captured for all baseline tests. The goal of this test, in addition to test connectivity robustness, was to measure the effect on current consumption that different traffic levels had on the system to thus mimic real world environments.

Tools used:

- Iperf (traffic generator): This tool was used for generating throughput congestion during the test. Commands used during the test are shown below:
    - Ethernet Laptop: iperf -c <IP> -u -b <amount of UDP traffic> -P1 -fm -i1 -t 300
    - Wi-Fi Station: iperf –s -u
- Tera Term extracting serial logs of the DUT.
- Simplicity Commander to update DUT firmware and binary
- MacBook Pro to capture sniffers for 0% channel congestion for Wireshark traces for each AP.
- Keithley DMM6500 7 1/2 Digit Multimeter: A multimeter with a 1A DC range used to measure power consumption of the DUT.

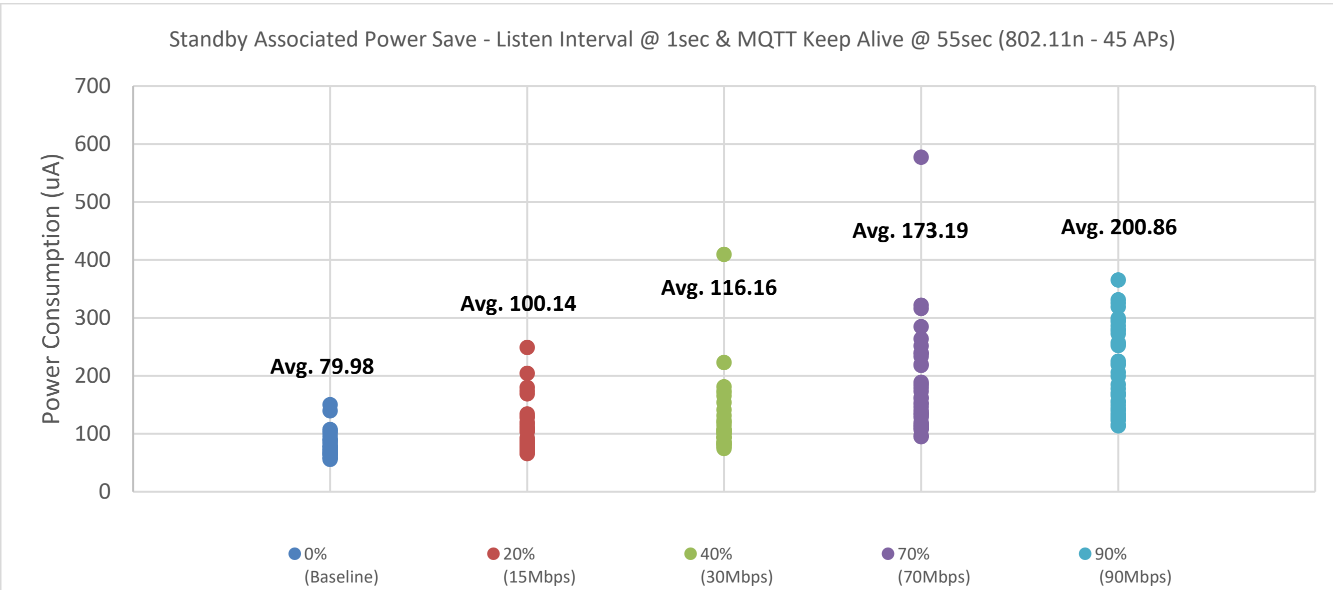
Test Steps:

