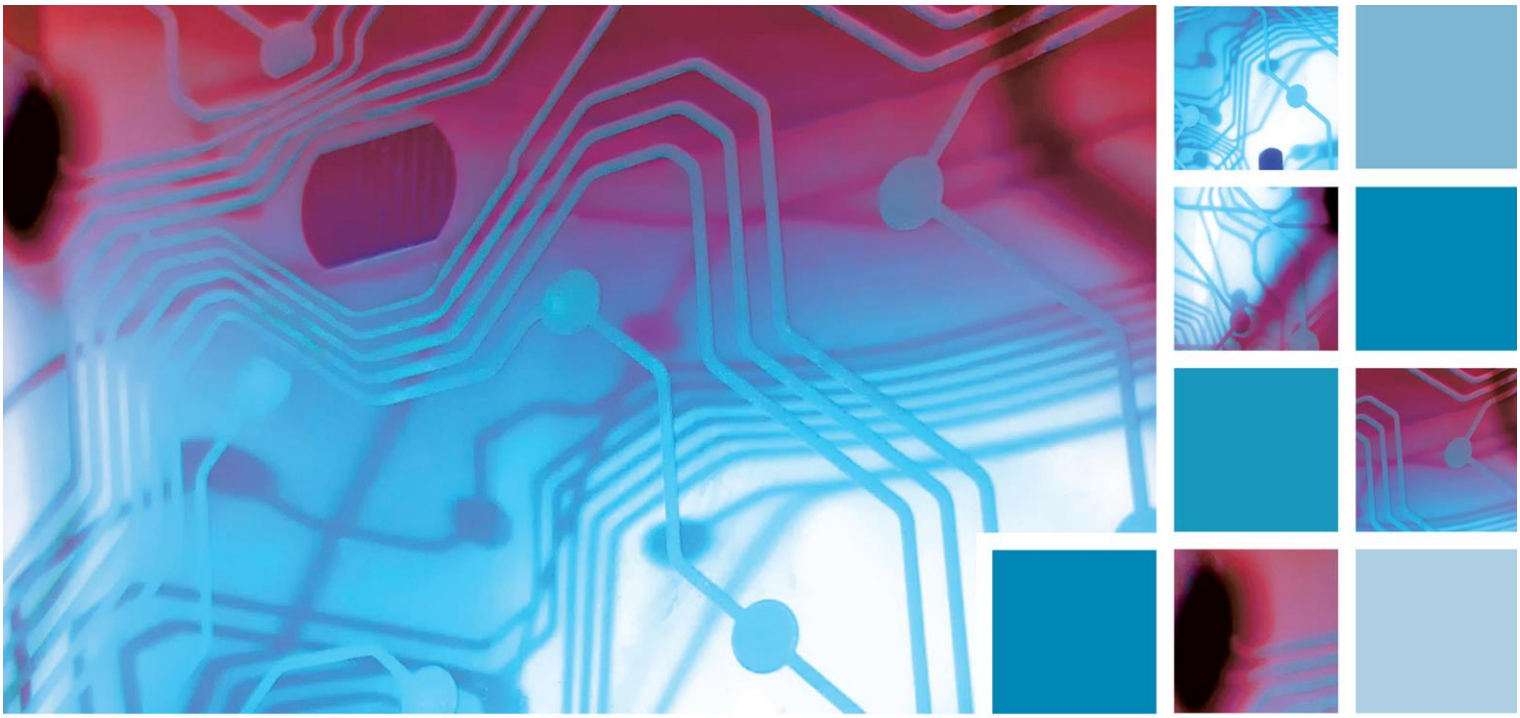


Information Systems

NTU Wi-Fi Principles and Standards

Purpose of this Document

This document will describe the principles and standards that NTU will use when designing the Wireless LAN (WLAN) in any given area.

