Wi-Fi Router Analytics in R7000 – beta test report

2018/10/9

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Feature Recap

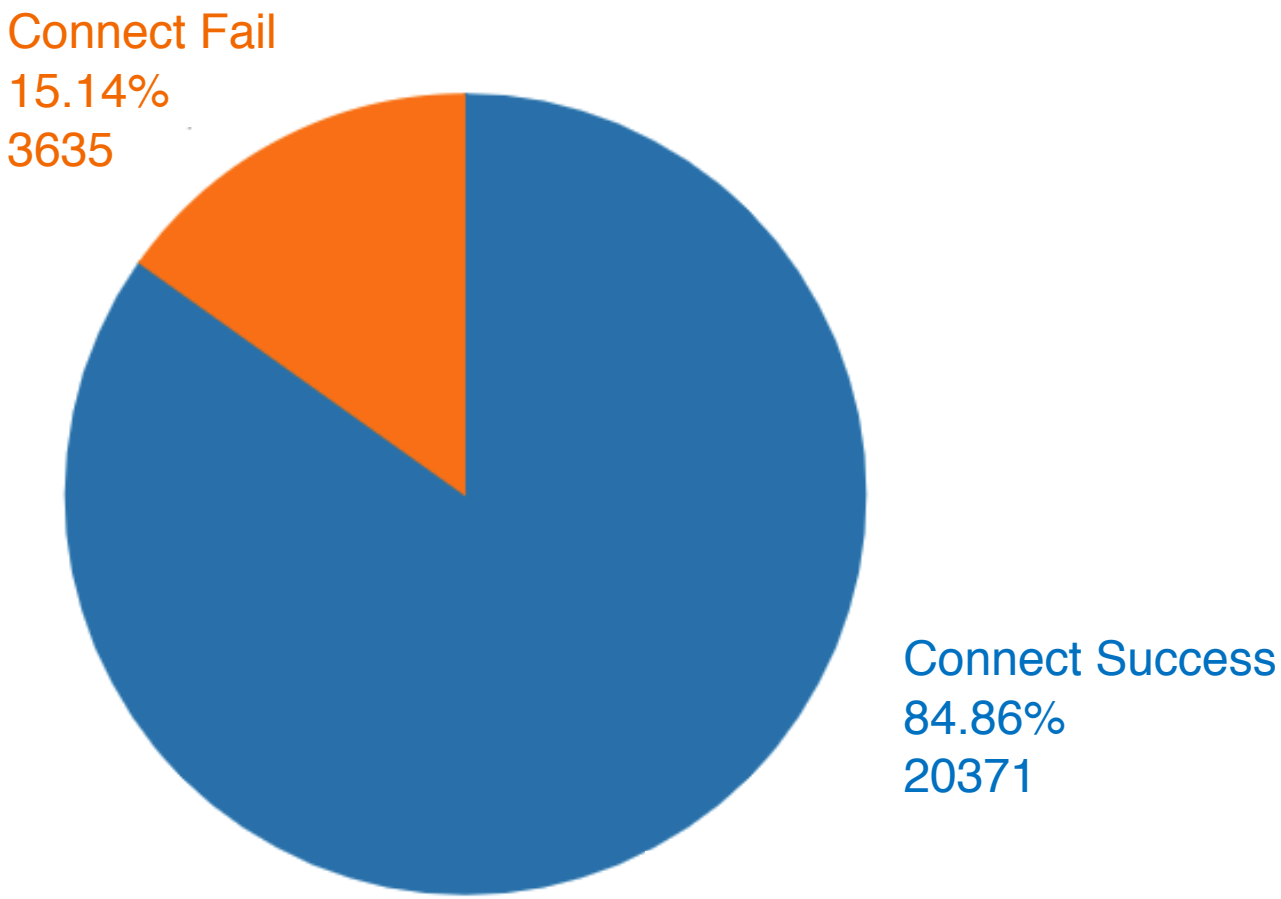
- Collect the wireless events happened between user's end devices and NETGEAR R7000.

- To be collected events include:
  - Connect success or failure
    - Including cases when Smart Connect is enabled (banding steering)
  - Disconnect by AP or Client