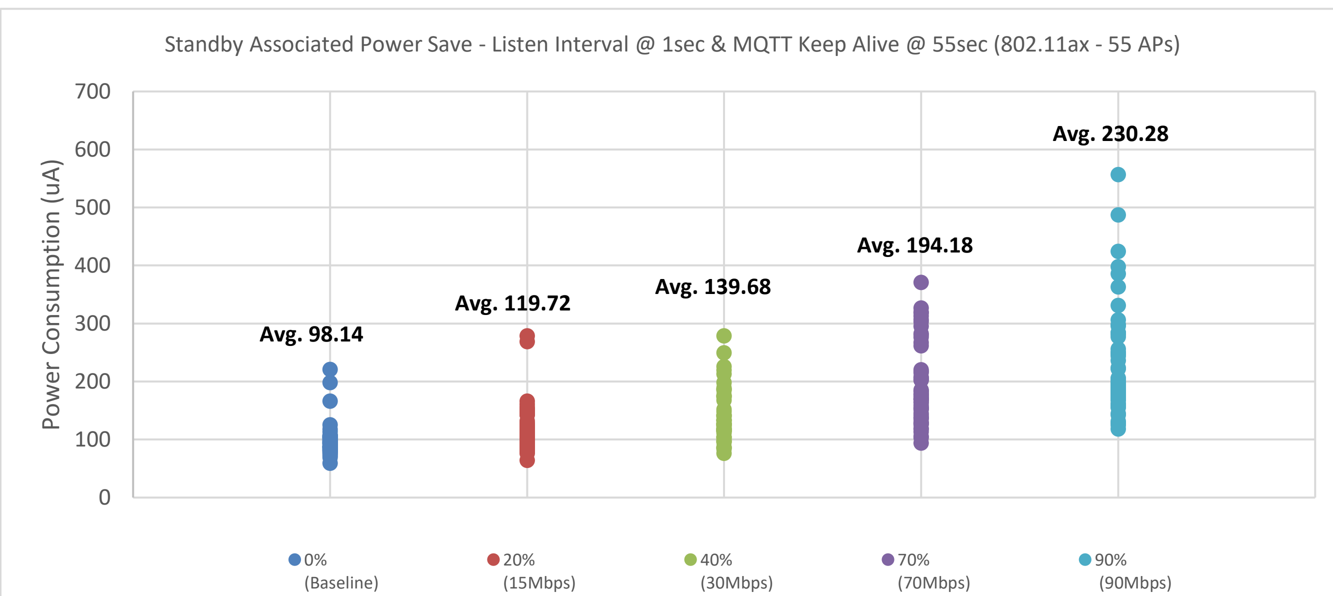
1. Place the power analyzer, SiWx917, and WiFi sniffer inside the isolated RF chamber.
2. Factory reset AP and configure: SSID, Ch. 6 (if AP allows), and WPA2-PSK key. Leave all other settings default.
3. Start Wi-Fi sniffer.
4. Start serial log.
5. Power on SiWx917.
6. Device-Under-Test (DUT) connects to AP.
8. Start KickStart software and 5 minutes timer.
9. Once 5 min timer is up, stop Kickstart, save the file, and record average power consumption for 5 minutes.
10. Start interference and repeat steps 7-8 for the following:
    a. 0% channel saturation (0Mbps) for 5 minutes.
    b. 20% channel saturation (15Mbps) for 5 minutes.
    c. 40% channel saturation (30Mbps) for 5 minutes.
    d. 70% channel saturation (70Mbps) for 5 minutes.
    e. 90% channel saturation (90Mbps) for 5 minutes.

Test Case 1: Standby Associated MQTT (100 APs)

Device: SiLabs SiWx917 Board running Firmware SiWG917-B.2.10.0.0.4
Board rev : BRD4338A Rev12
NWP: 352K & Application Processor: 320K with MCU 0K retention in Power Save
Listen interval of SiWx917 = 1 second (i.e. wakes up at 1sec intervals to check for data)
MQTT keep alive = 55 second intervals

The SiWx917 is optimized for ultra-low power operation during an active connection to the internet. Detailed testing done over multiple weeks by Novus labs has shown that this ultra-low power operation is sustained with multiple APs under multiple channel congestion scenarios. The graphs below show the current consumption for each channel congestion broken down to 802.11n APs, 802.11ax APs, and all 100 APs combined. It was seen during the tests that the average power consumption increased by only 128uA for a 'close to saturation' traffic channel. In addition, all APs passed with 0 disconnects.





