openreality
Value Added Wireless Distribution

Wi-Fi Survey - XXXX

FOR XXXXX

Survey Date: <<&12th July 2022

Wireless Engineer: Richard Shelford

bsi. ISO/IEC 27001 Information Security Management
IS 633662

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1.0 REPORTING REQUIREMENTS

The requirements for the network were based on the Requirement criteria for “Ekahau Best Practices” which are as below.

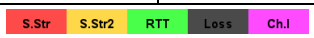
Coverage Requirement: **Ekahau Best Practices**		
2.4 GHz	Signal Strength Min	**-67.0 dBm**
	Signal-to-Noise Ratio Min	**20.0 dB**
	Data Rate Min	**24 Mbps**
	Channel Interference Max	**2 at min. -85.0 dBm**
	Round Trip Time (RTT) Max	**200 ms**
	Packet Loss Max	**0.0 %**
5 GHz	Signal Strength Min	**-67.0 dBm**
	Secondary Signal Strength Min	**-67.0 dBm**
	Signal-to-Noise Ratio Min	**25.0 dB**
	Data Rate Min	**24 Mbps**
	Channel Interference Max	**1 at min. -85.0 dBm**
	Round Trip Time (RTT) Max	**200 ms**
	Packet Loss Max	**0.0 %**

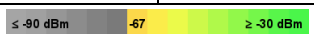
2.0 FINDING AND NOTES

2.1. Coverage Observations

Generally, the coverage inside of the building meets the minimum signal strength required. The external coverage in places fell below the minimum required signal strength. The areas where the signal strength failed to meet the minimum requirements can be seen in the Network issue reports where it is shown in red, this can also be seen in the signal strength reports where values below the minimum are shown in grey.

There are some areas that are covered only by a single access point, this can cause problems in the event of AP failure, these areas are indicated in yellow in the Network issues reports.

Network issues 2.4GHz Band	Network issues 5GHz Band
	
	

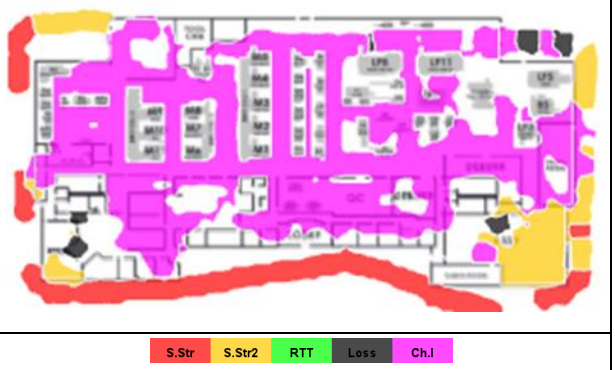
Signal Strength 2.4GHz Band	Signal Strength 5GHz Band
	
	

2.2. Antenna mounting and directions.

It was observed that several access points internally were using external directional antennas, some of which had these antennas aligned at odd angles, this odd alignment may result in the coverage being provided by the access point not being what was originally designed. The access point “MXXX001-0101AP0” is an example where the antenna appears to be mounted at unusual angle, others are mounted either horizontally or vertically.

2.3. Interference caused by poor channel usage.

In some places the number of access points on the same channel was seen to exceed the maximum limits. The Network issues reports indicate these areas in pink, and in the cross channel reports the actual numbers of access points are displayed.

Network issues 2.4GHz Band	Network issues 5GHz Band
	

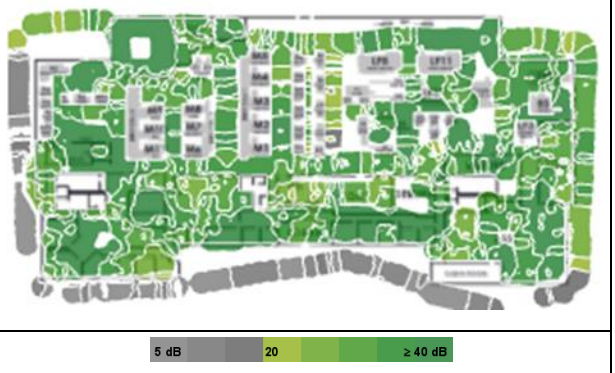
Cross Channel interference 2.4GHz Band	Cross Channel interference 5GHz Band
	
	

2.4. 3rd Party or Rouge Access Points

There were several 3rd party or rouge access points detected. Some of these based on their signal strengths appear to be located internally so require further investigation and actioning.

2.5. Spectrum analysis and Signal to Noise

Spectrum analysis did not identify any areas with high levels of interference caused by non 802.11 wireless devices. There is however in some areas where the noise level on the 2.4GHz band high which has resulted in a small area failing to meet the signal to noise requirements. This area can be seen on the 2.4GHz Network issue report where it is indicated in blue. This area is also only just failing to meet the minimum requirements.

Network issues 2.4GHz Band	Signal-to-noise 2.4GHz Band
	

2.6. Access point names

It was observed that the access points seemed to all be broadcasting as their names either “MXXX001-0102AP0” or “MXXX001-0101AP0”. This can make the cross reference between the controller and the actual access points more difficult. This is due to the way that Cisco broadcasts the AP name in beacons, the “additional Information Element” which contains the AP name is limited to 15 characters, which in this case results in the loss of uniqueness in the AP name being available to Ekahau.

3.0 RECOMMENDATIONS

3.1. Coverage Recommendations

If the external coverage failures are causing issues, then our recommendation would be that additional access points will be needed with directional antennas. Directional antennas should be used to contain the coverage as much as possible to the required areas. The locations of these access points and antennas are best selected by doing an APOS as this approach allows for the AP mounting requirements to be taken into consideration, cable runs etc as well as allowing for optional antenna selection.

In the areas where secondary coverage is a failure, I would recommend that a further survey was carried out after any additional access points were deployed and the misalignment of the external antennas were either corrected or confirmed as it is possible that the secondary coverage failures may be addressed by that work.

3.2. Antenna mounting and direction.

It would appear from a visual investigation of the antennas used that they are of a directional type, which are commonly used where the access point is mounted at a height to help to improve the performance by directing more of the RF energy towards the clients, you can think of a directional antenna to be like a flashlight beam of light in that it directs its light in a single direction and like a flashlight the RF coverage is also conical in shape when a directional antenna is used.

Generally, this type of antenna is mounted in the horizontal plane so that the beam is directed towards the floor as this way it provides the best signal to and from the clients. If these antennas are mounted in the vertical plane, then they will provide an increased coverage in a single direction but with the cost of reducing coverage in other directions. Additionally, the conical shape of the signal can result in poor coverage close to the access point as you may be in an area that is not provided with signal, the affected area is also influenced by the height of the antenna due to the conical shape of the antenna coverage, for this reason you normally either mount the antenna in a horizontal plane or carefully align the antenna to provide coverage in the required area if mounted in a non-horizontal manner.

A drawback of using a directional antenna to try and extend the coverage too far is that the client devices generally do not use a directional antenna for its transmissions and quite often coupled with having less power available as well, this results in poor performance in the direction of client to access point transmissions. For this reason, it is very common that these directional antennas, if mounted in the vertical plane, will have some down tilt applied to limit the coverage area.

You should also make sure that there is a clear a line of sight as possible to the client areas, you need to take into account the conical effect of the signal as the distance increases from the access point and make sure that that is a clear as possible, this is equally important for antennas in both horizontal and non-horizontal orientations, however generally the non-horizontal orientations are more susceptible to objects blocking the coverage, however horizontally mounted antennas can also be effected for example in areas of racking, tall machinery or other obstacles.

My recommendations would be to check the alignment of external antennas used on some access points and corrected as required. If the antennas are misaligned then they may be causing problems to other access points in that the coverage is extending beyond the original designed areas, which may help to alleviate some of the other problems for example the secondary AP coverage as well as the channel overlap.

You can see in the per ap reports the locations of each AP, signal coverage and photographs of the access point or antenna mounting assuming that they were visible.

3.3. Interference caused by poor channel usage.

One of the biggest causes of interference to wireless is other wireless activity on the same channel. As wireless is a shared medium only one device at a time can transmit, if there are multiple access points on the same channel covering the same area then devices need to wait for longer before they can transmit. The wireless controller will try and select the best channels to use, however there may need to have some assistance.

There are several ways that this type of interference can be reduced.

a) Reducing the number of access points (or turning off radios).
b) Reducing the power.
c) Changing the channels used or reducing the channel width used.
d) By moving the access points or antenna alignment.

If the first 2 methods are used, then this should be carried out with care as it may have a negative effect on the coverage. I would recommend that the work confirming the antenna alignment and the rouge access points was carried first and then looking at the channel usage here as that work may affect the RF environment sufficiently to allow the controller to address the channels used automatically.

3.4. 3rd Party or Rouge Access Points

Where these were detected as likely to be located internally, they should ideally be removed, as they could be seen as security risk if they are also connected to the wired network, as they may provide a simple and insecure route to the internal network, this is in addition to the RF pollution that they are creating. If they cannot be removed then their power, channel and channel widths should be adjusted if possible, to reduce the impact on the corporate wireless environment, in addition the network security of these devices should be verified that they are conforming to the corporate security requirements. The approximate location, coverage, channel, and other collected data for these access points can be seen in the rouge AP report section.

3.5. Spectrum analysis and Signal to Noise

The small area that has the signal to noise failure could be addressed in a few ways.

a) By increasing the signal strength, the measured strength would normally be considered acceptable however it may have affected by the pallets that were adjacent, resulting in a lower-than-normal signal, being recorded during the survey, thus resulting in a lower signal to noise ratio.
b) Remove the source of noise, this may not be easily achieved as it does not appear to have any of the common spectrum signatures to help identify it and as such may just random interference generated by machinery, looking at the spectrum else ware I can an increase in noise in the areas of machinery.
c) Use the 5GHz band instead, if available for the clients.

