

## Next Generation Wireless LAN



### NexGen Wireless LAN

*Julie Nordquist:*

Hello and welcome to the Cisco on Cisco seminar. I'm Julie Nordquist, Program Manager, IT and part of the Cisco on Cisco team. Today's presentation is about Cisco's next generation wireless network. You will see how Cisco IT has achieved greater availability, stability and security through the next generation wireless LAN program.

I'd like to introduce our technical expert for today's show on the next generation wireless network, Oisín MacAlasdair. Oisín is a program manager in the network and data center services organization and IT. He has been with Cisco for more than seven years in addition to managing enterprise wireless strategy and architecture for Cisco IT, he also manages the next generation wireless network upgrade which consists of the global deployment of more than 7,000 access points to Cisco offices.

Welcome Oisín.

*Oisín MacAlasdair:*

Thanks Julie, it's great to be here. Cisco has one of the largest deployments of Cisco enterprise wireless network solutions. Our next generation wireless network has been designed as a primary access medium from day one and as this has been possible due to our adoption of the Cisco unified wireless LAN solution based on the latest access points, wireless LAN controllers and the wireless control system for advanced management capabilities.

*Julie Nordquist:*

So sit back and enjoy as we explore Cisco next generation wireless networks. Let's take a look at the agenda for today's segment.

### Agenda

*Oisín MacAlasdair:*

As you can see here we're going to start off with a snapshot of enterprise wireless networking at Cisco. We'll look at the past, the present and the future where NexGen wireless LAN is taking enterprise

wireless networking at Cisco.

I'll then cover the architectural goals of NexGen wireless LAN, what we set out to achieve with this global enterprise wireless networking program, I'll then give you an overview of the actual architecture itself; finally we'll have a look at the support costs.

### Snapshot-the past, present & future

So here we have a snapshot of enterprise wireless networking at Cisco. We can see the past, the present and the future, where we started and where we're going with the NexGen wireless LAN program. Our infrastructure has increased dramatically, we've gone from 3,000 access points up to more than 7,000 access points, the main architectural change has been the adoption of the centralized, unified wireless LAN solution to replace the old autonomous, the legacy autonomous solution which is based upon IOS access points, our number of clients have increased dramatically, the management capabilities have improved significantly from essentially no real dedicated management capabilities for the RF domain to today where we have the wireless control system that gives us full visibility into the RF domain.

The enhanced services have increased dramatically, originally we really didn't have any real advanced or enhanced services with the enterprise network and as time progressed we added support for voice and guest networking but with the NexGen wireless LAN program those are being dramatically improved and we're also introducing things like support for the jewel mode smart phones and location based services to track high value assets at data centers and the like and our SLA is also increased.

As you can see described at the bottom there, a very – capabilities of above, we started off with a secondary network that was designed for intermittent data usage and we're evolving to a network that's been designed from the bottom up as a primary access medium that's got a high SLA, it's more resilient, it can self-heal, it can self-configure so we've been able to increase our SLA, we've been able to increase and improve our availability.

*Julie Nordquist:* What prompted that change?

*Oisin MacAlasdair:* What prompted the –

*Julie Nordquist:* How did we get from – why have we now made this a primary access medium?

*Oisin MacAlasdair:* Well what we found is about 18 months after the initial deployment we only took a voice of the client summary –

*Julie Nordquist:* This is in 2001.

*Oisin MacAlasdair:* In 2001 and we discovered that at that stage 25% of Cisco employees described the wireless network as the primary, only the primary medium. Now this was a surprise because as I mentioned earlier we'd originally designed the network as a secondary network, as a mobility enabler. Culturally Cisco very much embraced the concept of staff mobility and a dynamic workplace and every Cisco employee was provided with a laptop on one end yet the only place to get access to the network was at their desk, we were in fact were tethering users to their desks so that's why we made the decision to undertake a ubiquitous deployment and comprehensive entitlement.

However, the technology was such that we didn't think it would replace the wired infrastructure so it was designed as a secondary network. Eighteen months after the deployment, nearly a quarter of our global

workforce said they use the wireless exclusively or almost exclusively. So that really set our mind, our thought processes in training and we decided we really need to upgrade this network, we really need to design this as a primary access medium from the bottom up because people have truly embraced this technology. We also saw the introduction of newer capabilities; wireless voice was becoming very, very popular.