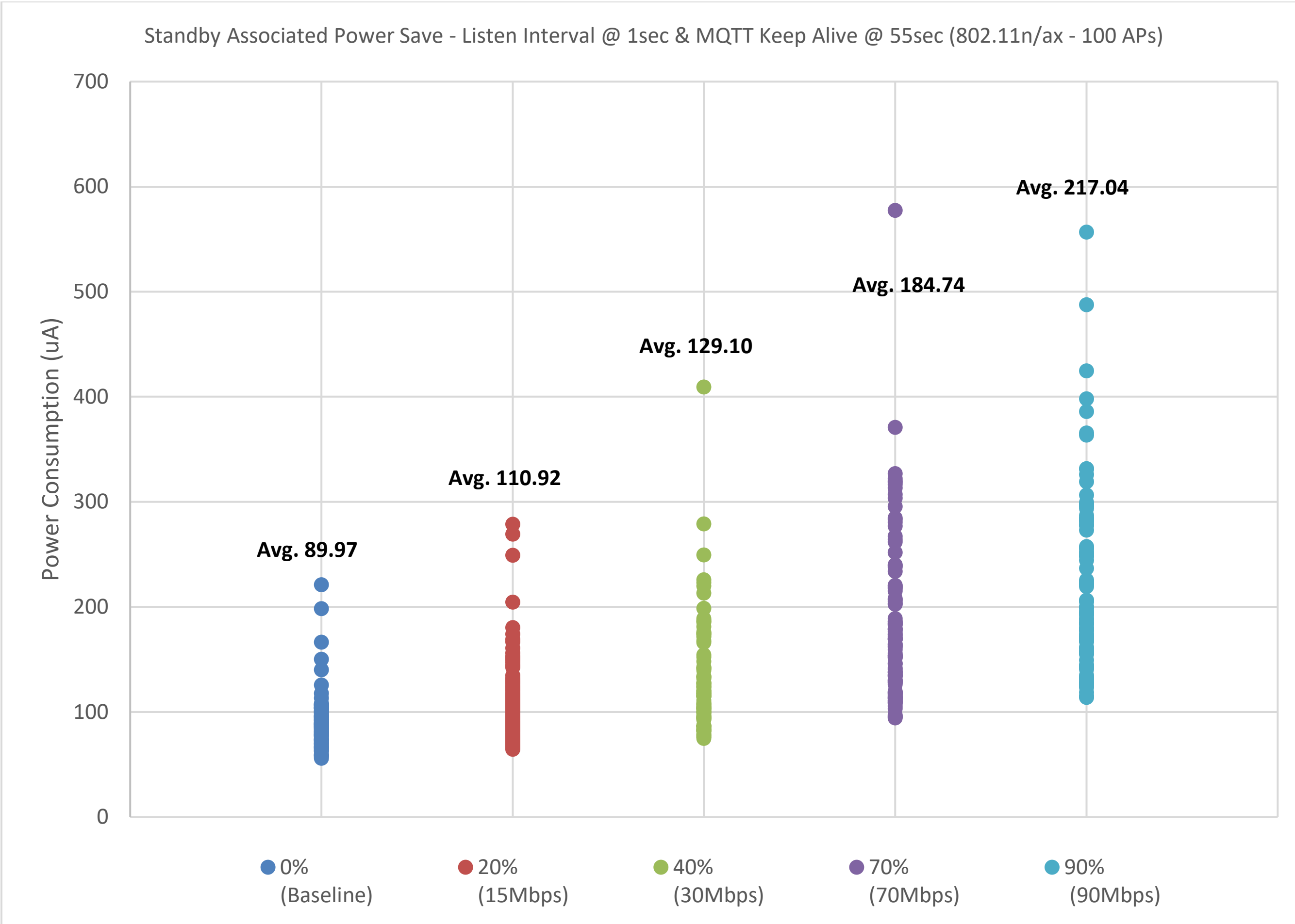


Figure 2 – Silabs SiWx917 – Power Consumption (Standby Associated MQTT)

Notes (according to studies done by Silicon Labs):

1. Main causes of higher power consumption in congested scenarios are **AP Extra Transmissions**. These extra transmissions are of the following types:
    a. Frequent QOS Null packets from AP
    b. ARP requests from AP
    c. Multiple ADDBA requests from AP even if SiWx917 declines
    d. No data being delivered from AP even if SiWx917 sends trigger packets
2. APs with very low DHCP lease times can cause frequent renewals which leads to higher power consumption.
3. Some APs send BTM requests to switch to another 5GHz BSS which is invalid in this scenario as the SiWx917 only supports 2.4GHz. This can lead to a BG scan and eventually a disassociation (observed in mesh APs).
4. Reason for Non-Linear current consumption with increase in channel congestion:
    a. As channel congestion is obtained by running data traffic , this data traffic does not always overlap with the SiWx917's active timeline activity (packet transmission and reception). Due to this, current consumption does not always increase linearly with increase in channel congestion.

Test Case 1: 100 AP List

Device: SiLabs SiWx917 Board running Firmware SiWG917-B.2.10.0.0.4
Board rev : BRD4338A Rev12
NWP: 352K & Application Processor: 320K with MCU 0K retention in Power Save
Listen interval of SiWx917 = 1 second (i.e. wakes up at 1 second intervals to check for data)
MQTT keep alive = 55 second intervals