- Target
  - Overall statistics
  - Per device diagnosis

Overall Statistics

Connect Success & Fail Rate



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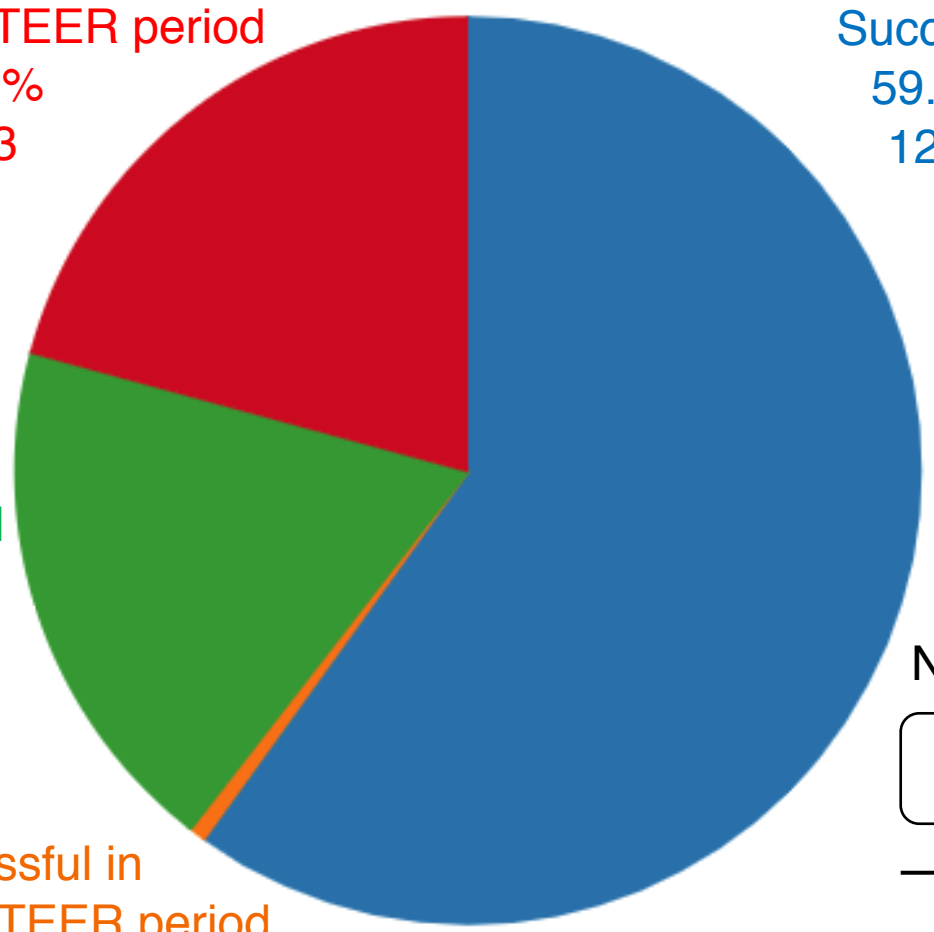
Success Reason Distribution



Note:

STEER Period → OPEN Period

Time

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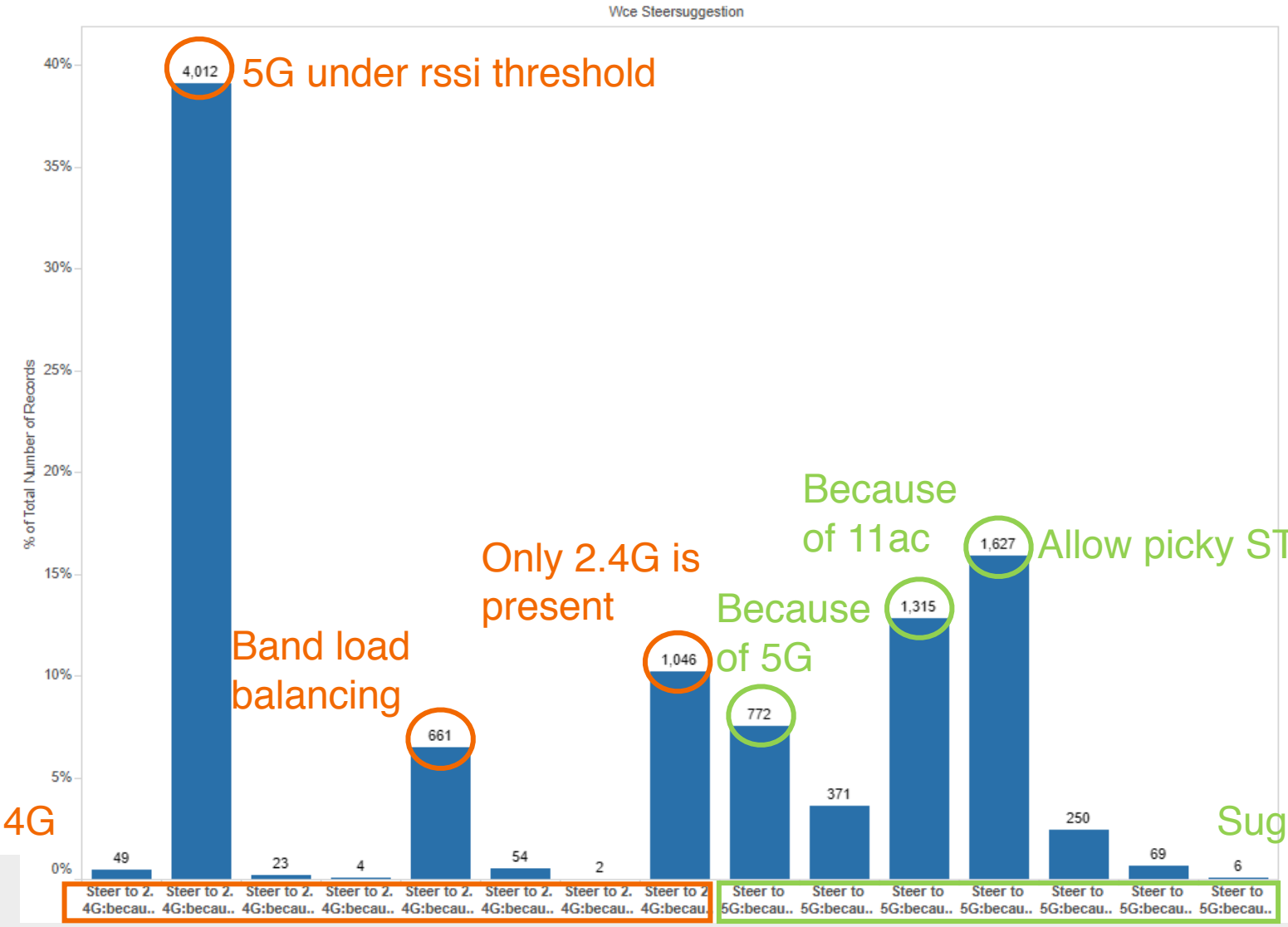
Steer Reason Distribution



