

Whole Class Learning

30 Laptops Per Class

Whole School Learning

30 Laptops in Every Class

Non Teaching Wireless

Lower speeds for low user density areas

The Roaming User

Coverage in the corridors, playgrounds and communal areas

Interference

Look out for interference from non wi-fi devices.

Meru Networks Wireless School Design Methodology

Siracom offers its resellers a wireless network design service, to enable our customers to accurately provide quotations for wireless networks for their end-users. This service is provided either as a desktop survey or as an on site site survey. The design service answers the questions “how many access points do I need?” and “where shall I put them?” These are not simple questions with straight forward answers as the answer depends on how the network is to be used. This document provides clarification on the design criteria and explains the questions we will ask, and why we are asking them.

Simple with Single Channel

The Meru Networks single channel architecture simplifies wireless network design. Working with Meru we can assume that all access points will be on the same channel and will all be set to the maximum allowable transmit power. This means that the RF design is reasonable predictable. With Meru we only have to work out how many access points we need and where we are going to put them. Other technologies

have more design criteria. They have to cater for channel interference which means that the design process needs to include working out a channel plan and working out a power plan. These MicroCell designs are a compromise between performance and coverage, and are often inaccurate. Meru designs enable seamless coverage with the maximum possible performance.



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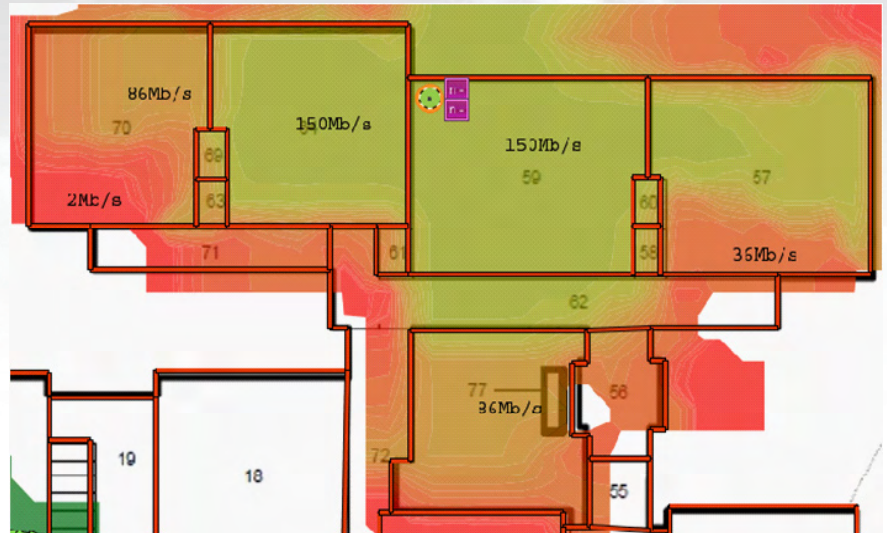
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The Design Parameters

1) Coverage

This heat map shows the coverage that might be expected from an access point positioned as shown in a typical classroom. (room 59) in a typical school. It would be accurate to say that the access point provides coverage in all but the white areas: ie there is coverage in classrooms 70,64,59,57 and 77 from the one access point. Just putting one access point in this area would however not necessarily provide a suitable infrastructure for a school network. Many tenders specify universal coverage. Usually they mean something else!



2) Connection Speed

The connection speed is the speed at which a device is likely to connect. So from the heatmap we can see that in classroom 70 we have a minimum connection speed of 2Mb/s in class 59 a minimum connection speed of 150Mb/s.

4) Resilience

In some circumstances it is prudent to specify that two or more access points must be visible from every location. This would ensure that some wifi service is available everywhere even if there is an access point failure.

3) Throughput

If all the devices connected to an access point have a connection speed of around 150Mb/s then we are likely to get an overall TCP throughput of around 200Mb/s shared between the devices. If there are a high number of devices with low connection speeds then the overall performance of the access point will drop. For high user densities we want all the clients connected at the highest possible connection speed to deliver the highest total throughput.

5) Concurrent Connections

Each Meru access point can support up to 64 devices per radio concurrently, if the devices are using encryption, or 256 unencrypted devices. The amount of bandwidth available is shared between the devices so the more devices connected the lower the performance of each device will be. Meru manages this contention efficiently. With other systems the amount of bandwidth available to share between connected devices diminishes as the number of connected devices increases.

The Design Process

How do we design a Meru wireless network? That depends on what we want to do with it. Experience tells us that one radio on one access point is suitable for teaching one class of around thirty laptop users provided that the users are in an area of high connection speed. By "teaching" we mean it will enable simultaneous log-in and simultaneous use of multimedia content.

Whole of class teaching would therefore be possible in room 64 or room 59. But not both at once. At the same time it would be possible for a small number of other users to share the network – for example teachers in the other rooms shown with coverage could take the register, and do their email. In the area shown above we could say:

- One access point is providing coverage for five classrooms.
- We can teach using thirty laptops simultaneously in one of two classes and we can use the network for administrative purposes in the others.
- If we want to teach using thirty laptops simultaneously in all five classes we need five access points.

Design Accuracy and Limitations

We have two methods of working out the design, a desktop survey or a full on-site site survey. As we only need to worry about access point location (other wireless designs must consider co-channel interference and therefore channel and power settings) this is a reasonably accurate process, however a desktop survey is making many assumptions and a "real" on site survey is accurate only on the day of the survey. Putting up a new white board for example will change the RF characteristics of a wall.

To allow for inaccuracies it is prudent to specify the system with some leeway for change and inaccuracy. To do this we would specify a minimum connection speed we are allowing.

In the example – if our assumptions are 20% out, rooms 64 and 59 would still be suitable for teaching. Rooms 57 and 77 would still be suitable for admin over wifi. Parts of room 70 may have no coverage.

The Siracom Recommended Design Methodology

1) Design for potential for whole of class teaching

Specify the classrooms in which you want whole of class teaching. Input access points to the coverage planning tool to a density where each class specified has 150Mb/s coverage.

2) Design for potential for simultaneous whole of class teaching

Specify additional access points to ensure that there are enough access points to cover simultaneous usage. In the example above if we were teaching simultaneously in classrooms 59 and 64 we would need an access point in both classes.

3) Design for coverage

The access points specified in 1) and 2) above may provide coverage across much of the school. The school should identify all areas where coverage is required, and a minimum connection speed should be agreed. Next we build in some leeway by designing to a higher minimum agreed speed / signal strength than the minimum required. 36Mb/s might be a good number. Access points should be added to the planning tool to give this coverage.

4) Install

After purchase the system should be installed as agreed.

5) Test

The site survey tool may be used to map coverage and confirm (or otherwise) that the system is operating as designed. With Meru's single channel design if there are coverage holes these are easy to fill, by adding an access point, without having to reconfigure the whole network.

Look Out For Interference

The most common cause of problems with Meru wireless is interference. Wireless operates in the 2.4GHz and the 5GHz frequency bands. These are unlicensed bands and other wi-fi and non wifi devices may cause interference.

2.4GHz is the worst affected frequency but also the frequency on which most wifi devices operate. An RF scan should be carried out before installation using a tool such as Wi-Spy.

Common interference sources are:

Neighbouring wi-fi	Microwave Ovens
Alarm systems CCTV cameras	Handheld telephones
Bluetooth.	

This sounds like a long list but with the correct configuration Meru wi-fi is very resilient to noise.