This document will be reviewed every 6 months

Author:	M Pearson
Version:	2.2
Date:	11/05/2018

NOTTINGHAM TRENT UNIVERSITY

Document Control:

Version	Author	Date	Version details	Reviewer	Date
1.0	S Meadows	20/03/14			
1.1	S Meadows	01/04/14			
1.2	S Meadows	14/04/14			
1.3	M Pearson	26/4/16			
1.4	M Pearson	18/8/16			
1.5	M Pearson	23/8/16	Additional review comments		
1.6	M Pearson	29/9/16	Added AP documentation handover notes		
1.7	M Pearson	3/10/16	Added mounting link		
1.8	M Pearson	17/10/16	Added 3802 AP models		
2.0	M Pearson	23/05/17	Various small amendments		
2.1	Mpearson	10/10/17	Amended ekahau parameters		
2.2	Mpearson	11/5/18	Updated fo Cat6a cabling		

Contents

Principles

Information Systems (IS) will endeavour to design NTU Wi-Fi around these principles:

1. Ease of Access – little or no user intervention/setup of the client device
2. Mobility – ability to roam between Wi-Fi access points and maintain connection
3. Wi-Fi will be installed as standard in all occupied university buildings
4. Design to use Location Awareness where practical to do so but as a minimum design to Voice capability
5. NTU Wi-Fi designs will be carried out using industry standard Wi-Fi design tools
6. Designs will be carried out by IS (or a 3rd party agreed by IS) and these will be used by NTU Estates to install as designed

IEEE 802.11 Standards

IEEE 802.11 is the standard that governs Wi-Fi. Where possible, IS will standardise on a single vendor model of Wi-Fi access point and other supporting infrastructure in order to support the latest IEEE 802.11 standards. This will be flexible to suit the situation (especially when designing external access) and may change if the current vendor has no suitable models available or if it is determined that a different solution is required.

In addition, where the IEEE 802.11 standard is introduced in phases (such as the case with 802.11ac) it may be decided to skip certain phases and wait for future releases to reduce upgrade costs and maximise new features.

Internal Wi-Fi at NTU

All occupied NTU buildings will be provisioned with Wi-Fi. Plant room, toilet, lift and stair areas will not be directly covered but will likely have indirect bleed from surrounding areas.

The current standard models of internal access point is listed in Appendix 2. These are to be ceiling mounted where possible with no obstruction.

An alternative model may also be used in conjunction with an external semi-directional antenna. These access points and antennae may be wall mounted if the situation prohibits the use of a ceiling mounted access point. However, careful attention must be given to their placement to avoid any line of sight obstructions.

Placement must also take into account ease of access for maintenance purposes. As such very high ceilings or locations requiring specialist access equipment should be avoided.

External Wi-Fi at NTU

IS will aim to achieve a sufficient level of coverage to enable light Internet browsing in thoroughfare areas. Outdoor spaces that see high levels of student or staff congregation and or will be used for teaching will aim to have sufficient coverage and data rates for medium bandwidth usage.

Solutions for external Wi-Fi

External Wi-Fi would be provisioned using the current standard model of external access point (s), which are listed Appendix 2. These are to be fixed to the building with no obstruction.

External patterns of Wi-Fi usage other than those described above need a complete solution design, either performed solely by IS or in conjunction with a partner who specialises in this area. For example: if Wi-Fi provision is needed for outside stalls or other temporary structures, this requirement may need a custom solution.

Antenna Placement (outdoor installations)

Where a dedicated external access point is undesirable then external antenna may be used. These are connected to access points mounted inside the building and the antennae fixed to the outside with cabling between them through the building. These antennae will be wall mounted using either flush to the fabric of the building or using a tilt and pivot wall bracket. However, careful attention must be given to their placement to avoid any line of sight obstructions.

Camouflaged covers can be applied to the antennae to mask their appearance

Considerations for landscaping schemes

External Wi-Fi relies heavily on line of sight and may not easily be moved, so some considerations should be made not only to the initial landscaping but also to the maturing of any planted landscape.