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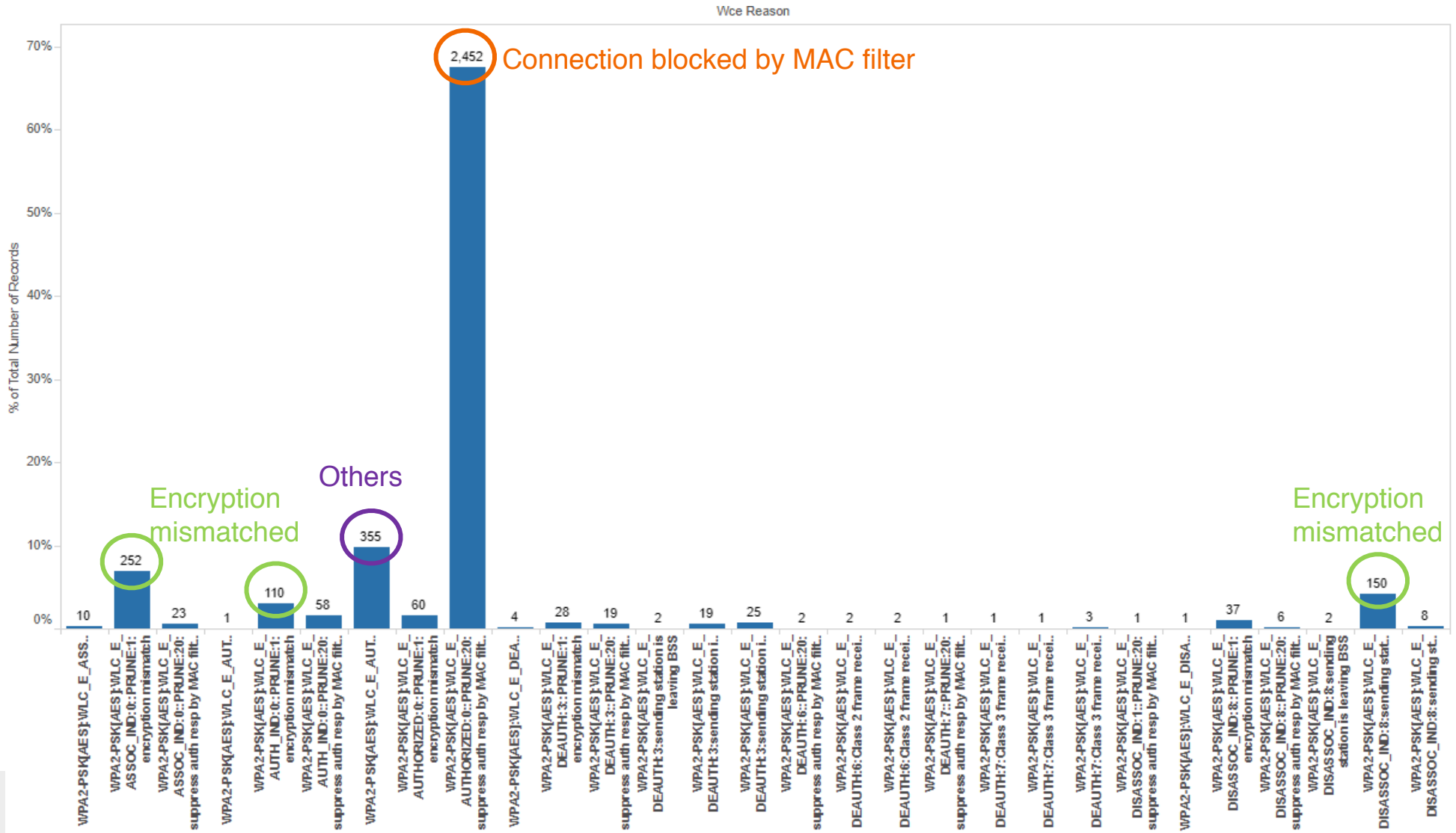
Connect Fail Reason Distribution