	Make	Model	Regional Market	0% (Baseline)	20% (15Mbps)	40% (30Mbps)	70% (70Mbps)	90% (90Mbps)
802.11n	Buffalo	WHR-1166DHP3	Japan	78.99329	79.64449	104.1698	135.0547	286.8516
	D-Link	DIR-890L	US	88.34108	204.5019	222.9867	239.4264	293.8825
	ActionTec	C3000A	US	70.28492	72.77786	100.7322	109.2597	131.234
	Arris/Motorola	SBG6580	US	139.9797	174.0317	166.0042	251.8634	296.7512
	ARRIS	SBG6950AC2	US	84.86108	120.2883	131.5544	162.5916	206.2203
	ARRIS	SURFboard SBG10	US	90.16147	105.4991	107.806	237.8445	185.1612
	Asus	Lyra Trio (ASUS MAP-AC1750)	US	73.45551	108.3881	118.3136	134.2321	167.0369
	Asus	RT-N300 B1	US	89.83546	180.3018	171.3734	233.7854	325.8538
	Asus	RT-AC68U vC1	India	79.69132	108.7433	109.074	316.5963	273.0444
	BT	Smart Hub Type A	UK	76.95659	104.0154	103.8296	137.7228	221.2238
	D-Link	DIR-636L revA1	US	107.1337	82.97931	93.08345	117.1667	132.4086
	D-Link	DIR-882	US	58.81204	74.91167	92.51632	129.1214	134.7747
	D-Link	DIR-842	US	107.6477	134.6699	141.3927	186.2412	257.5323
	D-Link	DIR-822	Taiwan	69.08172	72.97365	82.05436	112.6833	114.9804
	Huawei	AP5030DN	US	150.2585	75.34011	86.17749	284.7362	219.2228
	Huawei	B315s-22	Germany	62.49653	68.9421	76.65061	96.84057	140.7068
	Huawei	Honor Pro WS851	China	66.04814	65.83953	82.34076	108.7104	123.1393
	Linksys	EA7500	US	58.74916	66.8113	86.64127	151.5202	144.0142
	Linksys	EA8300	US	58.13189	71.08835	94.59837	110.6573	126.2517
	Linksys	E5350	US	63.06228	73.09361	114.5588	95.10693	114.5766
	Netgear	Nighthawk X6 R8000	US	103.9582	169.1106	181.279	239.8925	280.615
	Netgear	Nighthawk R7000P	US	73.26124	82.53164	105.88	188.8847	168.9865
	TP-LINK	Archer C4000	Canada	95.60856	128.2684	123.4067	114.1246	252.4401
	TP-LINK	Archer A20	US	86.42206	112.5107	119.9261	179.1386	225.5809
	Belkin	F9K1105 v2	US	64.60131	74.12848	74.8201	173.4774	177.9208
	Cisco	WAP300N	US	78.39377	90.33458	121.4886	161.6489	170.2123
	Netgear	R9000	US	103.4707	130.4076	94.03653	130.4371	167.538
	Eero	Home Wifi System (B010001)	US	77.45828	76.04803	78.289	108.2052	125.8628
	Google	WIFI (NLS-1304-25)	US	67.98907	69.86671	81.51345	115.7899	319.1737
	I-O Data	WN-G300R3	Japan	57.21966	74.54926	99.53488	219.7708	255.0976
	Linksys	WRT1900ACSv2	US	89.55511	249.0823	409.3745	264.0734	297.3555
	Xiaomi	R4A	Brazil	65.29892	73.54341	84.18198	113.1326	113.7407
	Deutsche Telekom	Speedport W724V Type B (German)	Germany	63.53698	68.17156	81.5453	95.89544	127.6815
	Motorola	MG7550	US	70.00836	86.68691	94.23207	183.7561	278.4454
	NEC	Aterm WG1200HP3	Japan	73.51647	105.3147	174.3123	577.5475	365.565
	Nokia	HA-020W-B	US	99.94275	116.7393	154.2144	218.2565	331.5351
	Synology	RT1900AC	US	78.14147	92.98108	102.7892	146.3218	156.5694
	Buffalo	WSR-3200AX4S/NBK(No AX on 2.4)	Japan	82.92196	86.77366	102.3909	114.5389	149.2861
	Synology	RT2600AC	US	74.63169	109.741	99.59921	117.94	155.0573
	Aruba	APIN0305	US	91.65373	105.5545	106.6005	153.1729	199.6572
	ASUS	Lyra Voice	US	66.60846	73.07945	86.67075	119.4226	125.5479
	Lenovo	NeWiFi Mini R6830	China	55.91542	71.70654	83.54077	134.0154	142.2354
	HiWiFi	HC5861	China	66.9971	70.41507	78.92357	110.8951	125.9433
	Tenda	N315	China	71.89357	69.00652	107.525	322.2037	299.4374
	Xiaomi	Mi Router 3 Pro (R3P)	China	66.43086	75.30594	95.31951	140.2654	132.3637
802.11ax	Asus	BRT-AC828	China	86.16173	121.9387	133.0141	126.1873	157.0987
	TP-Link	TL-WDR7620	China	59.642	64.57595	76.64788	103.2434	118.6095
	Asus	RT-AX88U	US	95.4362	106.7552	142.7075	182.5189	223.8781
	TP-LINK	Archer AX50	US	107.764	117.894	134.2874	178.3611	177.2017