1. Trees and high shrubs should avoid line of sight or Fresnel zone (an elliptical area surrounding the line of sight) interference.
2. Wi-Fi surveys should be done in conjunction with landscaping planning to maximise Wi-Fi coverage and signal strength.

Any non-planted landscaping (sculptures, water features, other structures) should avoid line of sight or Fresnel zone interference.

Site Surveys

In order to adequately design a suitable Wi-Fi network IS will need to perform both a pre-install site survey and a post-install site survey. These will be done using the Ekahau Survey tool. Cisco Prime Infrastructure can also be used to assist in planning.

Pre-install Site Survey

This can be done in two ways: active or predictive.

Active
If IS have suitable access to site then an active survey is the best option as it provides the most accurate readings. This will be done using a powered access point with readings taken from Ekahau Survey Pro to produce a report detailing how many access points will be required.

Predictive
Where IS do not have access to site or site access is not an option (for example if the site does not yet exist, in the case of a new build or the site is to radically change in layout and construction in the case of refurbishment) then a predictive site survey may be a more practical option. Details of the construction materials being used and detailed scale drawings of the building will need to be supplied by Estates in order for this to happen.

The parameters that IS will design the Wi-Fi network to is set out at Appendix 1. These are the standard settings but may be tailored to suit the building or area being designed for. For example less populated buildings.

Post-install Site Survey

A post-install site survey is highly recommended to validate the installed design and to recommend any changes that will need to take place, such as moving access points, adding or removing access points or turning off radios to eliminate channel interference.

Should building usage change (such as converting an area into a teaching space) then a survey will be needed to determine if any changes are required. In some cases this may mean a complete re-design of access point placement to achieve the desired outcome.

Installation of Access Points

Contractors will work from an IS supplied Wi-Fi design plan that will indicate the position and quantity of APs to be installed. As stated above, these will be ceiling mounted unless specifically stated otherwise. Any deviation needs to be reported back to IS for approval.

IS will provide the APs to the contractor that are included in the design for mounting.

The contractor will annotate, on a Wi-Fi install drawing, the mac address of the AP against its position and the data point number so that IS can configure and identify the correct AP on their monitoring systems. The completed Wi-Fi install drawing is to be handed to IS on completion.

The link describes how the APs can be mounted
http://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-3/b_cisco_aironet_series_2800_3800_access_point_deployment_guide/b_cisco_aironet_series_2800_3800_access_point_deployment_guide_chapter_010.html

Solutions to help with aesthetics should be considered where appropriate. Enclosure type solution such as available from companies like Oberon (http://oberoninc.com with UK distributor being www.anixter.com)

Assumptions and Caveats

This document makes a number of assumptions, when it comes to the provision of Wi-Fi connectivity:

1. Adequate infrastructure (power, Ethernet connectivity within 90metres) exists or can be provisioned in the area requiring Wi-Fi.
2. Obstructions will not be placed within the Fresnel zone of external Wi-Fi point to point links.
3. Where such obstructions do occur (due to the maturing of landscaping for example), measures will be taken to either remove said obstructions or to move Wi-Fi equipment so as to bypass the obstruction.
4. Access points will not be hidden or obstructed in any way, except when placed in outdoor enclosures to protect the equipment.
5. Access to replace access points will be granted as and when required.
6. Where required, adequate provision will be taken to protect against weather effects and lightning strikes.
7. Access to rooftops may be required for some external Wi-Fi solutions.
8. Dual Cat6a cabling is to be used for Ethernet connectivity to each AP for new installations. This maybe dependant on location and the requirements for that area. IS are to be consulted if in doubt.
9. Switch port will be at Gigabit Ethernet or multiples thereof.
10. 30W of PoE will be provided by the switch for each AP port.
11. IS are not responsible for student halls Wi-Fi provision.