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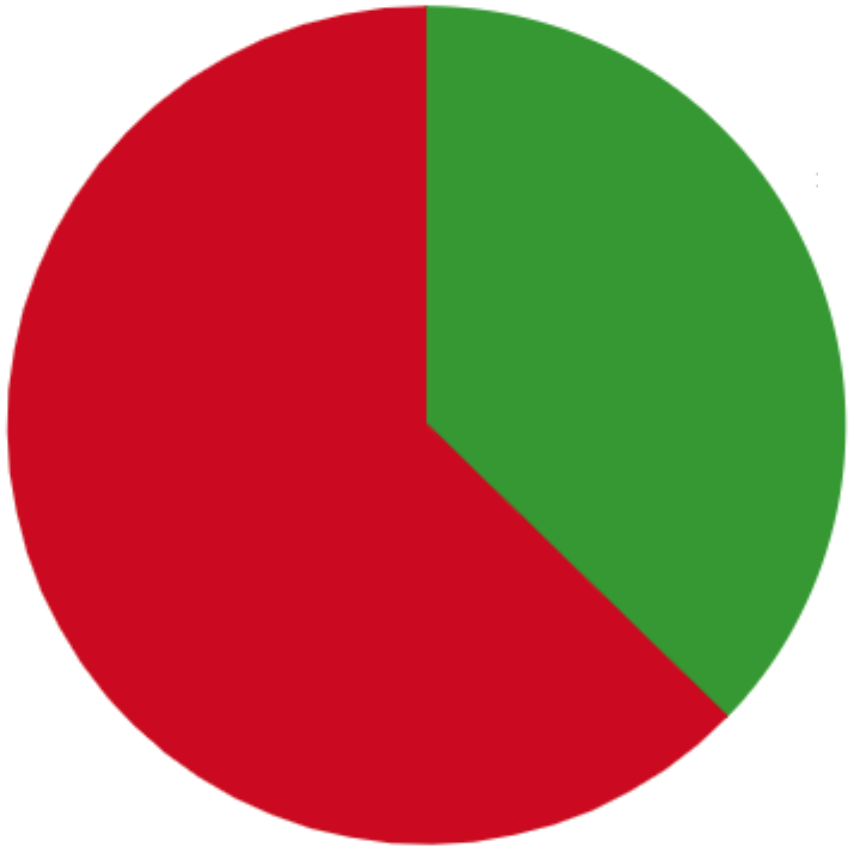
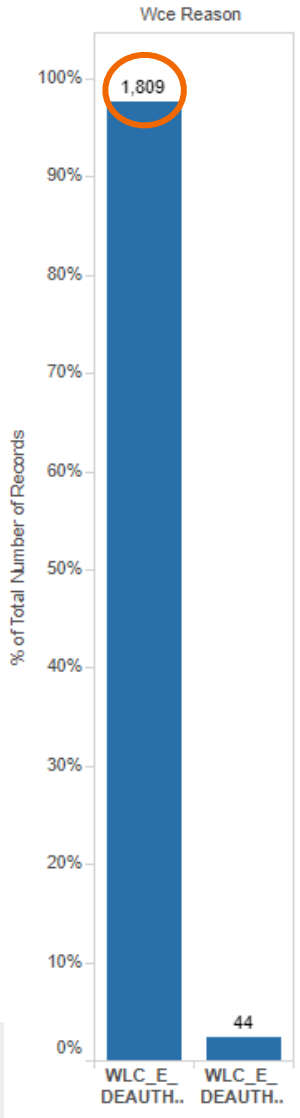
Disconnection Rate