I would however expect that no remedial work is required as the area is quite small and the failure to meet the SNR requirements is only by a small margin, the actual user experience would be a slight reduction in perceived throughput.

3.6. Access point names

I would suggest that the controller and access were reconfigured so that the broadcast name for each access point was unique, however this may not be an easy remediation due to this being a multi-site environment.

3.7. Suggested order of remediation

I would suggest that remediation order would be.

1) The removal of the rouge access points.
2) The antenna alignment and the AP naming if possible
3) I would then check the channel overlap as removal of the rouge APs and the antenna alignment may have improved this due to the improved RF environment.
4) Addressing any areas with poor coverage and those being served by a single access point, for these areas as it is most likely that additional access points would be required, I would suggest following the APOS method as at the same time the physical install requirements can be verified.

4.0 ACTIVE SURVEY RESULTS

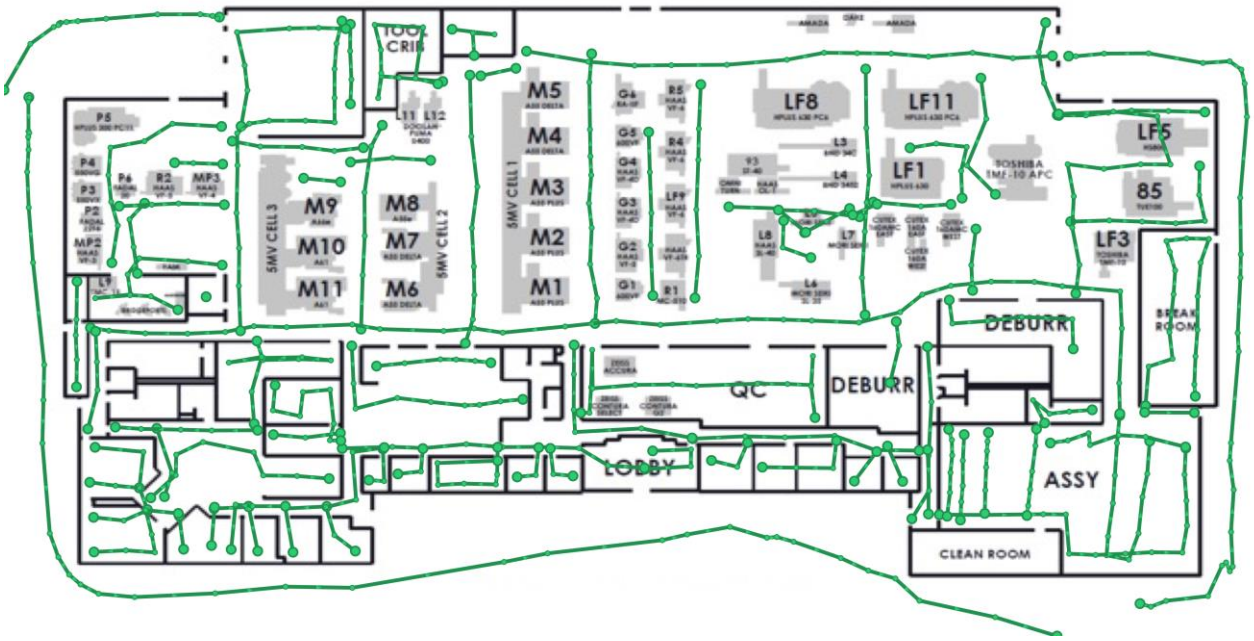
An active survey was performed onsite using the Ekahau Sidekick which discovers all sources of network radio frequency as well as spectrum analysis from non-network devices which may cause interference The noise is considered when creating the predictive model as it was sampled during the survey.

4.1. Ground Floor

4.1.1 Access Point Locations and Path

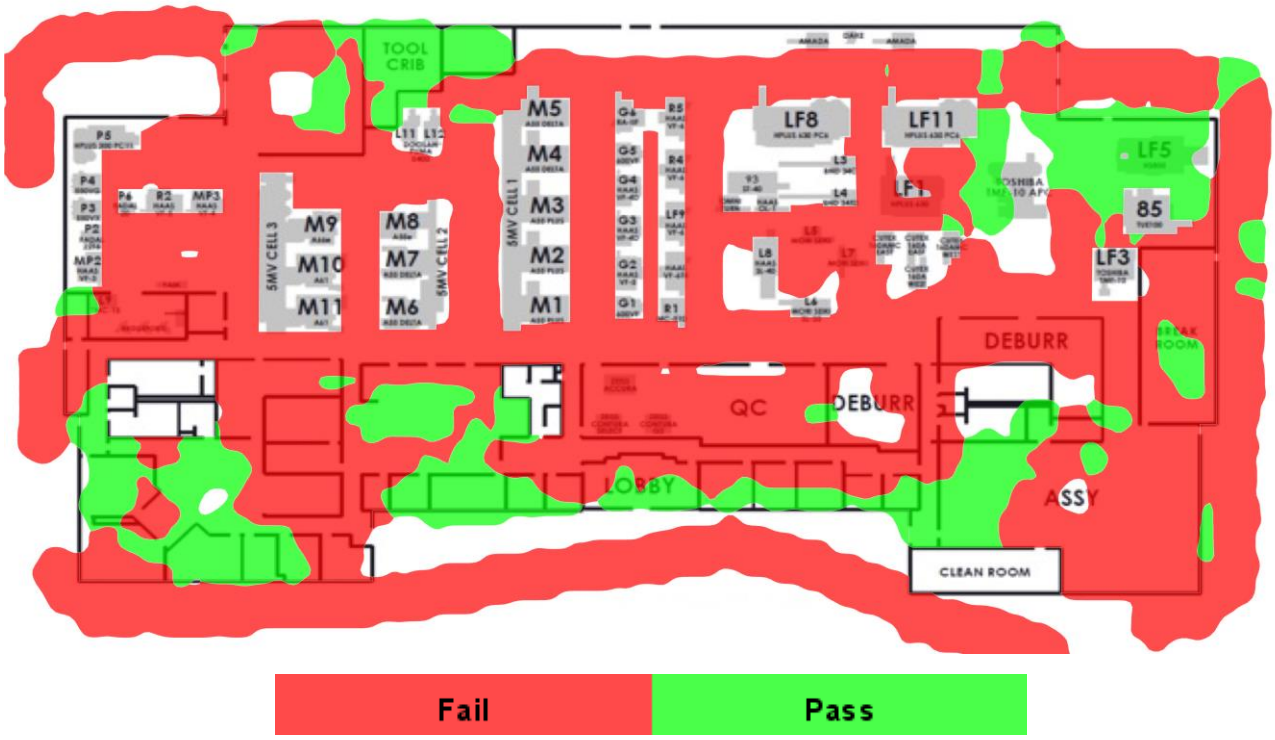
The identified or estimated locations of the existing access points.

The survey path that the engineer took is below.



4.1.2 Network Heath 5GHz Band

This report shows at a high level where the wireless network meets or does not meet the required standards. Later reports show the actual problems.

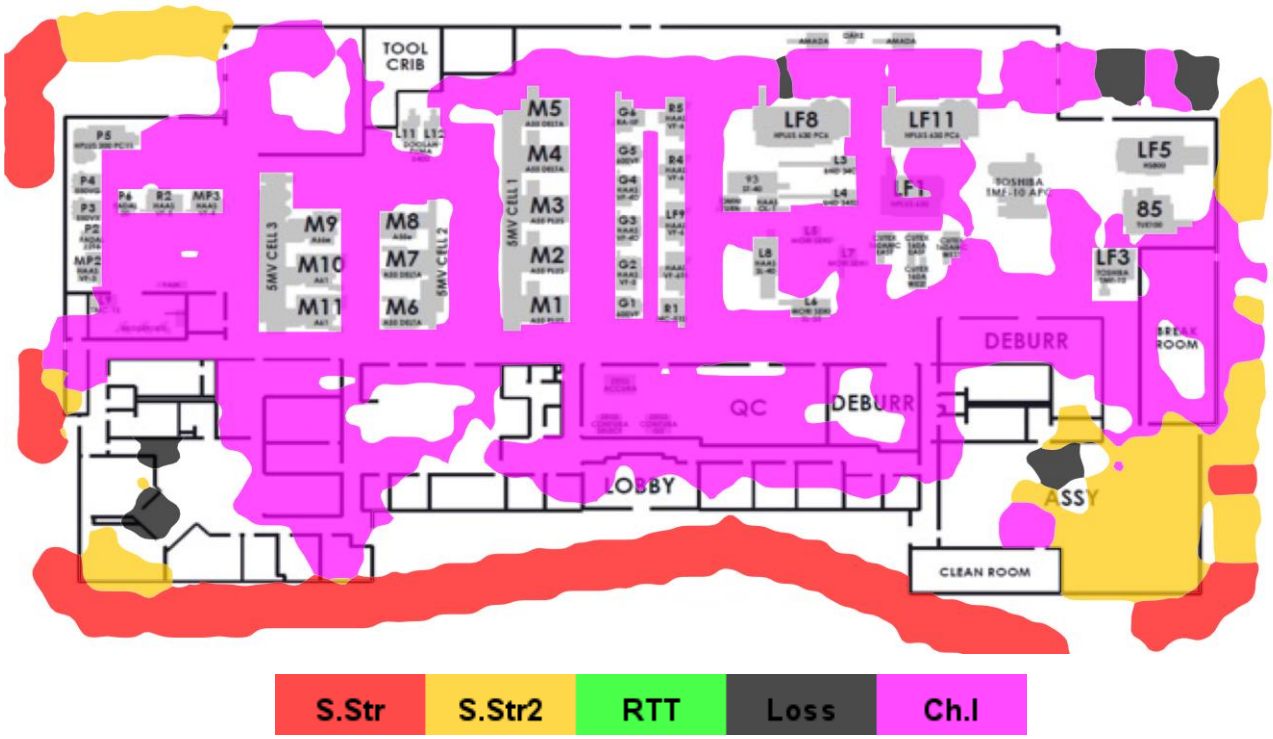


4.1.3 Network Health 2.4GHz Band.

This report shows at a high level where the wireless network meets or does not meet the required standards. Later reports show the actual problems.