There are also a number of caveats to be aware of when provisioning Wi-Fi:

1. Due to the nature of Wi-Fi actual throughput will be roughly half of the advertised data rate, for example a 300Mbps capable access point will provide approximately 150Mbps of actual throughput for one user with a dual stream device.
2. As a shared medium, Wi-Fi will distribute bandwidth across all users. This will be affected greatly by the type of device being used and will lower the total bandwidth available to all users. The addition of a single stream device to the example above will

result in user 1 having 75Mbps and user 2 having 30Mbps, giving a total of 105Mbps total throughput, down from 150Mbps.

3. Wi-Fi performance cannot be guaranteed as it is affected by elements outside of the control of IS (movement of people and objects, weather, other Wi-Fi and non-Wi-Fi devices, types of devices connecting and sources of interference).
4. The 2.4Ghz spectrum is especially susceptible to interference (non-Wi-Fi wireless devices, Bluetooth, microwave ovens, other Wi-Fi devices).

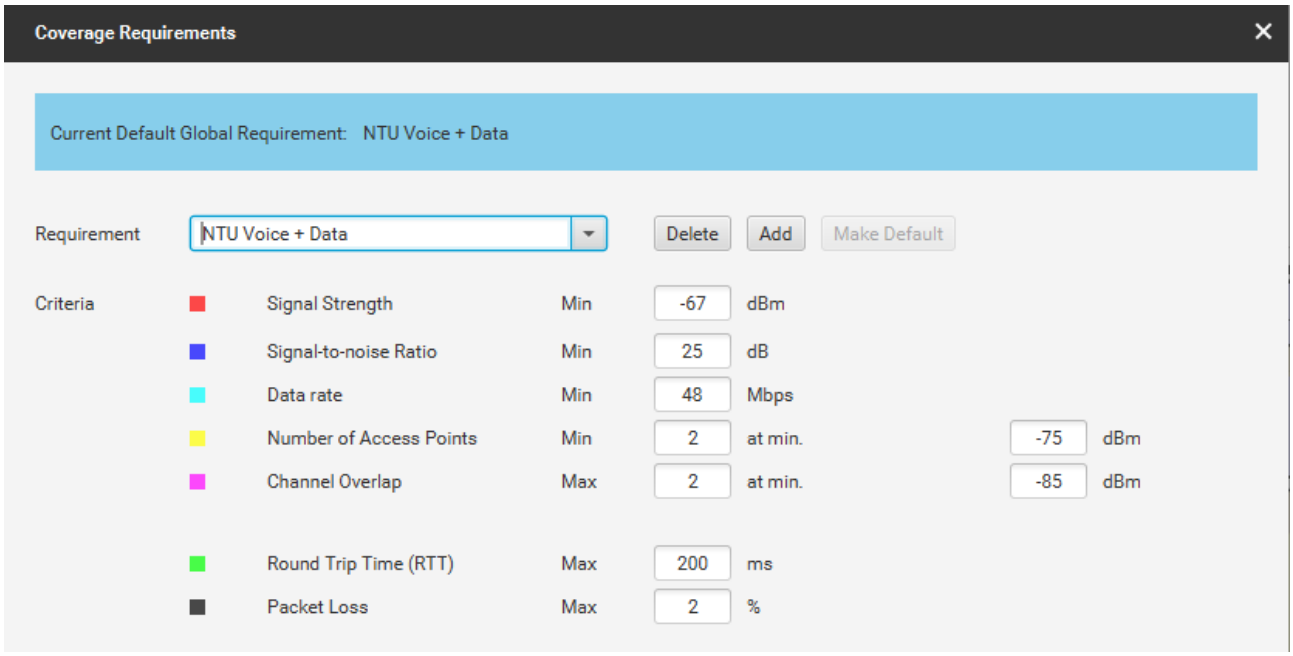
Supporting Documentation

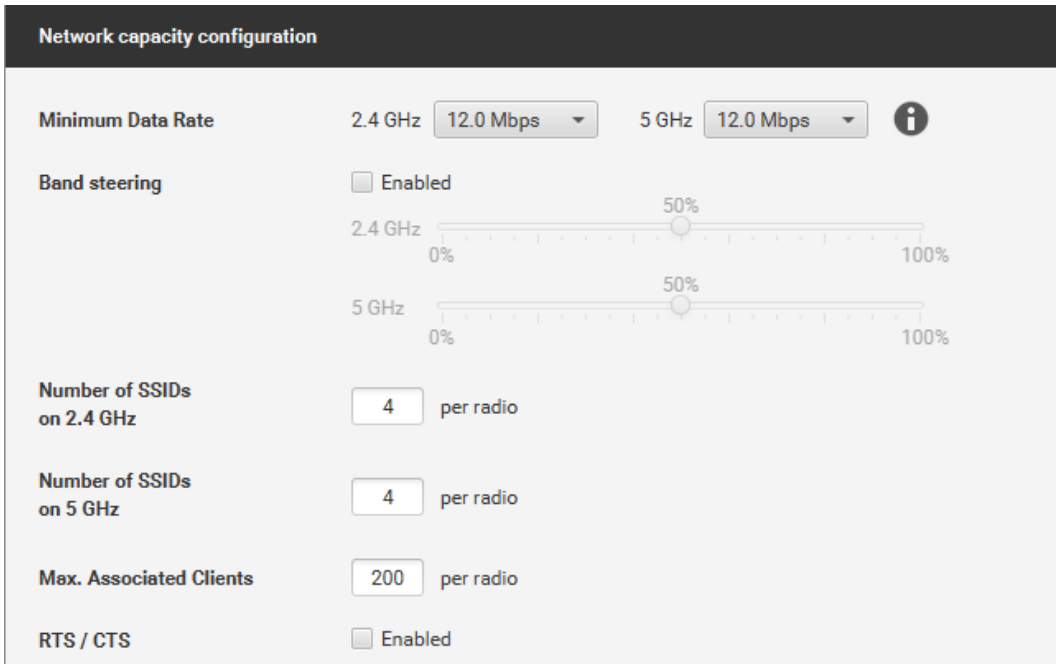
For documentation on current IS Networking standards please refer to
http://www.ntu.ac.uk/is_standards

Appendix 1 – Ekahau Survey tool parameters

These parameters are used in the Ekahau Surveying tool for designing internal building Wi-Fi networks within NTU incorporating capacity and high load requirements. These are a guide only but as a general guide designs should be created to support Data and Voice. Signal strength and load may be adjusted depending on the building and its use.

For new builds and major refurbishments/refresh the cisco 3802/2802 model should be used. A combination of the two models can be used. 3802 model is used in higher density areas and where the additional features maybe realised.