Disconnected by Client
62.73%
3119

Disconnected by AP
37.27%
1853

Disconnected by AP Reason Distribution



Over 95% of disconnected by AP is due to client device was idle and timeouts

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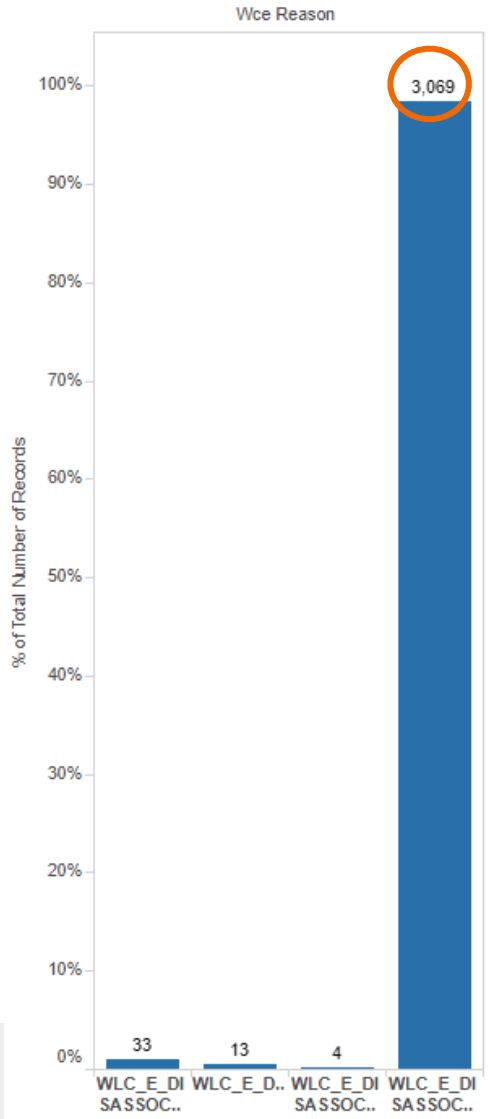
Disconnected by Client Reason Distribution



Over 95% of disconnected by Client is due to client device is leaving out of AP's range

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Abnormal case – connect fail

				Event Date							
Serialnumber	Wce Clientmac	Wce Devicen..	Wce Devicetype	9/3/2018	9/4/2018	9/7/2018	9/11/2018	9/12/2018	9/13/2018	9/14/2018	9/15/2018
3LK23B7202285	B0:34:95:98:0D:ED			58							
3LK4437HA2E44	20:EE:28:53:3F:3C									90	
	34:08:BC:36:97:CB							74	56	78	
4422497HA0D53	BC:A9:20:4C:0C:B6						72	104	60	84	50
4427617K75DF7	4C:34:88:59:D0:0D						72	130			
4451487KA05A5	B0:CA:68:83:34:65				73			116			
		iPhone-Phil	Apple Watch/iPad Pro				104				
44314876A0314	E4:9A:DC:7A:77:5F					70		130		88	

- Abnormal connect fail
  - Certain end device issue connect fail event over threshold times per day

- Device identification can only work once client device has ever connected success
  - Otherwise, we can only track by mac address

Abnormal case – disconnect by AP or by Client

- Disconnected by AP

				Event Date						
Serialnumber	Wce Clientmac	Wce Devicename	Wce Devicetype	9/9/2018	9/10/2018	9/11/2018	9/12/2018	9/13/2018	9/14/2018	9/15/2018
3LG1387H00062	40:B8:37:C9:14:D8	android-18a4ec4391b9f45c	Sony Xperia Z5						10	
3LK23B7202285	90:B9:31:B8:27:9B	Drses-iPad	Apple iPad Air					10		
	C8:3A:6B:A3:F1:48	Express	Roku Device			12				
3LK4437HA2E44	34:08:BC:36:97:CB	FranklinsiPhone				10				
	F8:77:B8:16:E3:F8						10		10	
4422497AA0982	08:3D:88:EE:F2:53	android-862467035b11836f	Samsung Galaxy S3					10		
4427577DA7312	54:4E:90:70:D5:D2	iPhone-di-Luca	Apple iPhone 6				16	12		
	78:4F:43:60:36:6A	MBP-di-Marco	Mac OS X			16				
	C8:E0:EB:DA:AB:F0	iPhone-di-Paola	Apple iPhone 5	15			10		56	28
4451487KA05A5	B0:CA:68:83:34:65	iPhone-Phil	Apple tWatch 2					16	10	
			Apple Watch/iPad Pro		14	10				
0000367300176	74:4A:A4:A2:A5:54	android-e13e15fc36fb7c41	Android 7.0					12		

- Disconnected by Client

				Event Date								
Serialnumber	Wce Clientmac	Wce Devicen..	Wce Devicetype	9/3/2018	9/4/2018	9/5/2018	9/9/2018	9/10/2018	9/11/2018	9/12/2018	9/13/2018	9/14/2018
3LK23B7202285	00:06:80:01:39:5F						39		68	38	30	57
3LK4437HA2E44	34:08:BC:36:97:CB									32		
44534C70A1A13	74:E1:B6:71:F8:74	iPad-Viruz	Apple iPad 2		70							
4422497GA3B06	B0:19:C6:6E:10:A7	iPhone-X		30	51	31						
4422497HA0D53	64:20:0C:3F:64:79							33				
4427637MA00BF	DC:68:EB:C2:E5:CC		Nintendo Switch								54	46

Case Study 1: BSI-008 (Disconnect by Client)

- Target
  - End device with mac address 64:20:0C:3F:64:79 (device name: iPhone-di-Mily, device type: Apple iPad 3)
- Symptom
  - It successfully connected to R7000 and disconnected from R7000 several times from 8/13 10:18 pm ~ 8/14 12:13 am.