TP-LINK	Archer AX6000	US	98.7857	156.0144	167.8676	203.0486	284.6167
Linksys	MX5300	US	80.3828	123.9973	111.1126	176.4807	200.1365
Verizon	Fios Home Router G3100	US	221.1312	278.6472	278.9211	303.4457	277.1948
Netgear	R6700AX	US	88.05224	97.22366	116.8643	135.2366	170.2877
TP-LINK	Archer AX21	US	92.94982	114.0891	119.6235	153.3728	183.2078
Asus	RT-AX3000	US	92.18078	160.8766	176.154	217.5351	191.7398
Asus	RT-AX86U	US	88.58639	166.5767	115.071	178.6857	168.267
Netgear	Mesh WiFi 6 Base station (MR60) Satellite (MS60)	US	84.24471	85.87322	95.56811	129.974	155.4325
TP-LINK	Archer AX11000	US	87.86398	105.7184	117.1712	169.4849	174.3701
CenturyLink	C4000XG	US	113.3428	143.253	175.1075	307.0646	250.7134
Netgear (Orbi)	Base station (RBR850) Satellite (RBS850)	US	69.51511	103.5073	83.49849	94.16174	144.8372
CenturyLink	C4000LG	US	101.0772	123.7776	133.3818	154.0788	244.4272
Linksys	MR7350	US	88.34286	115.5822	117.2462	220.4984	247.8037
Linksys	MR9610	US	96.70607	103.7382	104.852	171.7611	179.9052
Buffalo	WSR-5400AX6/NMB	Japan	96.33365	126.8326	185.1799	318.7009	424.7039
Buffalo	WXR-6000AX12S/N	Japan	74.45004	91.29541	97.40832	145.6226	179.8294
TP-LINK	Archer AX73	Japan	81.32086	147.1606	152.324	280.3976	248.6681
Asus	RT-AX56U	Japan	94.93055	82.10487	249.5019	185.7116	487.6499
Buffalo	WSR-5400AX6-MB	Japan	106.8782	112.554	172.748	319.7347	385.8495
Buffalo	WXR-5700AX7S/N	Japan	77.71474	78.10841	87.13363	137.4873	173.0074
TP-LINK	Archer AX20	Japan	117.5876	151.9092	213.2208	295.5207	556.8013
Buffalo	WSR-1800AX4-C/NB	Japan	166.2672	132.1427	123.9854	326.8743	282.6761
Buffalo	WSR-1800AX4S/NBK	Japan	78.81377	84.43608	187.0831	261.8365	184.2635
Linksys	Hydra Pro 6E (MR7500)	US	88.97238	82.57768	86.23068	128.1944	128.1944
Netgear	Nighthawk RAXE500	US	125.6711	142.4895	188.7777	313.1413	331.301
AT&T	BGW320-500	US	98.31414	151.4568	198.5673	370.7754	397.9569
Eero	Eero Pro 6 (K010001)	US	106.701	89.26455	125.6527	141.9579	188.731
Techincolor	CGM4331COM (XB7-T) and xFi Pod (XE2-SG B1A)	US	105.9501	113.2442	174.4258	169.0792	221.9611
Linksys	Atlas Max 6e (MX8500)	US	103.0777	98.98967	117.8095	184.0629	198.4685
ASUS	GT-AXE11000	US	100.0276	152.8673	126.4512	207.7221	195.8245
Netgear	WAX630E	US	91.9974	95.2146	96.31655	127.9077	170.8741
Netgear	WAX204	US	83.16203	115.6459	133.5264	282.9662	282.8176
TP-LINK	Archer AX55	US	198.3231	269.0771	219.7478	267.1573	306.4605
Asus	RT-AX55	US	86.27074	106.2051	102.8585	174.1079	363.3896
Netgear	Nighthawk AX6 (RAX50)	US	81.06804	94.49243	147.963	276.7629	295.9839
Eero	Eero Pro 6E (S010001)	US	106.1081	76.68833	127.3572	202.5477	283.75
TP-LINK	Deco XE75	US	103.8411	122.8357	128.0117	155.7057	187.9443
Asus	RT-AX68U	US	96.2394	121.5714	139.4964	159.2673	194.0293
Netgear	Nighthawk XR1000	US	76.39946	84.78753	104.365	151.8757	204.8976
Eero	Eero 6 (N010001)	US	94.18133	115.1489	114.8918	118.2904	142.6937
Eero	Eero 6 + (R010001)	US	103.6523	144.4983	142.2156	138.2212	170.2284
Asus	RT-AX1800S	US	104.3348	111.7073	119.6089	164.4941	161.7365
Netgear	Nighthawk RAX30	US	84.42431	88.9538	127.5831	113.3155	160.167
TP-LINK	Archer AXE75	US	104.1888	149.6295	225.7455	215.2846	298.1336
Netgear	Nighthawk RAX43	US	87.49412	112.9479	141.2885	205.1255	256.5474
TP-LINK	Archer AX73	US	93.8252	128.2863	124.1841	206.7951	236.6575
Netgear	WAX202	US	72.21916	122.4211	85.90975	105.5884	125.1661
TP-LINK	Archer AX75	US	100.9455	101.5703	186.2677	169.4488	206.2124
Google	Nest Wifi Pro (G6ZUC)	US	85.54694	89.12273	114.7108	170.3545	157.4803
Netgear	Nighthawk RAX70	US	81.93641	104.9302	115.3577	164.0103	193.3391
TP-LINK	Archer AX90	US	86.65	101.68	99.64	118.9047	131.5959