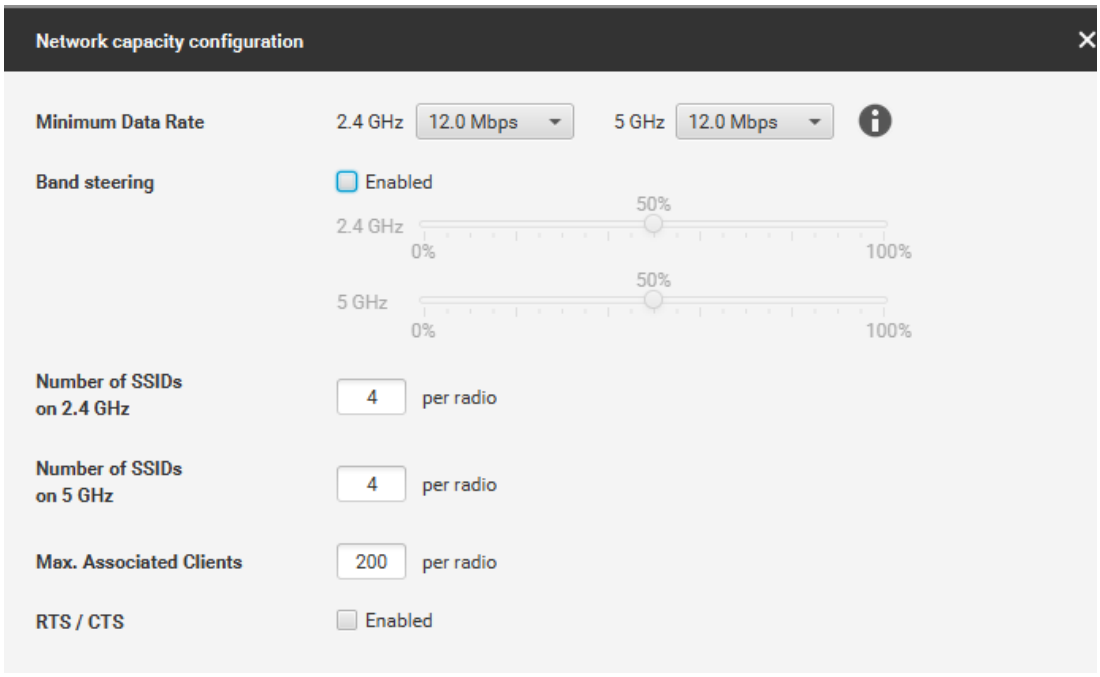


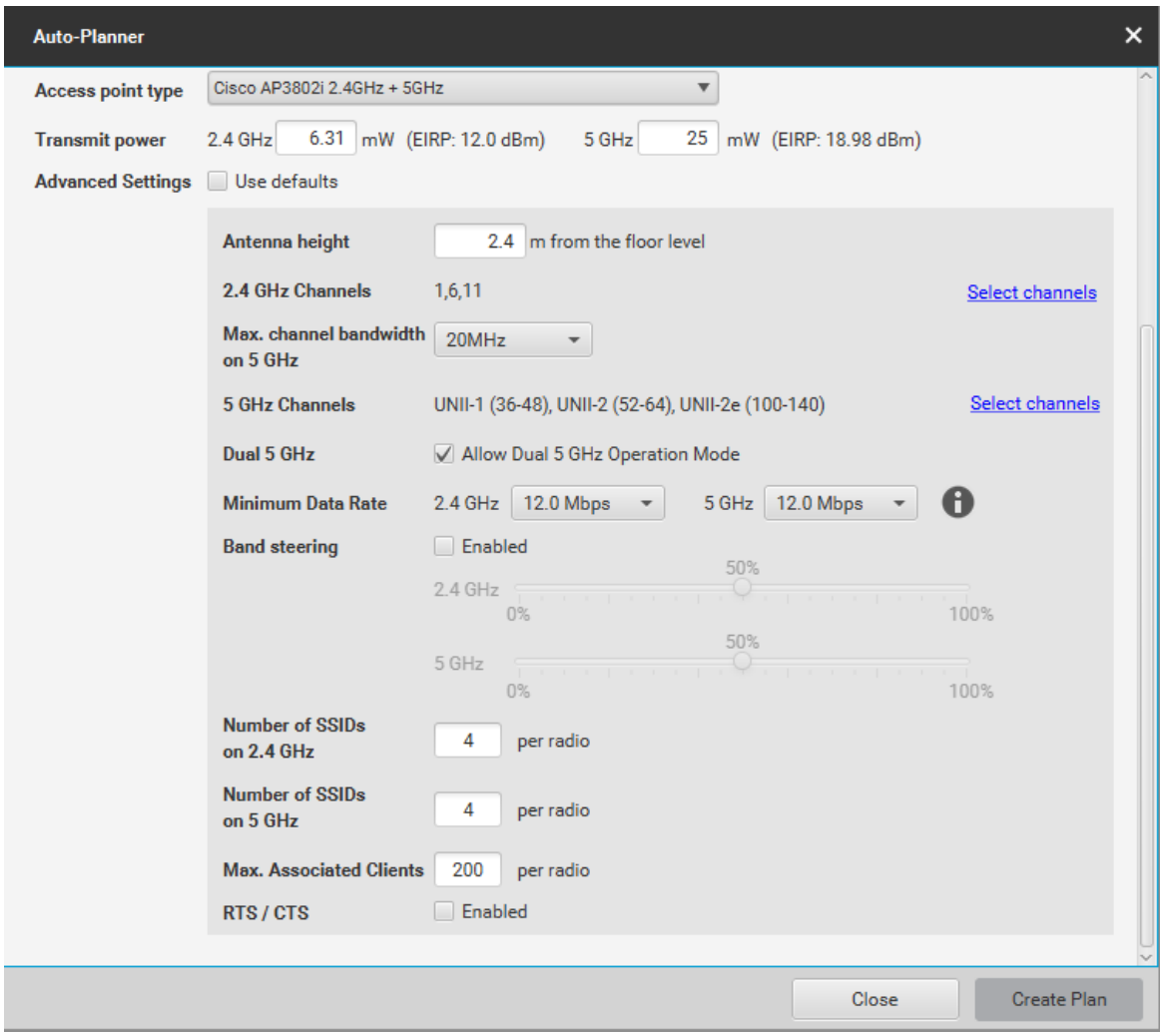


Bandwidth on 5Ghz may be set to 40Mhz channels depending on building

Designs will be maximised for 5Ghz channels.

Capacity requirements should be factored in where they need to be taken into consideration. These model load on the Wi-Fi network being designed. An example is below. The numbers and types of devices will depend of the building being designed for. This information may be available from the Project Manager.




Auto-Planner
Access point type
Cisco AP3802i 2.4GHz + 5GHz
Transmit power
2.4 GHz 6.31 mW (EIRP: 12.0 dBm)
5 GHz 25 mW (EIRP: 18.98 dBm)
Advanced Settings
Use defaults
Antenna height
2.4 m from the floor level
2.4 GHz Channels
1,6,11
Select channels
Max. channel bandwidth on 5 GHz
20MHz
5 GHz Channels
UNII-1 (36-48), UNII-2 (52-64), UNII-2e (100-140)
Select channels
Dual 5 GHz
Allow Dual 5 GHz Operation Mode
Minimum Data Rate
2.4 GHz 12.0 Mbps
5 GHz 12.0 Mbps
Band steering
Enabled
50%
2.4 GHz
0%
100%
50%
5 GHz
0%
100%
Number of SSIDs on 2.4 GHz
4
per radio
Number of SSIDs on 5 GHz
4
per radio
Max. Associated Clients
200
per radio
RTS / CTS