8/13/2018 10:18:35 PM	1:Connect success	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:18:57 PM	4:Disconnet by client	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:23:54 PM	1:Connect success	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:24:08 PM	4:Disconnet by client	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:28:55 PM	1:Connect success	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:29:08 PM	4:Disconnet by client	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:33:55 PM	1:Connect success	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:34:08 PM	4:Disconnet by client	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:38:55 PM	1:Connect success	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:39:07 PM	4:Disconnet by client	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:43:55 PM	1:Connect success	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1
8/13/2018 10:44:08 PM	4:Disconnet by client	64:20:0C:3F:64:79	iPad-di-Mily	Apple iPad 3	1

- Feedback
  - Beta user replied that there's one wireless dead spot in his home, and frequently the device goes into that zone (his child). That iPad is early model and has a poor Wi-Fi reception respect other devices connected.
- Inference
  - User's feedback can explain the symptom. Tableau data validated after engaged with user.

Detail link: https://tableau-uat.netgear.com/authoring/Wi-FiRAchecking/3_AbDisByClientCaseStudy_1#1

Case Study 2: IR-028

1. **Alessio Provera** (IT)	1-2 times in the whole testing cycle	1. Apple MacBook Pro (Atheros 5416) 2. Both 2.4GHz and 5GHz	Reported as IR-028 (Sudden Wi-Fi disconnection)	1. Manually reconnected 2. Yes, LG G3 phone, Samsung Galaxy S3 Neo phone, Google Chromecast, LG 49SK8500 Smart TV, Raspberry Pi	[Tego] Verified - symptoms can be observed from Tableau: it looks like client sensed that AP signaling is weaken so sends disconnect by client.

Wce Begin Timestamp	Wce Steerreas..	Wce Eventtype	Wce Reason	Wce Device..	Wce Clientmac	
7/21/2018 11:48:56 AM	Pre-association	1:Connect success	0:Successful in OPEN peri..	macbookpro	00:1B:63:BF:89:5E	-43dbm
7/21/2018 2:52:00 PM		4:Disconnet by client	WLC_E_DISASSOC_IND:8:..	macbookpro	00:1B:63:BF:89:5E	-42dbm
7/21/2018 2:52:09 PM	Pre-association	1:Connect success	0:Successful in OPEN peri..	macbookpro	00:1B:63:BF:89:5E	-42dbm
7/22/2018 12:08:36 AM		3:Disconnet by ap	WLC_E_DEAUTH:4:Disass..	macbookpro	00:1B:63:BF:89:5E	
7/22/2018 9:06:33 AM	Pre-association	1:Connect success	0:Successful in OPEN peri..	macbookpro	00:1B:63:BF:89:5E	
7/22/2018 12:07:01 PM		4:Disconnet by client	WLC_E_DISASSOC_IND:8:..	macbookpro	00:1B:63:BF:89:5E	-40dbm
7/22/2018 12:38:04 PM	Pre-association	1:Connect success	0:Successful in OPEN peri..	macbookpro	00:1B:63:BF:89:5E	-40dbm
7/23/2018 2:13:18 AM		3:Disconnet by ap	WLC_E_DEAUTH:4:Disass..	macbookpro	00:1B:63:BF:89:5E	
7/23/2018 9:46:05 AM	Pre-association	1:Connect success	0:Successful in OPEN peri..	macbookpro	00:1B:63:BF:89:5E	

Case Study 3 – client with burst traffic

Serialnumber	Wce Clientmac	Wce Eventtype	Wce Reason	Wce Devicen..	Wce Devicet..	9/12/2018	9/13/2018	9/14/2018	9/15/2018
44255572A0..	D8:42:E2:0A:9F:8..	1:Connect success	0:Successful			1,402	1,170	784	385
44314876A0..	02:0F:B5:45:C1:9A	1:Connect success	0:Successful in OPEN period				336		
	34:C0:59:0D:86:41	1:Connect success	0:Successful in OPEN period	Aleasha-Ipad-2	Apple iPad 4			316	
		4:Disconnet by client	WLC_E_DISASSOC_IND:8:s..	Aleasha-Ipad-2	Apple iPad 4			490	

- Certain clients have burst traffic a day, e.g. issued more than 300 events a day.
- Overall statistics are adjusted by such extreme case.
- Topic can be further discussed with vendor from reason code or other information.