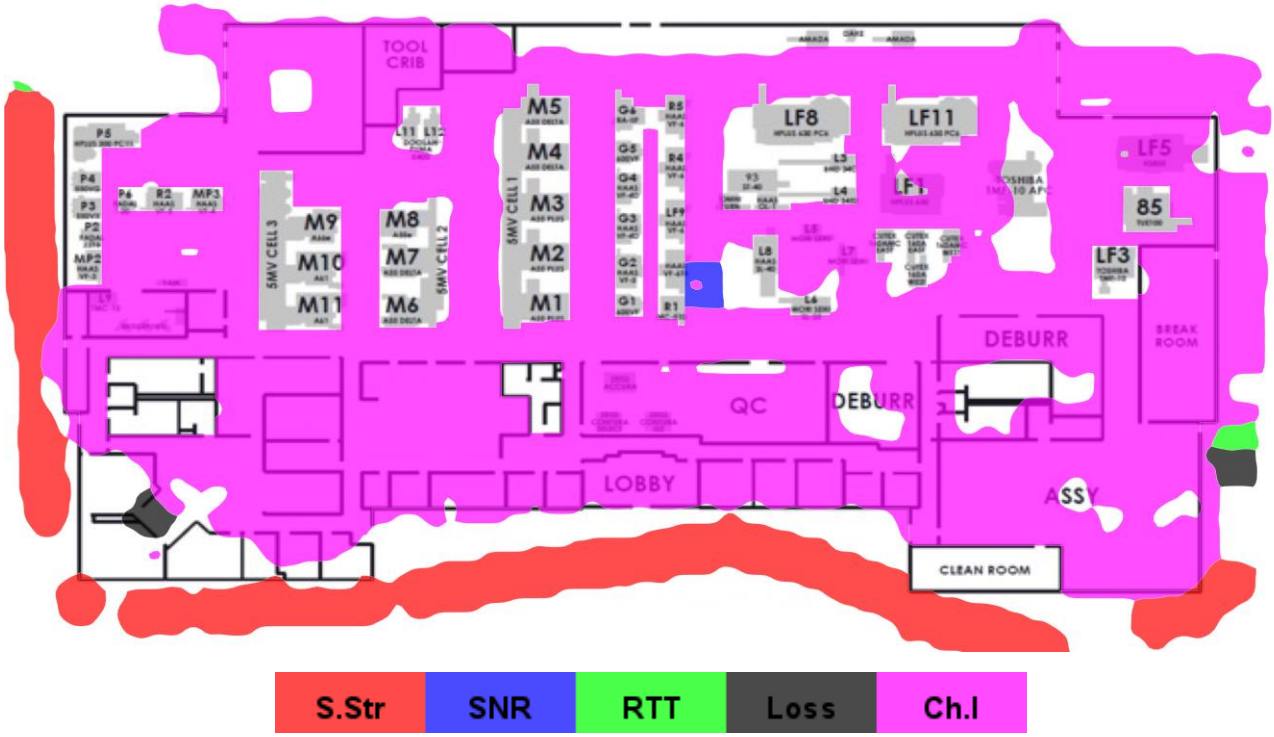
4.1.4 Network issues 5GHz Band

This report drills down into the network issues report showing where and what the failures are.



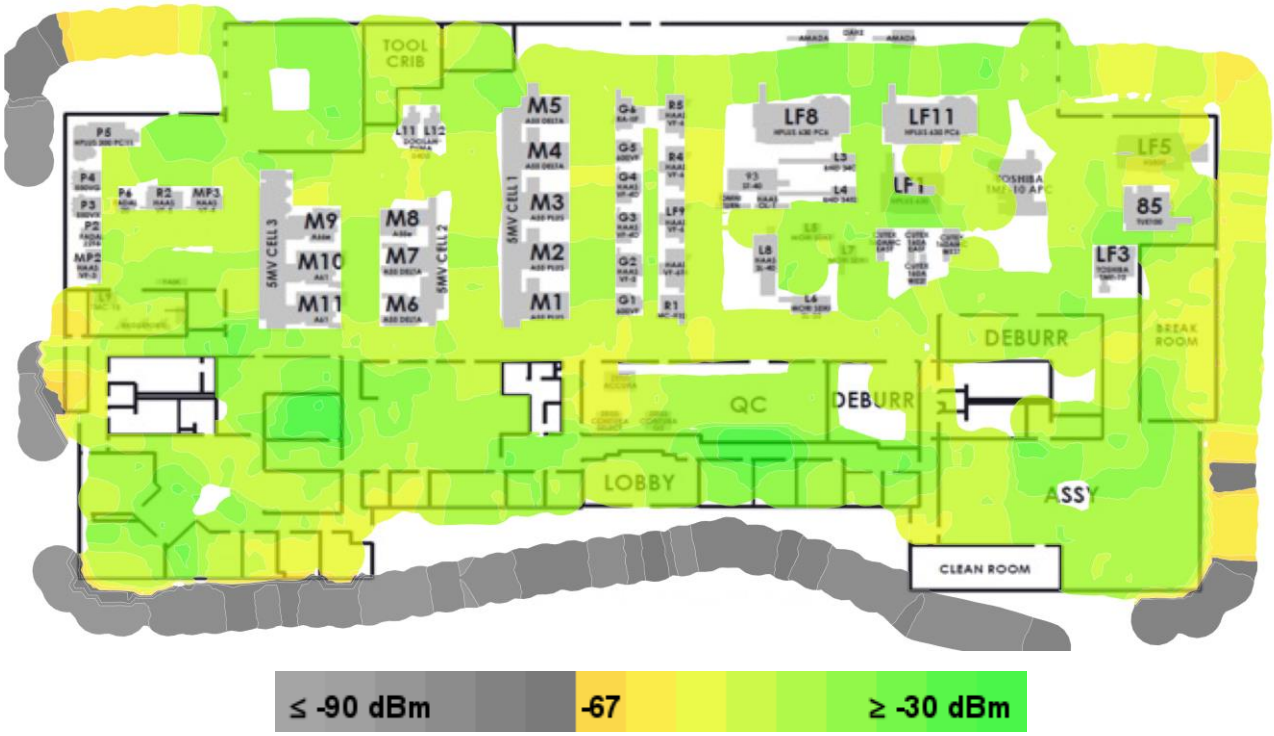
4.1.5 Network issues 2.4GHz Band

This report drills down into the network issues report showing where and what the failures are.



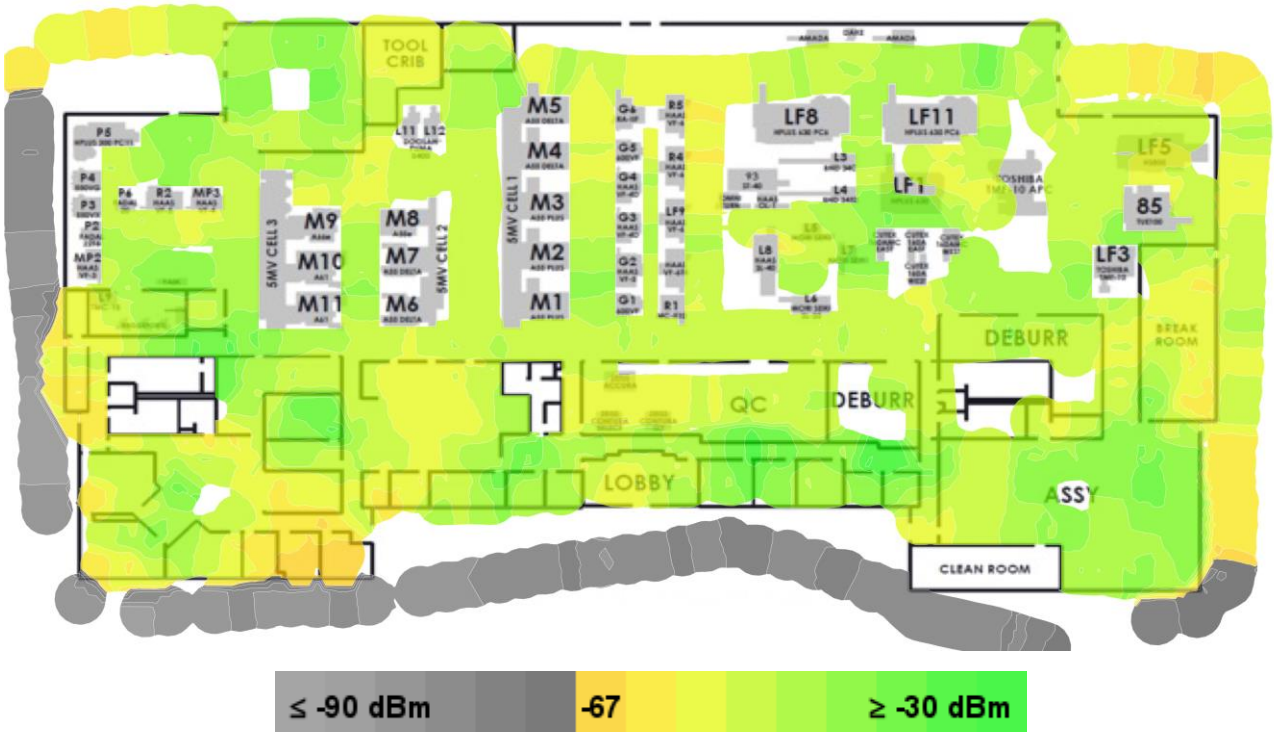
4.1.6 Signal Strength 5GHz Band

Signal Strength indicates the measured radio frequency energy. A strong signal is required to provide a reliable network connection.