Enabled
Close
Create Plan

Appendix 2 – Access Point models

Standard Internal Access Points

The standard models of internal access point is the Cisco 3702i/3802i for ceiling mount and the 3702e/3802e for wall mount.

Cisco 3702i (ceiling mounted) 8.7 x 8.7 x 2.11 in. (22.1 x 22.1 x 5.4 cm) (without mounting bracket):

Cisco 3702e (wall mounted) 8.7 x 8.7 x 2.11 in. (22.1 x 22.1 x 5.4 cm) (without mounting bracket)

Cisco 3802i (ceiling mount) access point (without mounting brackets): 3802I: 8.66 x 8.68 x 2.46 in. (22 x 22 x 6.25 cm), weight 4.6 lb (2.09 kg)

Cisco 3802e (wall mount) access point (without mounting brackets): 3802E: 8.66 x 8.68 x 2.62 in. (22 x 22 x 6.7 cm), weight 4.6 lb (2.09 kg)

Standard External Access Points

The current standard external access point is the Cisco 1532 (although this does not support the AC standard)

9 x 7 x 4 in. (23 x 17 x 10 cm)

Standard External Antenna

Cisco AIR-ANT2544V4M-R= Omnidirectional Antenna

Length 8.6 in (21.8cm), Dia 6.3 in (16cm), Weight 1.48lb (671.5g)

Cisco AIR-ANT2566P4W-R= Semi-directional Antenna

Length 6.3 in. (16 cm) Width 11 in. (27.9 cm) Depth 1.2 in. (3.05 cm) Weight 1.4 lbs