In 2005 we undertook another survey and we found that 42% of our employees described the wireless network as their only a primary access medium so the technology was really becoming fundamental to the way we do business and it certainly justified the expenditure or the creating of the NexGen wireless LAN program and hence, we made the multi-million dollar investment in the a global deployment of the unified wireless LAN solution, doubling the number of access points, investing in this technology that has the intelligence to self-healing, self-configuring capability to allow us to increase the SLA and therefore be confident that the network was really for prime time as a primary access medium.

*Julie Nordquist:* Do you want to tell us a little bit about the architectural goals?

*Oisin MacAlasdair:* Certainly, yeah, let's have a look at the architectural goals that we set ourselves in late – well early 2006 and how we've hopefully achieved those currently.

#### **Architectural goals for NexGen WLAN**

*Oisin MacAlasdair:* We can summarize, if one was to ask me how could you summarize the architectural goals for NexGen wireless LAN in one sentence it would be as well let's architect the wireless network such that it's suitable as a primary access medium and that means, what does that actually mean in plain English to the average user. It means increasing the available bandwidth on a per user basis and providing native support for voice. It also means improving the availability of the network so reducing the number of service impacting incidents so that you can, you're more confident in that the service is available to your users, that the stability of the network is increased if you will, and we also wanted to increase or strengthen security. And that's not to say that there were security concerns, but as technology evolves and new security capabilities become available, it's incumbent upon a proven IT organization and a security organization to adopt those gold standard, if you will platinum standards that security protocols and capabilities.

So we decided to increase the available bandwidth per user, we wanted to provide native support for wireless voice and by implication wireless video, we set ourselves a goal of reducing the service impacting incidents by 75%, that's quite an aggressive or aspirational goal if you will but as-

*Julie Nordquist:* Why did – why that number?

*Oisin MacAlasdair:* Well part of the reason was from a legacy perspective we had 3,000 maybe 3,100 older access points, these were AP350's whilst they were the flagship product available in 2000, by 2005, 2006 they were certainly deprecated, they were end of life and they weren't necessarily capable and they weren't necessarily capable of supporting the load that we were putting on the network so we were experiencing certain circumstances where some of these AP's were failing due to hardware failure, sometimes they were just failing due to the extensive load. Not a huge amount but we decided if we wanted to go from a network that had been designed as a secondary network to one that was a primary network for more than, for 50% or more of our employees, we really have to make this as rock-solid as possible so a 75% reduction was deemed a good, an aspirational or aggressive target

that we set ourselves. And of course we wanted to increase the security.

Two ways we really adopt – or two targets we set ourselves under that category, one was the introduction of RF or Radio Frequency and based rogue IP detection so we already had a network scanning tools that allowed us to scan the enterprise network, with the wired network for a rogue or an unrecognized access points but we wanted to add the capability to do this over the airwaves as well and that feature is supported on the unified solution. So that was an introduction. And we also wanted to adopt or support the WPA or WiFi protected access, WPA2 encryption protocol.

That's not to say that WPA won – or WPA standard WPA is not acceptable, it remains entirely unbroken if when properly implemented but we've seen that with the introduction of the latest clients, many new clients, new laptops, new wireless adopt to support WPA 2 so we enabled the infrastructure to support that. This introduces a gradual hardening or strengthening of security because as clients support WPA2, the infrastructure will support it so as we defecate and remove all the hardware, all the hardware clients, newer, you know the general, the percentage of people who are supporting them, the new platinum level security will increase.

#### Architectural goals for NexGen WLAN

*Oisin MacAlasdair:*

Another target or key goal we set ourselves was to broaden the client base. Initially NexGen world satellite will support or we supported only our primary and our standard, what we call a Cisco IT image laptop so the standard Windows, Windows XP laptop. As time evolved, as our client base diversified we decided it was important for us to support multiple devices so not only borderlizes in the standard laptop but also application specific devices such as barcode scanners, WiFi handsets such as the 7920, the 7921, the brand new 7921 wireless VOIP handset, but also additional laptops or platforms like Mac OL or OSX for the McIntosh laptops, the Linux laptops etc., and even dual mode handsets so by – what we did in this circumstance, one of the biggest movements in that category was the adoption or support of PEEP. So not only do we support wireless protected authentication or extensible authentication protocols, not only do we standardize our standard 8 mechanism if you will is EEP Fast which is a Cisco technology but with the support of PEEP we've been able to broaden the church if you will and support more devices.