4.1.7 Signal Strength 2.4GHz

Signal Strength indicates the measured radio frequency energy. A strong signal is required to provide a reliable network connection.

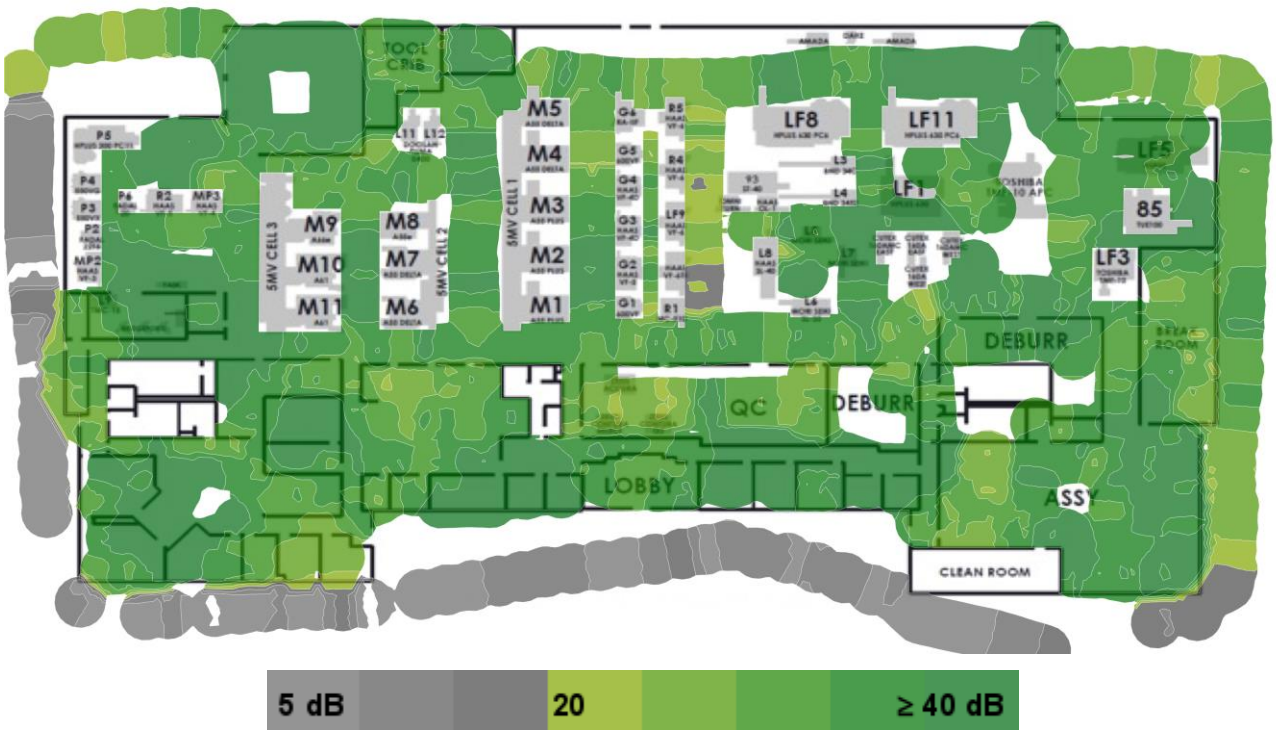


4.1.8 Signal-to-Noise Ratio 5GHz

Signal to Noise indicates the difference between signal and the noise. The larger the difference between the wanted signal to the unwanted noise the better.

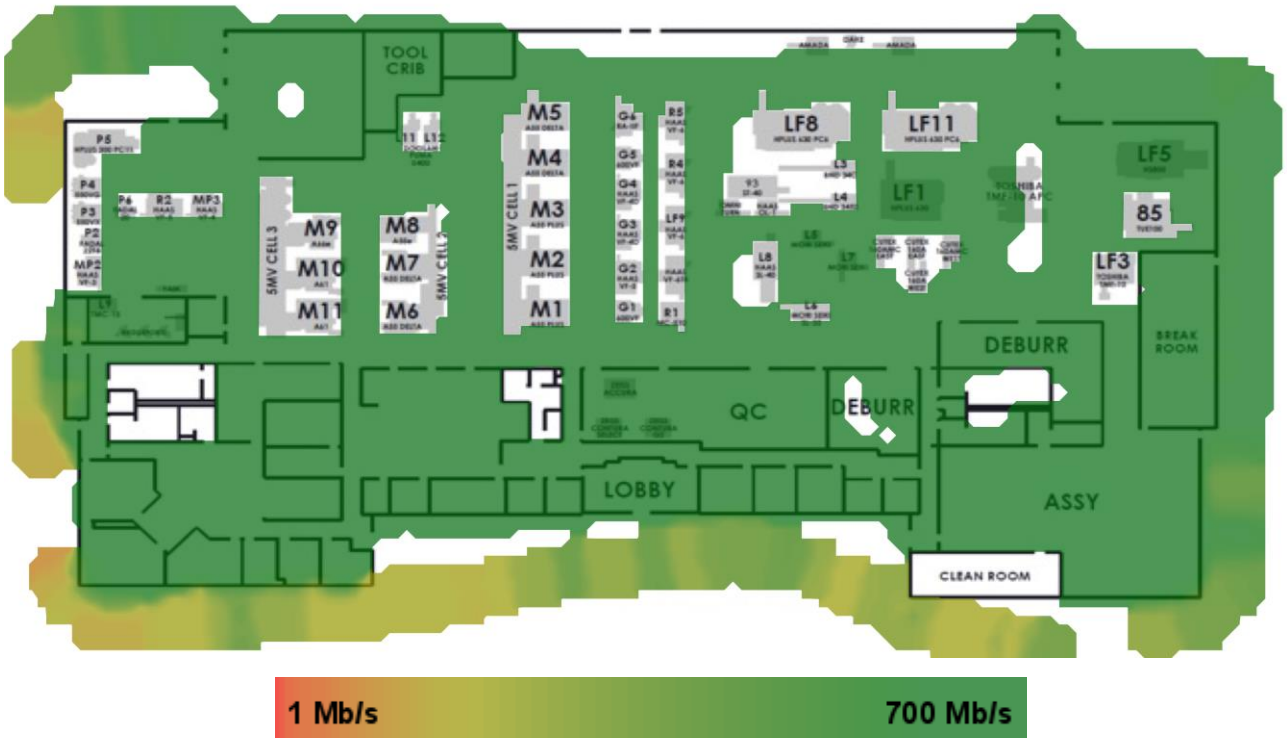
4.1.9 Signal-to-Noise Ratio 2.4GHz

Signal to Noise indicates the difference between signal and the noise. The larger the difference between the wanted signal to the unwanted noise the better.



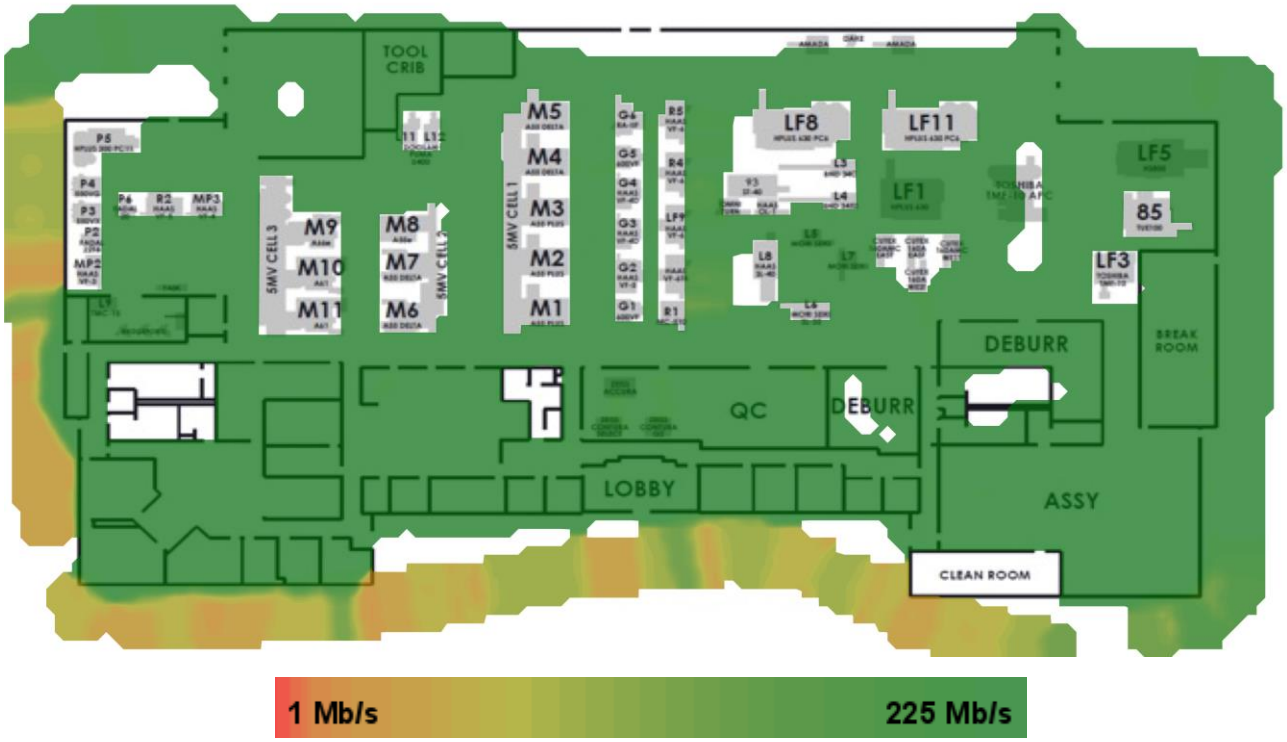
4.1.10 Predicted Data Rate 5GHz

Data rate indicates the available data rate to the client. As wireless is a shared medium, the actual data rate to the client will be affected by the number of devices currently connected to the access point and the transmitted and received data, it also depends on the actual client's capability.