Test Case 2: Standby Associated MQTT w/ TWT Enabled (10 APs)

Device: SiLabs SiWx917 Board running Firmware SiWG917-B.2.10.0.0.4
Board rev : BRD4338A Rev12
NWP: 352K & Application Processor: 320K with MCU 0K retention in Power Save
Adaptive TWT with 0Mbps throughput requirement and 30 sec latency.
MQTT keep alive at 55 second interval

The SiWx917 supports Target Wake Time (TWT) – An 802.11ax feature that can determine when and how frequently to wake up to transmit / receive data. This can drastically reduce power consumption and save battery life of the connected clients. The testing done across 10 APs that supported this feature showed that the average power consumption was noticeably lower with an average of 49uA in a 'clean channel' scenario.

TWT Enabled - Current Consumption:

	Make	Model	0% (Baseline)	20% (15Mbps)	40% (30Mbps)	70% (70Mbps)	90% (90Mbps)
802.11ax	Buffalo	WSR-5400AX6/NMB	45.33559	51.62164	56.67534	73.31437	72.44298
	Buffalo	WXR-6000AX12S/N	43.07483	48.98666	57.3593	130.3279	62.4796
	ASUS	GT-AXE11000	55.10851	59.16715	52.23065	80.00925	71.90372
	Netgear	WAX630E	52.00563	72.5398	79.75791	128.0484	79.51355
	Wyze	Mesh WiFi Router AXE5400	56.8227	78.14799	82.16158	81.35595	102.0493
	Asus	RT-AX68U	48.1625	60.57455	80.74446	71.64396	71.96422
	Asus	RT-AX1800S	36.28845	47.69726	46.89669	46.43344	49.70775
	TP-LINK	Archer AXE75	55.42571	44.54975	49.79476	51.51988	85.59743
	TP-LINK	Archer AX75	47.99656	48.70256	53.94078	66.66007	66.23317
	TP-LINK	Archer AX90	49.92027	43.53131	61.35519	64.09935	80.76737