Another goal very important was to reduce the actual total cost of ownership and it's no good having a very, very popular good service if it's extremely expensive to run so we've decided to set ourselves a target of 10% for operation optimization. That's effectively a reduction of 10% and yet your cost of ownership or the support costs.

And finally, one of the, from my perspective, from an IT perspective, one of the most important goals was the introduction of native wireless management capabilities. So we wanted to have visibility into the RF domain, we wanted to see, get true knowledge and service availability rather than just knowing that say an AP was up and running doesn't necessarily give you any visibility into what was happening in the RF domain and that capability has been derided by the wireless control system.

*Julie Nordquist:*

How did it happen before?

*Oisin MacAlasdair:*

Previously we had a in-house built, developed management system that gave us availability statistics on the actual access points themselves but that didn't give you true visibility on the RF domain. So you may have, you may be able to have you know 5-9's or 4-9's, 99.99% availability on

the access points but if there was interference in the RF domain, if unusually maybe an actual ready transmitter or an access point had failed, the AP may report a service had been open active but the actual service availability for the users wasn't as high as your availability statistics had implied. So we had a, we'd good idea of service availability but we didn't have true visibility into the RF domain. If you will the wireless LAN was like a dark black cloud and now it's, we have full visibility into that.

*Julie Nordquist:* So your management capabilities are greatly increased.

*Oisin MacAlasdair:* Yeah there's no question, there's no comparison between our historical management capabilities and the fully featured capabilities offered by the wireless control system, which is a fundamental aspect of the unified wireless and solution by, that's available from Cisco.

*Julie Nordquist:* Great.

### **Design Considerations**

*Oisin MacAlasdair:* So how do we actually go about designing NexGen wireless LAN? What are some of the design considerations or some of the fundamental decisions that we made when deploying this; well first of all defining the architecture and then deploying the actual solution? Well of course the wireless, unified wireless LAN solution is based upon wireless and controllers and LWAP enabled access points so when we decided to deploy this we had a broad number, a wide number of options when it came to the wireless LAN controllers. We chose to deploy the WISEM, the Wireless Service Module at our camps sites or multi-building sites and a variety of the appliance based controllers, the 4404, the 4402 and 2106. Each one of these are wireless and controllers but they can sport different numbers of access points. There's no point for example in me deploying a 4404 which can support up to 100 access points at a site that only had 20 or 30 AP's. It would not be cost effective.

We made the important decision to go with full wireless LAN controller resilience so we adopted what we call an N plus N model. Now this is different from the typical N plus 1 model where you deploy enough devices to support your target audience and then you add an additional single stand like controller, we decided to go with an N plus N which effectively doubled the number of controllers we deployed so a good example would be if we consider our Tokyo office. Now Tokyo office has approximately 160 access points and if we were to support that fully we would, and with an appliance, we would need two 4404's each supporting 100 AP's and then just a single extra controller would give us the N plus 1 so 2 – 200 supported AP's, we only have 160 plus 1 would give us the N plus 1 but we opted for the N plus N, so in actual fact we deployed 4 controllers in there.

Now the reason we made this decision is because we wanted to ensure that we had full resilience in the solution. If we considered that wireless networking or the NexGen wireless LAN is a primary access medium and we had a situation in Tokyo, hypothetically speaking, where a controller failed, we have 160 AP's, one controller fails, that means there's only a capacity to control or manage or keep up an active 100 AP's, that means you know almost a third of your service availability or AP's have disappeared so that's not really – we didn't feel confident that we had that, we didn't feel confident in relying simply on the N plus 1, we wanted to go with absolute full resilience, full redundancy.