4.1.11 Predicted Data Rate 2.4GHz

Data rate indicates the available data rate to the client. As wireless is a shared medium, the actual data rate to the client will be affected by the number of devices currently connected to the access point and the transmitted and received data, it also depends on the actual client's capability.



4.1.12 Cross-Channel interference 5GHz

Interference occurs when access points utilise the same or overlapping channels within the same proximity of each other. The number of channels available to use on the 5GHz band depends on the channel width as well.

4.1.13 Cross-Channel interference 2.4GHz

Interference occurs when access points utilise the same or overlapping channels within the same proximity pf each other. The 2.4 GHz band has only 3 non-overlapping channels and so therefore is not optimally suited for dense AP deployments.

4.1.14 Spectrum Channel Power 5GHz

Spectrum Channel Power shows the average RF energy measured at each location, it includes both 802.11 Wi-Fi and other RF sources in the same band.

4.1.15 Spectrum Channel Power 2.4GHz

Spectrum Channel Power shows the average RF energy measured at each location, it includes both 802.11 Wi-Fi and other RF sources in the same band.

4.1.16 Channel width 5GHz MY access points

This report shows the current channel width being used for access points that are transmitting one of the corporate SSIDs

4.1.17 Channel width 2.4 GHz MY access points

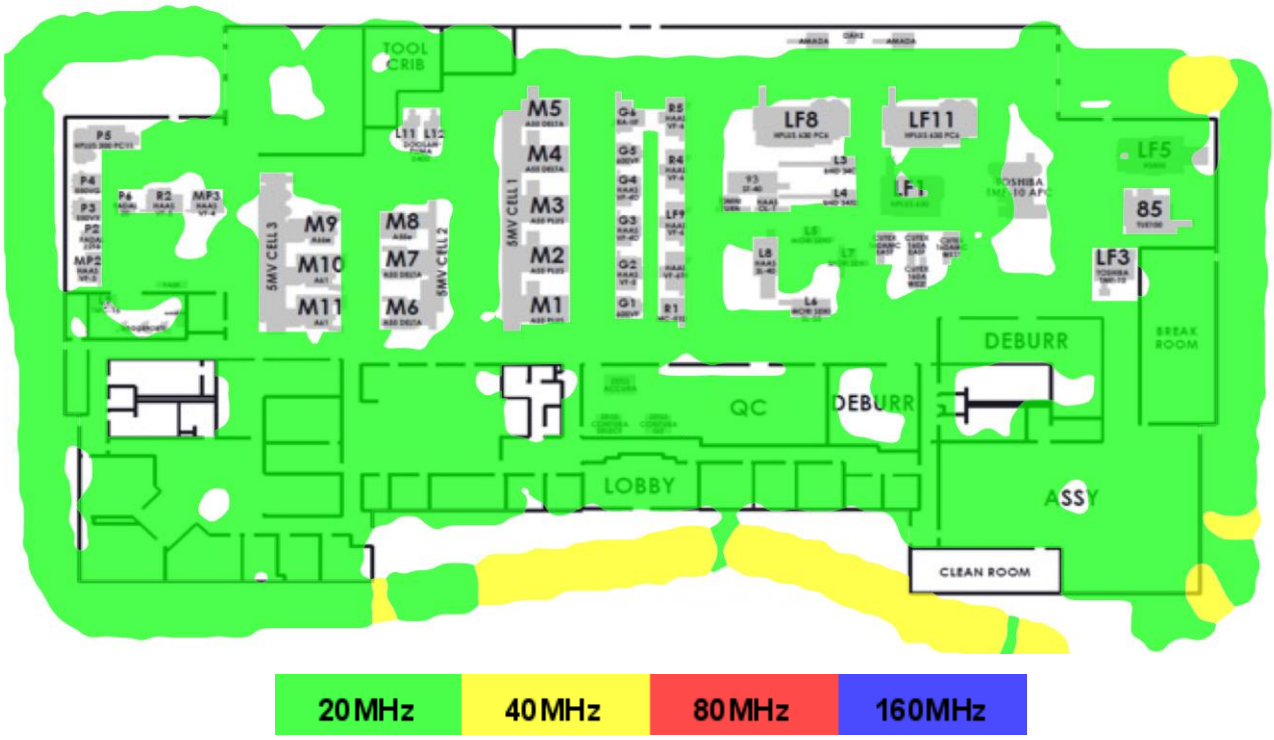
This report shows the current channel width being used for access points that are transmitting one of the corporate SSIDs

4.1.18 Channel width 5GHz other access points

This report shows the current channel width being used for access points that are not transmitting any of the corporate SSIDs.

4.1.19 Channel width 2.4GHz other access points

This report shows the current channel width being used for access points that are not transmitting any of the corporate SSIDs.



4.1.21 AP Notes and Pictures

A per AP inventory of the detected access points with their name, location, picture if available and any notes.

The SSIDs and channels of operation were valid at the time of survey.

4.1.22 MXXX001-0101AP0

AP name :-MXXX001-0101AP0 (if broadcast) AP Vendor :- Cisco (if detected)		
2.4GHz Band Channel :- 6 Transmit Power :- N/A		
Technology	SSID	
802.11n 802.11n 802.11n 802.11n 802.11g 802.11n	xxxxx2 XXXOFF0003 GuestWiFi xxxxx DMZ DMZ	
5GHz Band Channel :- 144@40 Transmit Power :- N/A		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	DMZ xxxxx GuestWiFi XXXOFF0003 XXXOFF0005 XXXil_voice xxxxx2	
		

4.1.23 MXXX001-0101AP0

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802.11n
802.11n
802.11n</td><td>GuestWiFi
xxxxx
XXXOFF0003
DMZ
xxxxx2</td><td>  </td></tr>
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802.11ac
802.11ac
802.11ac
802.11ac
802.11ac</td><td>xxxxx2
XXXOFF0005
XXXil_voice
GuestWiFi
XXXOFF0003
xxxxx
DMZ</td><td>  </td></tr>
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4.1.24 MXXX001-0101AP0

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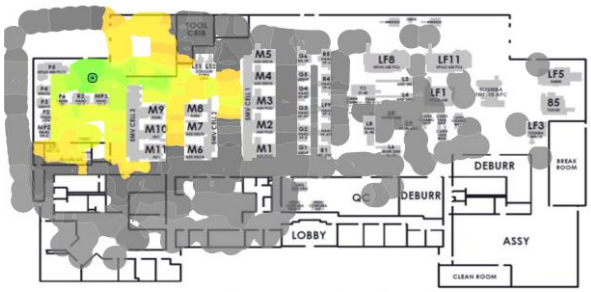
DMZ
XXXOFF0003
xxxxx2</td><td> 
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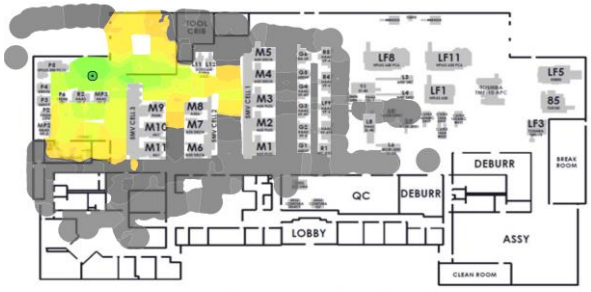
xxxxx
XXXOFF0003
DMZ
XXXil_voice</td><td> 
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4.1.25 MXXX001-0101AP0

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XXXOFF0003
GuestWiFi
xxxxx
DMZ</td><td>  </td></tr>
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GuestWiFi
XXXil_voice
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xxxxx2</td><td>  </td></tr>
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4.1.26 MXXX001-0101AP0

AP name :-MXXX001-0101AP0 (if broadcast) AP Vendor :- Cisco (if detected)		
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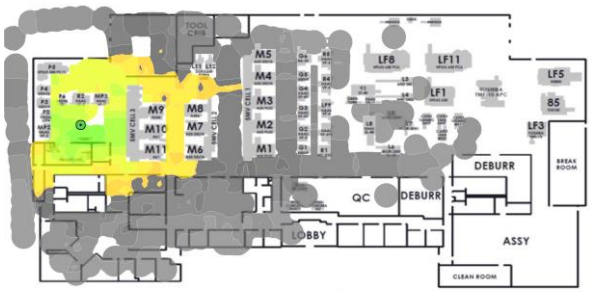
802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n	xxxxx GuestWiFi xxxxx2 xxxxx2 XXXOFF0003 DMZ xxxxx XXXOFF0003 DMZ GuestWiFi	
5GHz Band Channel :- 36@40 Transmit Power :- N/A		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	XXXOFF0003 XXXil_voice DMZ GuestWiFi xxxxx2 XXXOFF0005 xxxxx	
		

4.1.27 MXXX001-0101AP0

AP name :-MXXX001-0101AP0 (if broadcast) AP Vendor :- Cisco (if detected)		
2.4GHz Band Channel :- 11 Transmit Power :- N/A		
Technology	SSID	
802.11n 802.11n 802.11n 802.11n 802.11n	XXXOFF0003 DMZ GuestWiFi xxxxx xxxxx2	
5GHz Band Channel :- 100@40 Transmit Power :- N/A		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	xxxxx2 GuestWiFi xxxxx XXXOFF0005 XXXOFF0003 XXXil_voice DMZ	
		