Per Device Diagnosis

Case study 4: IR-009

IR009

Wce Begin Timesta..	Wce Eventtype	Wce Steerreason	Wce Reason	Wce Connba..	Wce Clientmac	
7/16/2018 8:09:55 PM	1:Connect success	Pre-association	0:Successful in STEER period	5G:153/80	20:DF:B9:66:4F:BC	
7/16/2018 8:09:56 PM	1:Connect success	Pre-association	0:Successful in OPEN period	5G:153/80	20:DF:B9:20:E8:27	-66dbm
7/16/2018 8:10:01 PM	3:Disconnet by ap		WLC_E_DEAUTH:3:sending station is leaving BSS	5G:153/80	20:DF:B9:20:E8:27	-66dbm
					20:DF:B9:66:4F:BC	-55dbm
7/16/2018 8:10:14 PM	1:Connect success	Pre-association	0:Successful in STEER period	5G:153/80	20:DF:B9:66:4F:BC	-55dbm
7/16/2018 8:25:56 PM	3:Disconnet by ap		WLC_E_DEAUTH:7:Class 3 fr..	5G:153/80	20:DF:B9:20:E8:27	
7/16/2018 8:26:02 PM	1:Connect success	Pre-association	0:Successful in STEER period	5G:153/80	20:DF:B9:66:4F:BC	
7/16/2018 8:26:08 PM	3:Disconnet by ap		WLC_E_DEAUTH:3:sending s..	5G:153/80	20:DF:B9:66:4F:BC	-63dbm
7/16/2018 8:26:27 PM	1:Connect success	Pre-association	0:Successful in OPEN period	5G:153/80	20:DF:B9:20:E8:27	-52dbm
7/16/2018 8:57:29 PM	1:Connect success	Pre-association	0:Successful in OPEN period	5G:153/80	20:DF:B9:20:E8:27	-67dbm
7/16/2018 8:57:34 PM	3:Disconnet by ap		WLC_E_DEAUTH:3:sending station is leaving BSS	5G:153/80	20:DF:B9:20:E8:27	-64dbm
					20:DF:B9:66:4F:BC	-62dbm
7/16/2018 8:58:42 PM	3:Disconnet by ap		WLC_E_DEAUTH:3:sending s..	2.4G:8	20:DF:B9:20:E8:27	
7/16/2018 8:58:47 PM	3:Disconnet by ap		WLC_E_DEAUTH:7:Class 3 fr..	5G:153/80	20:DF:B9:66:4F:BC	
7/16/2018 8:59:02 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:20:E8:27	-43dbm
					20:DF:B9:66:4F:BC	-24dbm
7/16/2018 8:59:42 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:66:4F:BC	-25dbm
7/16/2018 8:59:47 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:20:E8:27	-44dbm
7/16/2018 9:00:24 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:66:4F:BC	-25dbm
7/16/2018 9:00:26 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:20:E8:27	-43dbm
7/16/2018 9:01:05 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:66:4F:BC	-29dbm
7/16/2018 9:01:10 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:20:E8:27	-43dbm
7/16/2018 9:01:34 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:66:4F:BC	-29dbm
7/16/2018 9:01:56 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:20:E8:27	-41dbm
7/16/2018 9:02:05 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:66:4F:BC	-28dbm
7/16/2018 9:02:41 PM	1:Connect success		0:Successful	2.4G:5	20:DF:B9:66:4F:BC	-29dbm

- Target
  - Google home mini (mac address 20:DF:B9:66:4F:BC)
- Symptom
  - Google home mini disconnects. Ring video doorbell disconnects. Ring chime for video doorbell won't find SSID when smart connect is enabled.
- Feedback
  - Google home mini suppose shall have good signaling as no obstruction in between.
- Analysis
  - 8 ~ 9 pm (smart connect enabled): link to 5G is unstable with 2 reasons:
    - WLC_E_DEAUTH:3:sending station is leaving BSS
    - WLC_E_DEAUTH:7:Class 3 frame received from nonauthenticated station
  - 9 ~ 10 pm (smart connect disabled): too frequent connect success happen on the two devices
    - Although user have power on/off few times, the times of success connected is still unusual.
  - This is the case TBD with BRCM

Detail link: https://tableau-uat.netgear.com/authoring/Wi-FiRAchecking/IR009_1#1

Daily overall traffic in S3 count of Wi-Fi RA

- High loading per day
  - Daily event size per R7000 = avg. event number x avg. event size x 3 (multiple by 3 as peak)

  ⇒ 126.35 x 0.79 KB x 3 = 299.45 KB
  - Daily event size for R7000 product = 299.45 KB x 400K = 119.78 GB
  - Event per second = (126.35/81) x 400K / 86400 = 7.22 (Less than 1000/sec limitation from IT)
  - Total data size increase per day = 119.78
  - Keep data in Hadoop for 30 days: 119.78 x 30 = 3.59 TB
- Average loading per day:
  - Daily event size per R7000 = avg. event number x avg. event size