As I mentioned earlier we have a broad number of sites, we have sites that are all the way from 2 or 3 people in some of our what we call VSL, very small sites, all the way up to multi-building campuses like we have here in San Jose where we have 50 buildings and over 20,000 employees. So again we have to consider at what sites do we deploy

what controllers so we undertook a site categorization effort where we – rather than just doing it on an ad hoc basis at every site, we'd come to a site and guess well what do with this circumstances, we defined a list of sites, six categories and we came up with 3 variants if you will, of the architecture that could be applied at each of those category, those site categories.

*Julie Nordquist:* And I think you're going into a little more detail a little bit later on on that.

*Oisin MacAlasdair:* I have some slides and I'll tell you but I'll describe that in more detail.

By increasing or decreasing, increasing the number of access points or decreasing the user to AP ratio, we effect – historically we had a 25 to 1 user to AP ratio so typically speaking if you on a statistical basis if you looked at the legacy wireless LAN across the globe you would find that for every AP there was around about 25 users. We based it upon the users as opposed to the native floor space, so 25 desks, 25 seats per AP and because we wanted to increase the available bandwidth for users we opted to double the number of AP's or decrease the user to AP ratio. It's two sides of the same coin if you will.

And the actual AP's we actually adopted were the latest brand, the latest flagship products available so the AP 1131AG and for sites where some circumstances and some locations around the globe where the dot 11A frequency range or the dot 11A wireless net –WiFi protocol is not A to 2 dot 11A is not a officially sanctioned or regulated or legal to use, we opted for the trail 42 which is a modular access point and we put in a, just a G only module so we are still providing up to 54 megs of available bandwidth, obstansively 20, 25 megs in real world terms in those locations and we also use the 1242 interestingly in locations where we need an external antenna, the 1131AG has integrated antennas and the 1242 allows us to use external antennas so we can use patch antenna's, directional antennas where we might have a challenging environment or where we want to –

*Julie Nordquist:* Do you have an example of that?

*Oisin MacAlasdair:* A good example could be just an oddly shaped office or some of our data centers where we have a high or lot of metal or if impacting environmental challenges and some locations in Europe we have some buildings or some offices that were in buildings have very, very thick walls or a lot of steel reinforcing in, you need to ensure that you have, a good example we have one office in Europe in particular which is a very, very small office and we wanted to use a small or long thin office if you will so we wanted to use a, just 2 AP's and use directional antennas to cover the length row didn't have, maybe 3 or 4, 1131's and we wanted to minimize the bleed or a bleed on the network, outside of the actual physical office space.

*Julie Nordquist:* Makes sense.

### **Design Considerations**

*Oisin MacAlasdair:* Pairing the access points, how do we want to pair the access points, obviously we wanted to ensure that we didn't have to run actual AC power to every single locations in the ceilings or on the walls where the AP's were located so we adopted the power or regenet option which is probably pretty straight forward and typical in most deployments today. One interesting challenge we did have however was the new AP's they have quite power hungry in some ways so we needed to ensure that all of the access layer switches that were deployed in our offices around the globe supported the latest 82 to 3AF PAOE standard. So in some circumstances typically not in the emerging markets or the new offices where we deploy, you know typically they would have newer equipment but some of the older offices we had to wait for a technology refresh to

ensure that the access layer switches, the blades themselves were upgraded. This is something that we undertake on a regular basis anyway.

Internally we have this problem called the fleet program which ensures that we maintain a consistently capable infrastructure and we upgrade, with make major upgrades to our underlying foundation and fundamental infrastructure on a typically 2 to 3 years basis. So there were some sites we have to wait, the dependency if you will was they blades to support the delayed attitude, power Ethernet and protocol or standard.

When we actually chose the decisions we made on naturally deploying the access points, well if we think, if we give ourselves a thought experiment and consider a site that may have a cat 6K or catalyst 6K as an access layer switch which have multiple 48 port blades to support access ports and we didn't want to deploy or connect or interconnect every access point to just one single blade because then you're introducing another single point of failure and if that single blade for some reason, this does not, is not common as highly unlikely we do get a blade failure, you don't have to ensure, you want to avoid the fact that all the AP's because they were connected to that blade, all your IP's would fail so we ensured that we spread our AP's over multiple blades. Typically we actually ensure that we put 2 AP's per blade, supports 47, 48 on a cat 6K as a typical configuration we adopt.