4.1.28 MXXX001-0101AP0

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802.11n</td><td>xxxxx2
XXXOFF0003
DMZ
xxxxx
GuestWiFi</td><td> 
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GuestWiFi
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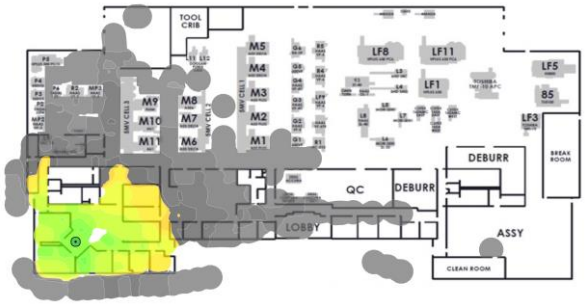
XXXOFF0005
XXXil_voice
xxxxx2</td><td> 
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802.11n
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802.11n
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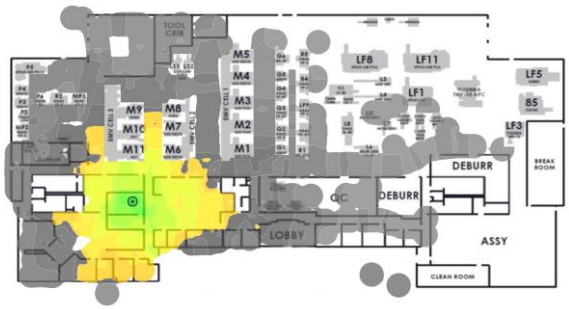
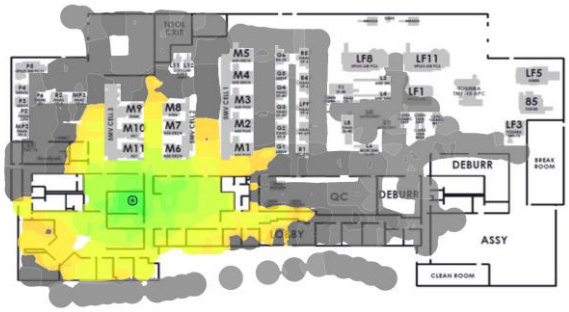
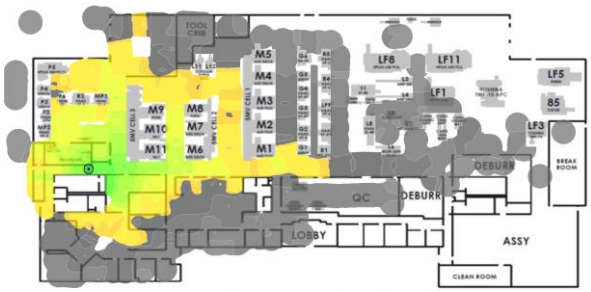
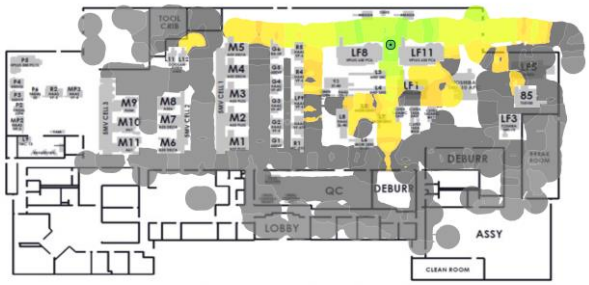
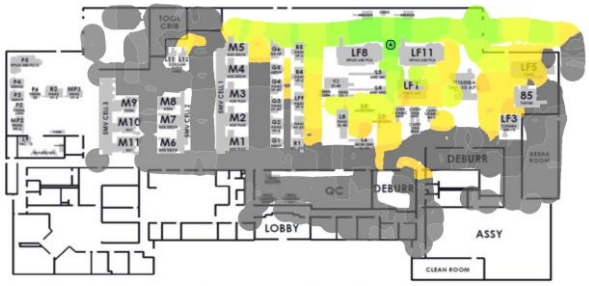
xxxxx2
DMZ
xxxxx
GuestWiFi
GuestWiFi
xxxxx2
xxxxx
XXXOFF0003
DMZ</td><td>  </td></tr>
<tr><td colspan="3">5GHz Band Channel :- 157@40 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac</td><td>DMZ
GuestWiFi
xxxxx
XXXOFF0005
XXXil_voice
XXXOFF0003
xxxxx2</td><td>  </td></tr>
<tr><td colspan="2">  </td><td></td></tr>
</table>

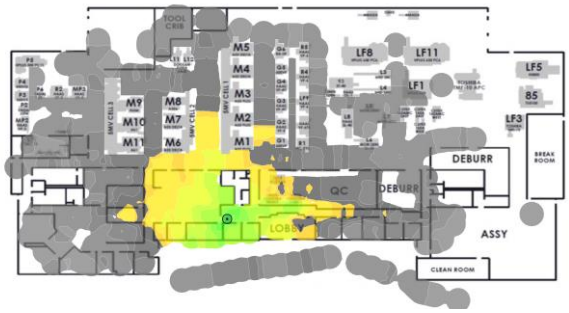
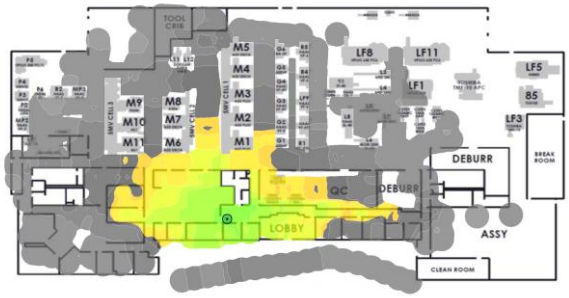
4.1.30 MXXX001-0101AP0

AP name :-MXXX001-0101AP0 (if broadcast) AP Vendor :- Cisco (if detected)		
2.4GHz Band Channel :- 1 Transmit Power :- N/A		
Technology	SSID	
802.11n 802.11n 802.11n 802.11n 802.11n	xxxxx GuestWiFi xxxxx2 XXXOFF0003 DMZ	
5GHz Band Channel :- 136@40 Transmit Power :- N/A		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	DMZ xxxxx GuestWiFi XXXOFF0003 XXXOFF0005 XXXil_voice xxxxx2	
		

4.1.31 MXXX001-0102AP0

AP name :-MXXX001-0102AP0 (if broadcast) AP Vendor :- Cisco (if detected)		
2.4GHz Band Channel :- 11 Transmit Power :- N/A		
Technology	SSID	
802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n	xxxxx DMZ GuestWiFi xxxxx2 GuestWiFi xxxxx XXXOFF0003 DMZ xxxxx2 XXXOFF0003	
5GHz Band Channel :- 149@40 Transmit Power :- N/A		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	xxxxx2 XXXil_voice DMZ XXXOFF0003 XXXOFF0005 xxxxx GuestWiFi	
		

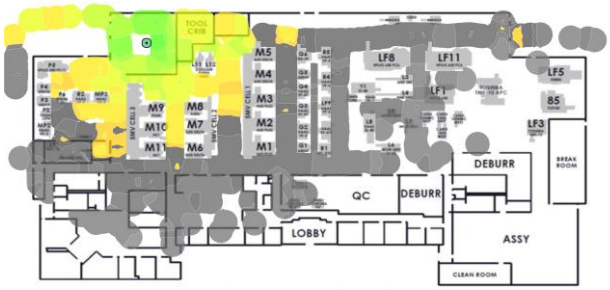
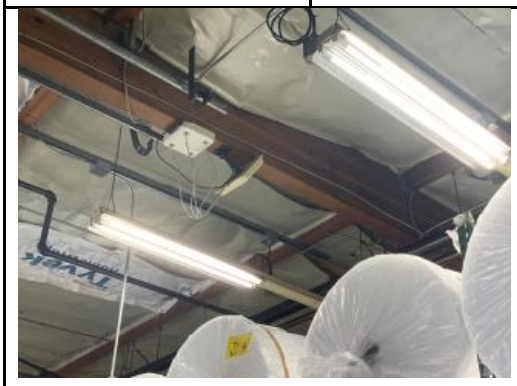
4.1.32 MXXX001-0102AP0

<table>
<tr><td colspan="3">AP name :-MXXX001-0102AP0 (if broadcast) AP Vendor :- Cisco (if detected)</td></tr>
<tr><td colspan="3">2.4GHz Band Channel :- 11 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11n
802.11n
802.11n
802.11n
802.11n</td><td>DMZ
GuestWiFi
xxxxx
XXXOFF0003
xxxxx2</td><td>  </td></tr>
<tr><td colspan="3">5GHz Band Channel :- 56@40 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac</td><td>XXXOFF0005
XXXil_voice
xxxxx2
xxxxx
GuestWiFi
DMZ
XXXOFF0003</td><td>  </td></tr>
<tr><td colspan="2"></td><td>AP not visible</td></tr>
</table>