  ⇒ 126.35 x 0.79 KB = 99.82 KB
  - Daily event size for R7000 product = 99.82 KB x 400K = 39.93 GB
  - Event per second = (126.35/81) x 400K / 86400 = 7.22 (Less than 1000/sec limitation from IT)
  - Total data size increase per day = 39.93
  - Keep data in Hadoop for 30 days: 39.93 x 30 = 1.20 TB

Wi-Fi RA aims to

- Metric of wireless connection quality
  - For each FW release, rate between connect success and fail and filter by FW version
- For future beta, this helps evaluate user's wireless environment more precisely.
- Cross reference statistics among NTGR models
  - Connect success, steer, fail, and disconnect reasons' distributions
  - Co-work further analysis with vendor
- Real time data collection for further debug/tracking with vendor

Wi-Fi RA analysis in Tableau:

1. Overall: https://tableau-uat.netgear.com/#/workbooks/1546/views
2. Case study: https://tableau-uat.netgear.com/#/workbooks/1586/views

Beta team report

Beta summary - Tego

- Follow up is separated into below categories:
  - To be clarified – in contact with user and awaits feedback
  - Verified - symptoms can be observed from Tableau
  - Verified – the CPU issue is confirmed fixed
    - RA daemon, aws_json, to issue unnecessary data fetch to cause CPU increase.
    - Forum discussion: CPU loading is normal from the observation in Tableau on users' R7000.
    - Fixed in firmware V1.0.10.10

- Category suggestion
  - Not wifi RA related (PE)
  - Wifi RA related
    - Feature cause system stability concern
    - CPU
    - Data accuracy
  - Wireless connectivity issue
    - Tableau check and share in the next report

Before going to the topic

- Data accuracy
  - Data not observed
    - Data were sent to prod due to NVRAM: RA_stage not removed. (Default = prod)
    - ⇒ Ask user to factory default to correct it
    - Data not being parsed correctly in cloud due to implementation of Snowflake wifiConnectEvent data source.
    - ⇒ Data resumed after beginning of August
  - Data not daily sent
    - RA daemon crashed due to incorrect behavior of file open and close.
    - ⇒ Fixed in firmware V1.0.10.14, and initiate RA testing in 14 days endurance test
      - RA daemon crashed again due to NTGR-defined link_down event
      - ⇒ Removed the implementation
  - UAT data missed
    - R6800 sent incorrect format of data to cause other platforms' data can be processed correctly
    - ⇒ Notify Sercomm to fix it and in discussion with IT on the detecting mechanism
    - Server outage from IT side
    - ⇒ Await IT to fix it.

Data Accuracy Percentage

0. BetaDeviceSN

Serialnumber	9/3/2018	9/4/2018	9/5/2018	9/6/2018	9/7/2018	9/8/2018	9/9/2018	9/10/2018	9/11/2018	9/12/2018	9/13/2018	9/14/2018	9/15/2018
						Event Date							
3LG1387B00040		7	8	6	1					2			
3LG1387H00062		15	21	22	7	42		18	40	2	42	36	25
3LK23B7202285	162	81	80	70		81	151	81	324	162	162	243	81
3LK4437HA2E44	81	25		81	18	81	51		72	194	162	324	162
44275B7CA57F5	7	6	6	16	14				24		6	7	
44534C7WA1670	19			26			47						
44534C70A1A13	12	162	48	10	20		26	13	32	30	12	26	22
4422497AA0982	11	14	12	17	14	17		16	162	162	70	38	18
4422497GA3B06	81	162	81										
4422497HA0D53						54		81	162	162	116	162	79
4422497L003F2			15	17	11					2	24	6	1
4427577DA7312		46			40	81	81		152	250	146	162	143
4427577RA731D	13	8	9	5	2	2	1		2	4	16	12	8
4427617K75DF7		3	12		5	5		1	172	162	24	16	1
4427637MA00BF	162	57	56	52	37	9	57	81	82	76	162	144	55
4427637TA03C9		77	40	86	23	81		7	2	12	14		3
4427677L71342	4			11		13		26	12	40	28	13	
4451487KA05A5	81	162	62	70	81	26		50	162	162	116	70	162
4453517JA0DB1								3	14	22	4		
44224978A415E	24	29	14	20	28	8	6	14	20	8	12	10	8
44255572A0806	567	648	324	1,296	1,053	567	1,134	1,053	1,620	1,539	1,296	891	405
44276373A030A									50	136	146	162	52
44314876A0314		51	81		405	162	243	162	486	648	810	1,620	486
44414870A0750		10	6										
44624976A027D		24	22		21				20		32		14
0000367300176	5	11		8	9	12		5	22	30	70	18	10

- Event Date
  - 9/3 ~ 9/15
- SN
  - 26 devises
- Last case by case verification (9/11)
- Data not observed
  - Solved
- Data not daily sent
  - Solved
- Data missed
  - Solved

Summarized of Data Accuracy Percentage:

96%

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