And finally the AP controller registration if you will, and because we're going with the N plus N module or model we have the options of well the decision was how do we configure the – how do we ensure or distribute the IP's amongst those controllers? Do we go with a full salt and pepper approach where we you know one IP is on one controller and one IP is on the other controller, do we put all the AP's on one controller and have the second one just as fully standby or do we split them?

Well the answer to that is actually a bit of both so in the sites where we deploy the appliances or the 4404, the 4402 and the 2106, we spread the AP's 50-50 across the controllers and in the group world on the campus sites and I'll talk to more to more detail on this in a moment, we put all the AP's on a single controller or single WiSM blade.

### **NexGen WLAN Architecture at a glance**

*Oisín MacAlasdair:*

If we look at the slide in front of us now, it's a rather busy slide in some ways but it gives again it gives a schematic overview of the NexGen wireless LAN architecture at a glance. The top of the page we can see the concept of multi-building campuses where multiple buildings are served by a single collection, a single group of two or more WiSM blades that are in the data center or the NOC for those multiple buildings and this is a campus environment. We can see that while it's management capabilities are provided by the WCS and support the location based services by the location server, the 2710 location server, both those and the actual dual WiSMs in fully redundant cut 6K controllers or chassis provide support to multiple buildings and those buildings are collected into clusters. Again I have a schematic that will hopefully make this more clear in some following slides.

*Julie Nordquist:*

I just want to ask you one question. Sorry if this is obvious but for the location services, what is that for? Is that –

*Oisín MacAlasdair:*

So the location server supports the capability of the location based services and this allows us to put a third party or they call asetile tags on high value assets in our data center and therefore we can track those, we can locate them and track them. In some of our test environments there are individual testing equipment that sometimes are extremely costly so we sometimes, individual pieces of equipment that

cost in excess of over \$100,000.00 US, you want to make sure that you can A, locate those when possible and B, that they don't, that they aren't used or taken from that location without record right? You want to be able to track those expensive assets.

*Julie Nordquist:* Are those deployed in every, at every deployed area or is that only when you need those services?

*Oisin MacAlasdair:* So we only deploy location-based services when a customer, that is a customer like \_\_\_\_\_ or an internal IT business, customer business client requests that capability. So we have a 2710 location based server and when that is required to support that capability. Now the wireless controlled system, those give you real-time visibility into your client devices but if you want to do large scale location based services or support for RFID you really need the location server, it offloads that computing capability off the control system so it's effectively adding additional horsepower to the concept of location services.

At the bottom left we see a schematic that gives you an idea of the remote sales offices or the field sales offices and the architecture there is pretty straightforward. We have 2 resilient or in some circumstances 4 resilient and dual or quad controllers to support the AP's in those sites and in very small sites, what we call VSO's we have opted for only a single controller. Now I know that goes against what I said earlier but the exception is we do have some exceptions and these are sites that are very, very small, they may only have 1 or 2 employees and the whole network infrastructure of those sites has a lower SLA so the SLA at those sites typically is P4 so it makes economic sense for me, another way of looking at it is why would I spend more money on making the Wireless LAN have a higher SLA at those sites when the underlying infrastructure to which those AP's are connected is only a P4 anyway so we adopted a lower SLA a few selected sites where we only have a very small number of AP's and users.

### One architecture, three models

*Oisin MacAlasdair:* So I mentioned the different variance, it's a consistent architecture if you will but with 3 different variance or 3 different models. The first variant is the multi-building wireless solution, the campus environment. In these circumstances we typically use \_\_\_\_\_ some circumstances actually quad WiSMs depending upon how many AP's are supported in a multi-building campus you may need 2 or 4 or even 6 controllers but the underlying consistent characteristic is that they're in a dual chassis so you have fully resilient cut 6K chassis and 2, 4, 6 WiSM controllers to support the number of AP's in that variant, in that group site.