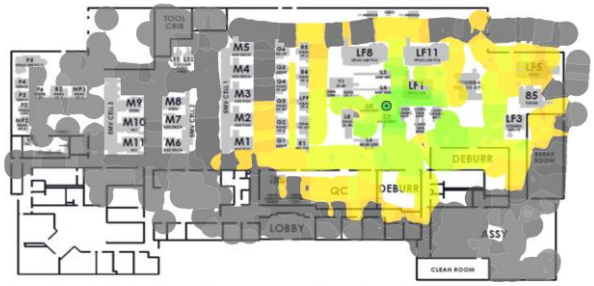
4.1.33 MXXX001-0102AP0

<table>
<tr><td colspan="3">AP name :-MXXX001-0102AP0 (if broadcast) AP Vendor :- Cisco (if detected)</td></tr>
<tr><td colspan="3">2.4GHz Band Channel :- 1 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11n
802.11n
802.11n
802.11n
802.11n</td><td>XXXOFF0003
DMZ
GuestWiFi
xxxxx2
xxxxx</td><td>  </td></tr>
<tr><td colspan="3">5GHz Band Channel :- 116@40 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac</td><td>XXXil_voice
XXXOFF0003
DMZ
xxxxx
XXXOFF0005
xxxxx2
GuestWiFi</td><td>  </td></tr>
<tr><td colspan="2">  </td><td></td></tr>
</table>

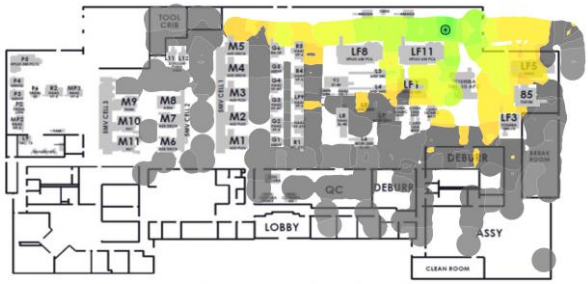
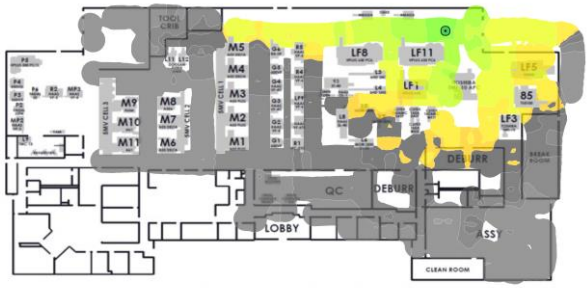
4.1.34 MXXX001-0102AP0

AP name :-MXXX001-0102AP0 (if broadcast) AP Vendor :- Cisco (if detected)		
2.4GHz Band Channel :- 6 Transmit Power :- N/A		
Technology	SSID	
802.11n 802.11n 802.11n 802.11n 802.11n	XXXOFF0003 DMZ xxxxx2 xxxxx GuestWiFi	
5GHz Band Channel :- 128@40 Transmit Power :- N/A		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	XXXil_voice XXXOFF0005 xxxxx2 xxxxx XXXOFF0003 GuestWiFi DMZ	
		

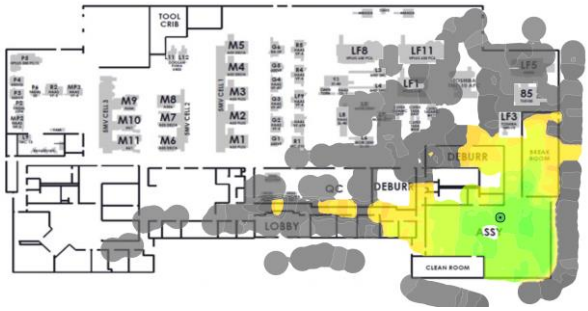
4.1.35 MXXX001-0102AP0

AP name :-MXXX001-0102AP0 (if broadcast) AP Vendor :- Cisco (if detected)		
2.4GHz Band Channel :- 6 Transmit Power :- N/A		
Technology	SSID	
802.11n 802.11n 802.11n 802.11n 802.11n	XXXOFF0003 xxxxx2 DMZ xxxxx GuestWiFi	
5GHz Band Channel :- 100@40 Transmit Power :- N/A		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	xxxxx2 GuestWiFi xxxxx XXXOFF0005 XXXOFF0003 DMZ XXXil_voice	
		

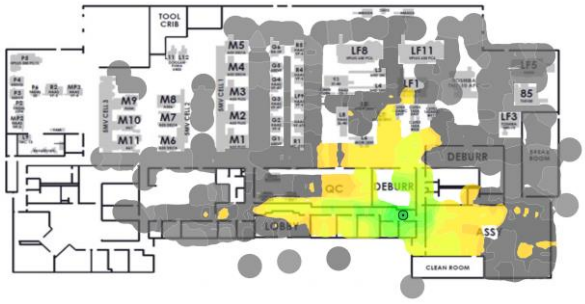
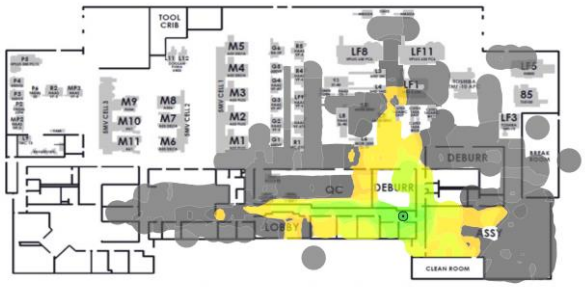
4.1.36 MXXX001-0102AP0

AP name :-MXXX001-0102AP0 (if broadcast) AP Vendor :- Cisco (if detected)		
2.4GHz Band Channel :- 1 Transmit Power :- N/A		
Technology	SSID	
802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n 802.11n	GuestWiFi xxxxx xxxxx DMZ xxxxx2 GuestWiFi XXXOFF0003 DMZ xxxxx2 XXXOFF0003	
5GHz Band Channel :- 56@40 Transmit Power :- N/A		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	xxxxx2 XXXOFF0005 XXXil_voice GuestWiFi DMZ XXXOFF0003 xxxxx	
		

4.1.37 MXXX001-0102AP0

<table>
<tr><td colspan="3">AP name :-MXXX001-0102AP0 (if broadcast) AP Vendor :- Cisco (if detected)</td></tr>
<tr><td colspan="3">2.4GHz Band Channel :- 1 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11n
802.11n
802.11n
802.11n
802.11n</td><td>DMZ
XXXOFF0003
xxxxx2
GuestWiFi
xxxxx</td><td>  </td></tr>
<tr><td colspan="3">5GHz Band Channel :- 64@40 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac</td><td>XXXOFF0003
DMZ
GuestWiFi
xxxxx
xxxxx2
XXXil_voice
XXXOFF0005</td><td>  </td></tr>
<tr><td colspan="2">  </td><td></td></tr>
</table>

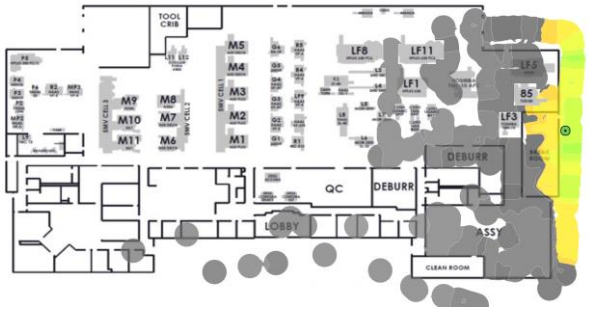
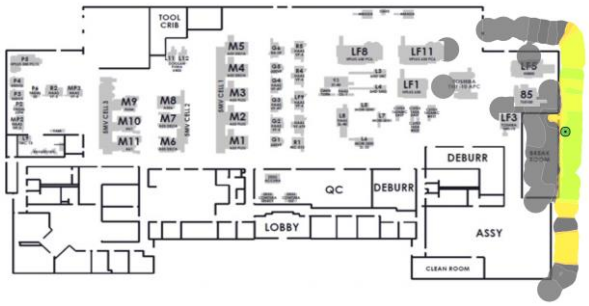
4.1.38 MXXX001-0102AP0

<table>
<tr><td colspan="3">AP name :-MXXX001-0102AP0 (if broadcast) AP Vendor :- Cisco (if detected)</td></tr>
<tr><td colspan="3">2.4GHz Band Channel :- 6 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11n
802.11n
802.11n
802.11n
802.11n
802.11n
802.11n
802.11n
802.11n</td><td>DMZ
xxxxx2
xxxxx
XXXOFF0003
DMZ
XXXOFF0003
GuestWiFi
xxxxx2
xxxxx</td><td>  </td></tr>
<tr><td colspan="3">5GHz Band Channel :- 136@40 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac</td><td>xxxxx
XXXOFF0003
DMZ
GuestWiFi
XXXil_voice
XXXOFF0005
xxxxx2</td><td>  </td></tr>
<tr><td>  </td><td colspan="2"></td></tr>
</table>

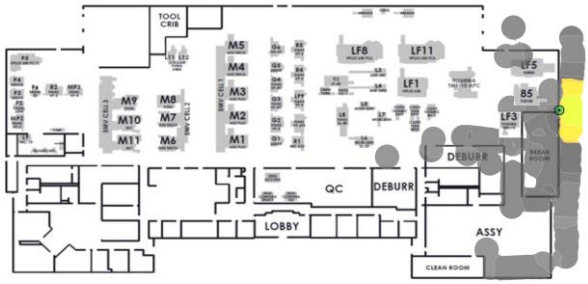
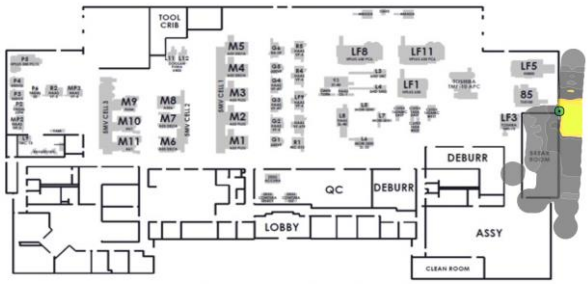
4.1.39 MXXX001-0102AP0