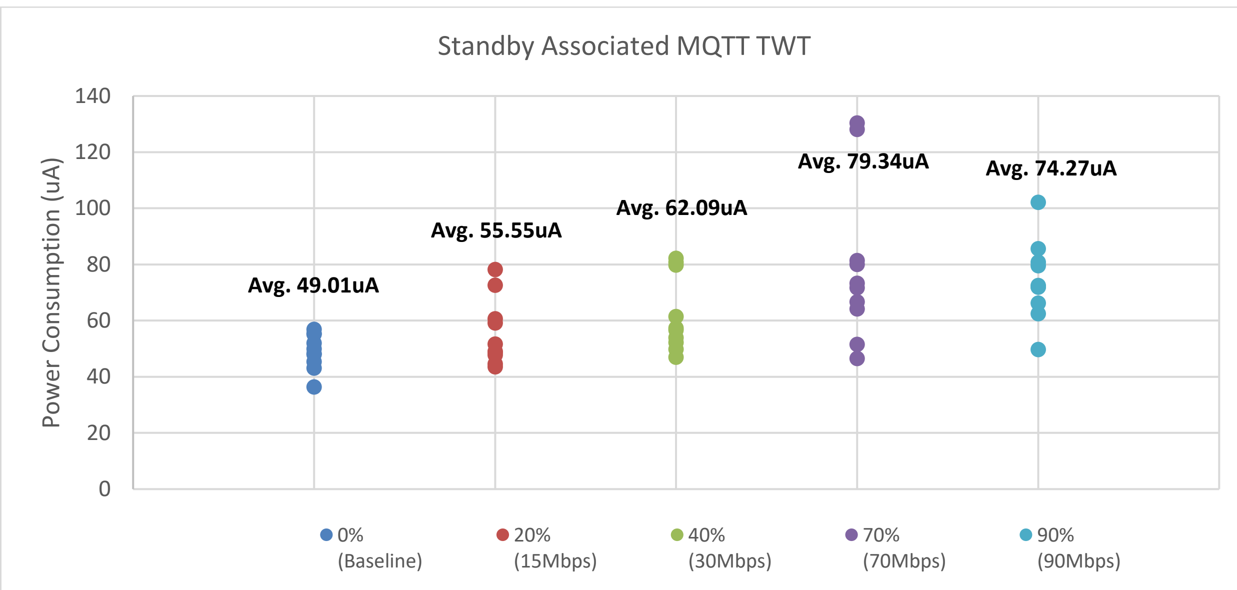


Figure 3 –Power Consumption (TWT Enabled)

Test Case 3: Wi-Fi / BLE Coex TCP TX Throughput (10 APs)

Device: SiLabs SiWx917 Board running Firmware SiWG917-B.2.10.0.0.4
Board rev : BRD4338A Rev12
NWP: 352K & Application Processor: 320K with MCU 0K retention in Power Save

The SiWx917 also has a BLE radio onboard. TCP TX throughput measurements of the SiWx917 were measured while a smartphone (Samsung Galaxy S21 Ultra) was paired and connected-idle. As shown below, the SiWx917 was able to achieve a max throughput of 35Mbps in a 'clean channel' and was able to maintain a 6Mbps throughput for the 'close to saturation' scenario.

(Mbps)	Make	Model	0% (Baseline)	20% (15Mbps)	40% (30Mbps)	70% (70Mbps)	90% (90Mbps)
802.11n	Asus	RT-AC68U vC1	36.03	29.4	23.87	11.36	5.75
	Netgear (Orbi)	RBR20 (Base Station) RBS20 (Satellite)	39.78	33.11	27.03	8.46	6.21
	Aruba	APIN0305	38.13	31.38	26.95	13.71	6.3
	Cisco	WAP300N	33.65	23.85	22	8.22	5.67
	TP-LINK	Archer C4000	34.98	28.94	24	12.54	6.84
802.11ax	Netgear	MR60 (Base station) MS60 (Satellite)	38.91	31.95	25.19	11.5	4.17
	Linksys	Atlas Max 6e (MX8500)	30.49	25.19	20.81	11.88	10.49
	Eero	Eero Pro 6E (S010001)	37.35	30.93	24.89	12.15	7.91
	Google	Nest Wifi Pro (G6ZUC)	36.92	31.34	25.9	12.82	8.39
	Technicolor	CGM4981COM (XB8-T)	33.68	26.47	21.53	9.74	5.74

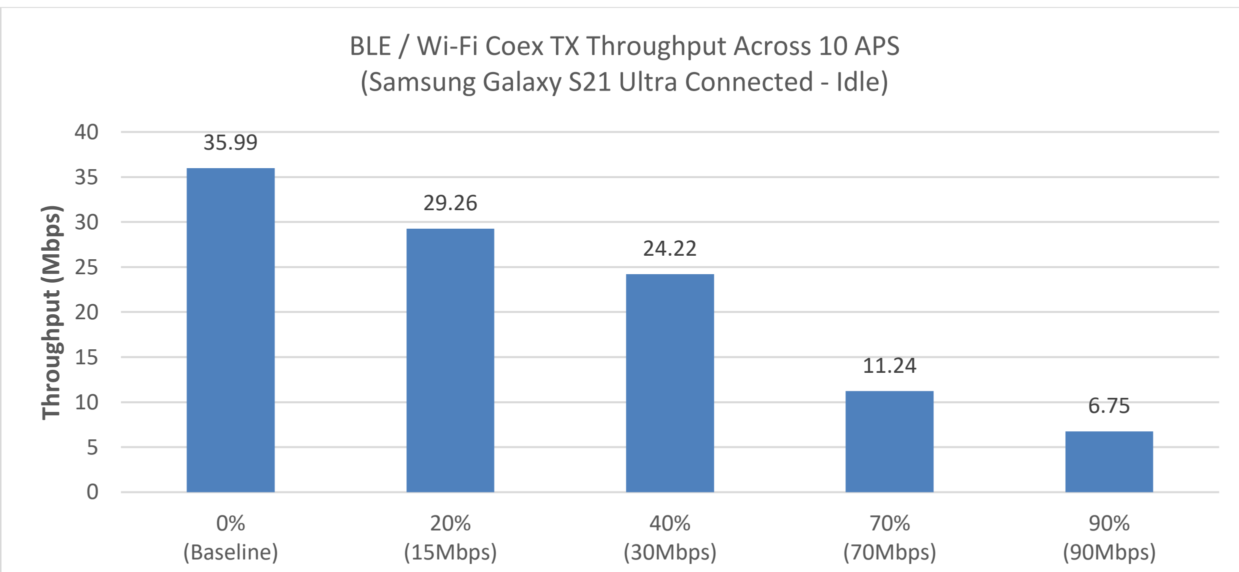


Figure 4 – BLE / Wi-Fi Coex Throughput

Appendix A IoT Battery Life Computation Under Congestion (100 APs)