<table>
<tr><td colspan="3">AP name :-MXXX001-0102AP0 (if broadcast) AP Vendor :- Cisco (if detected)</td></tr>
<tr><td colspan="3">2.4GHz Band Channel :- 1 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11n
802.11n
802.11n
802.11n
802.11n
802.11n
802.11n
802.11n
802.11n
802.11n</td><td>GuestWiFi
xxxxx
xxxxx
DMZ
xxxxx2
GuestWiFi
XXXOFF0003
DMZ
xxxxx2
XXXOFF0003</td><td>  </td></tr>
<tr><td colspan="3">5GHz Band Channel :- 128@40 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac
802.11ac</td><td>xxxxx2
XXXOFF0005
XXXil_voice
GuestWiFi
DMZ
XXXOFF0003
xxxxx</td><td>  </td></tr>
<tr><td colspan="2">  </td><td></td></tr>
</table>

4.1.40 MXXX001-0102AP1

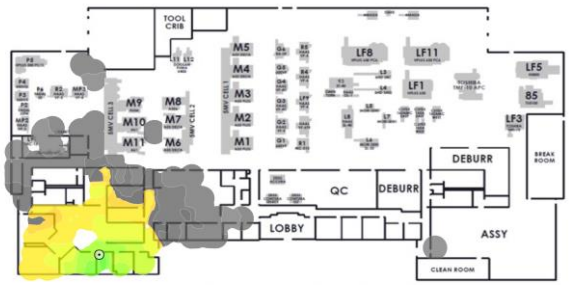
AP name :-MXXX001-0102AP1 (if broadcast) AP Vendor :- Cisco (if detected)		
2.4GHz Band Channel :- 6 Transmit Power :- 16.0 dBm		
Technology	SSID	
802.11n 802.11n 802.11n 802.11n 802.11n	XXXOFF0003 DMZ xxxxx GuestWiFi xxxxx2	
5GHz Band Channel :- 144@40 Transmit Power :- 14.0 dBm		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	XXXil_voice XXXOFF0003 DMZ xxxxx XXXOFF0005 GuestWiFi xxxxx2	

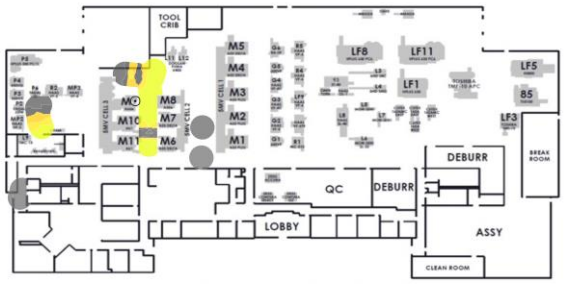
4.1.41 MXXX002-0103AP0

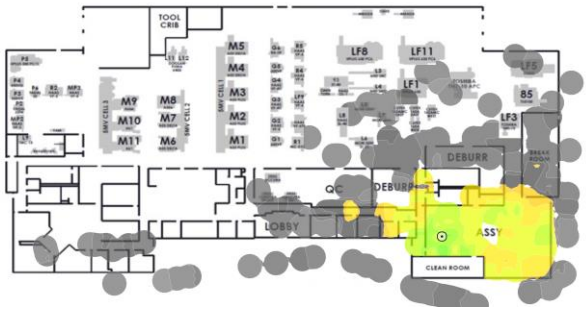
AP name :-MXXX002-0103AP0 (if broadcast) AP Vendor :- Cisco (if detected)		
2.4GHz Band Channel :- 1 Transmit Power :- N/A		
Technology	SSID	
802.11n 802.11n 802.11n 802.11n 802.11n	XXXOFF0003 xxxxx GuestWiFi xxxxx2 DMZ	
5GHz Band Channel :- 149@40 Transmit Power :- N/A		
Technology	SSID	
802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac 802.11ac	xxxxx2 XXXOFF0005 XXXOFF0003 DMZ xxxxx GuestWiFi XXXil_voice	
	Outside ap west side Facing building 2	

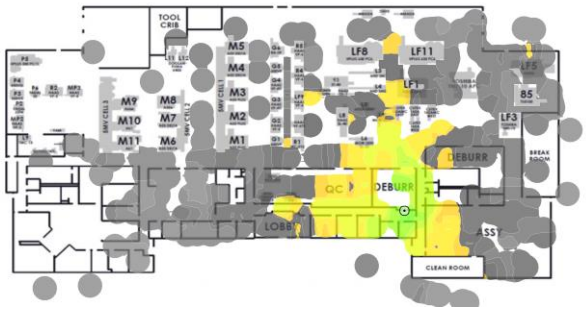
4.1.42 Rouge Networks

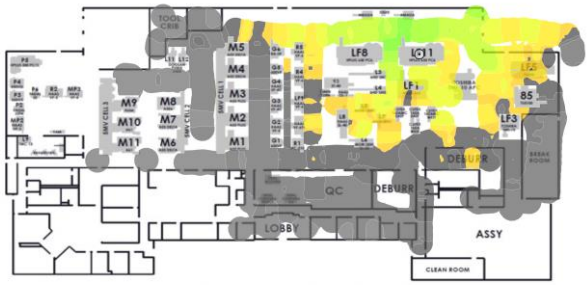
Rogue networks are wireless networks that usually originate from outside of the surveyed area and may cause noise and interference to the corporate wireless. Rogue networks that are inside the surveyed area should be investigated further; Rogue APs that have been identified as being most likely inside the building have been reported on. Rogue Networks are classified as any access point that is not broadcasting at least one of the corporate networks.

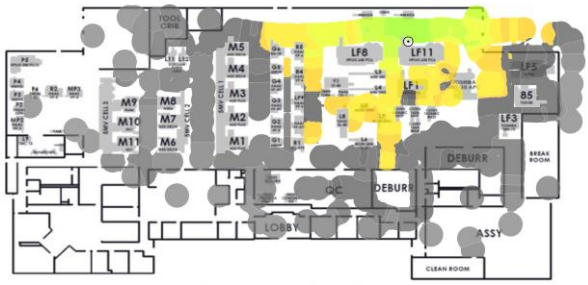
<table>
<tr><td colspan="3">AP name :-Measured AP-03:4a (if broadcast) AP Vendor :- (if detected)</td></tr>
<tr><td colspan="3">2.4GHz Band Channel :- 1 Transmit Power :- N/A</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td>802.11n</td><td>DIRECT-LBUSFRE00069640LTGM1L</td><td> 
</td></tr>
<tr><td colspan="3">5GHz Band</td></tr>
<tr><td>Technology</td><td>SSID</td><td></td></tr>
<tr><td colspan="2"></td><td></td></tr>
</table>

AP name :-Measured AP-2d:cb (if broadcast) AP Vendor :- (if detected)		
2.4GHz Band Channel :- 4 Transmit Power :- 20.0 dBm		
Technology	SSID	
802.11n		
5GHz Band		
Technology	SSID	

AP name :-Measured AP-7d:0f (if broadcast) AP Vendor :- (if detected)		
2.4GHz Band Channel :- 6 Transmit Power :- 20.0 dBm		
Technology	SSID	
802.11n	DIRECT-0F-HP OfficeJet Pro 7740	
5GHz Band		
Technology	SSID	

AP name :-Measured AP-82:e4 (if broadcast) AP Vendor :- PePWave (if detected)		
2.4GHz Band Channel :- 11 Transmit Power :- N/A		
Technology	SSID	
802.11n	PEPWAVE_5DBA	
5GHz Band		
Technology	SSID	

AP name :-Measured AP-c2:f0 (if broadcast) AP Vendor :- Novatel Wireless (if detected)		
2.4GHz Band Channel :- 6 Transmit Power :- 17.0 dBm		
Technology	SSID	
802.11n	Verizon-MiFi8800L-C2F0	
5GHz Band Channel :- 149@80 Transmit Power :- 13.0 dBm		
Technology	SSID	
802.11ac	Verizon-MiFi8800L-C2F0	

AP name :-Measured AP-d1:75 (if broadcast) AP Vendor :- Vizio (if detected)		
2.4GHz Band Channel :- 11 Transmit Power :- N/A		
Technology	SSID	
802.11n	VIZIOCastDisplay4095	
5GHz Band		
Technology	SSID	

5.0 ACRONYMS

Acronym	Description
AP	Access Point
dB	Decibels
mW	Milliwatts
SSID	Service Set Identifier
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
SNR	Signal-to-Noise Ratio

6.0 ABOUT OPEN REALITY

We were founded in 1999 with the aim of helping organisations achieve their goals by ensuring the successful delivery of business applications, keeping users happy and the business moving. At that time Open Reality was solely a value-added reseller with lots of sales and technical expertise in network design, monitoring and optimisation. We were (and still are) regularly commended for our outstanding customer service and proactive approach, so it's no surprise that much of our new business came from recommendations from our existing customers and vendor partners.

More recently, in 2018, we setup a dedicated and focused Value-Added Wireless Distribution team off the back of our success with Ekahau. We've added six (including Weblib) highly-complementary partners in the last four years with the aim of providing our MSPs and channel partners everything they need to design, deploy and monitor enterprise Wi-Fi networks. We back that up with first class customer service and support, making sure that every request and order is satisfied in a timely and professional manner.

Distribution Timeline

- Founded in 1999
- Became Ekahau's UK distributor in 2006
- Founded our Value-Added Wireless Distribution team and signed Hive Radar, Mojo (Arista) and 7Signal in 2018
- Signed Cambium in 2019
- Signed AccelTex in 2020
- Signed Weblib in 2021

Our Partners (Distribution)

Open Reality Ltd
10 Hitching Court,
Abingdon Business Park,
Abingdon OX14 1RG

01235 556 400
www.openreality.co.uk

bsi. ISO/IEC 27001 Information Security Management
IS 633662