Based on a study done by SiLabs, lower power consumption with an Always-ON AWS connection under congestion translates to longer battery life in the real-world. To quantify the impact on battery life we consider two scenarios. The first one is a Low-Congestion case of a single-family home with wireless traffic limited to single television and a few smartphones and laptops. The second one is a High-congestion case typical to multi-user dwellings like apartments or hotels – or enterprise environments like an office, retail space, etc.

Table of % Time in a typical Day seeing Channel Occupancy in the specified ranges:

Channel congestion	**<10%**	**10-30%**	**30-55%**	**55-80%**	**80-100%**
Low-Congestion (Single Family Home) %	85	10	2	2	1
High-Congestion (Apartments, Hotels and Offices) %	15	25	30	20	10

The table below summarizes the measured average power consumption of SiWx917 (uA @ 3.3V) with a secure and robust always ON 1-second latency wireless AWS connection and 55 second application keep-alive handshake:

Channel Congestion	**0%**	**20%**	**40%**	**70%**	**90%**
Measured Power Consumption (uA @ 3.3V) vs Channel congestion %	89.97	110.92	129.10	184.70	217.04

The average uA @ 3.3V for **Low-Congestion** traffic profile is computed from above two tables as:
89 * 0.85 + 110 * 0.10 + 129 * 0.02 + 184 * 0.02 + 217 * 0.01 = **95.08uA**

The average uA @ 3.3V for **High-Congestion** traffic profile is computed from above two tables as:
89 * 0.15 + 110 * 0.25 + 129 * 0.30 + 184 * 0.20 + 217 * 0.10 = **138.05uA**

Consider a Smart Lock with 4x Energizer Lithium AA cells providing 3000mAh @ 6V. The battery life of the Smart lock without Wi-Fi connectivity is 10 years => average power consumption of rest of the Smart lock electronics is 3000mAh/ (10*365*24h) = 34.2uA @ 6V. With addition of SiWx917 for secure, robust, always-ON AWS connectivity (1 second latency, 55 second application handshake) the above Smart Lock would have battery life computed as follows:

Low Congestion Environment:
SiWx917 consumes 95.08uA @ 3.3V => 58.10uA @ 6V (assuming 90% efficiency step down regulator from 6V down to 3.3V) => total current of Lock = 58.10uA + 34.2uA = 92.3uA. Battery life of Lock = 3000mAh /92.3uA = 32502hours = **3.71 years**

High Congestion Environment:
SiWx917 consumes 138.05uA @ 3.3V => 84.36uA @ 6V (assuming 90% efficiency step down regulator from 6V down to 3.3V) => total current of Lock = 84.36uA + 34.2uA = 118.56uA. Battery life of Lock = 3000mAh /114.3uA = 25303 hours = **2.88 years**

Appendix B IoT Battery Life Computation Under Congestion (TWT Enabled 10 APs)

A similar battery life computation can be done for TWT enabled APs:
The average uA @ 3.3V for **Low-Congestion** traffic profile is computed from above two tables as:
49 * 0.85 + 55 * 0.10 + 62 * 0.02 + 79 * 0.02 + 74 * 0.01 = **50.71uA**

The average uA @ 3.3V for **High-Congestion** traffic profile is computed from above two tables as:
49 * 0.15 + 55 * 0.25 + 62 * 0.30 + 79 * 0.20 + 74 * 0.10 = **62.9uA**

Low Congestion Environment:
SiWx917 consumes 50.71uA @ 3.3V => 30.98uA @ 6V (assuming 90% efficiency step down regulator from 6V down to 3.3V) => total current of Lock = 30.98uA + 34.2uA = 65.18uA. Battery life of Lock = 3000mAh /65.18uA = 46019hours = **5.25 years**

High Congestion Environment:
SiWx917 consumes 62.9uA @ 3.3V => 38.43uA @ 6V (assuming 90% efficiency step down regulator from 6V down to 3.3V) => total current of Lock = 34.83uA + 34.2uA = 72.63uA. Battery life of Lock = 3000mAh /72.63uA = 41300 hours = **4.71 years**

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