The second variant and this is probably the most common variant, the actual number of sites and that the fall of this variant is the most number of sites if you will and this is a single building solution so a field sale offices we have, oh at approximately 170 of these probably scattered around the globe and we got dual resilient controllers so difference here is it's a different model depending upon the number of AP's so it could be a 4404 or it could be a 4402 on the street you know 4402 that supports 50 AP's or 4402 that supports 25 AP's and a 4402 that supports 12 AP's and I have a table in a subsequent slide that hopefully will make this clearer. But these are sites where we have the high SLA, we want to have fully resilient capabilities so if the controller fails and the standby controller is there to provide full system resilience, service resilience and again this is critical when we keep reminding ourselves, we positioned this as a primary access medium and we can't afford for the entire network to fail simply if a single controller fails so we need that resilience. And then the third variant is those small number of single building sites which have a lower SLA and on those sites we

typically go with a small, a single smaller 2106 controller.

### Site categorization

*Oisin MacAlasdair:*

So how do we think about the different sites and how do we categorize them? So we have over 400 sites around the globe, 400 buildings scattered across the globe in over 100 countries at the moment so we decided to categorize them into 6 different groups. The categorization is really based upon the number AP's that are required and if we cast them on back to an earlier slide, the number of AP's required is based upon the number of users because we go with a typically an AP to user ratio. So if we had a site for example, hypothetically speaking, say with 30 Cisco employees and we have a user to AP ratio of 15 to 1 you – we know roughly when we're initially doing the design for that site it's going to be N or and 2 AP's if we have a site with 150 employees we know it's roughly going to be around 10 AP's. And so we can see the number of AP's is used to categorize, to define the category of the site and the number of AP's is effectively another way of saying the number of users.

The third category dictates the final variant that is applied for that site and it should become clear in the following slide.

### Site categories

*Oisin MacAlasdair:*

So as we can see if we look at the top of the table here we have the group 1 campus site, this is design variant 1 and typically more than 100 AP's in each one of these buildings or sites and it's an N plus N WiSM so fully resilient WiSMs which are in the cat 6K chassis and the number of buildings we have this is in around about 73 and at the moment that number is in a state of flux as it is a dynamic marketplace at the moment, so that number fluctuates this time and in or around about 3,000 access points.

Groups 2, 3, 4 and 5 are all field sale offices and they are, we applied the variant 2 at all of them so the only real difference between groups 2, 3, 4 and 5 is the number of AP's. If I think of a – and therefore the number of AP's dictate the controller that is required to support those.

*Julie Nordquist:*

So those four different site – types of sites have different controllers.

*Oisin MacAlasdair:*

Different controllers because the design variant is identical.

*Julie Nordquist:*

Okay because of the number of users.

*Oisin MacAlasdair:*

Because of the number of users. If you think of a group 5 site that might only have say 10 X access points, it doesn't make sense for me to deploy two 4404's that can support, each 4404 can support 100 AP's and then go with an N plus N model so I'd have to deploy two of them so I'd be deploying the capability to manage or support 200 AP's when I only have 10 there. It just doesn't make economical sense and that's one of the benefits or the value of the unified wireless solution that you have such breadth of options available to you, you can put in a WiSM module that can support up to 300 AP's because it has two controllers in pair blade that supports up to 150 AP's each and you can put in a 4404 that can deploy – that can support 44 – 100 AP's all the way down to the 2106 that can support up to 6 AP's. So you really have a menu if you will of choosing the most appropriate device or model number that's appropriate for your actual particular site or your environment.

### Campus sites-Variant 1

*Julie Nordquist:*

Actually I had one other question on that last slide, are the different sites more difficult to support? Is there a difference in your support model?

*Oisin MacAlasdair:*

Typically not and the campus sites tend to be slightly more complex

insofar as you have to configure the cat 6K chassis to any and those aggregation points the diagram in front of us now goes into some detail on that and typically no, I would imagine maybe a campus sites tend to be slightly more complex and therefore slightly more support intensive but it also has the flip side of that coin is that your campuses tend to be where the majority of staff and the majority of IT organization reside anyway. So, the easier sites to support are the variant 2, the groups 2, 3, 4 and 5 where we effectively shift the AP's or they are arranged for the Cabling bennet to install in the controllers I brought up and it's almost plug and play, it's a very – we've actually achieved a significant optimization in our – we set ourselves a goal of 10% operational optimization and we've actually achieved somewhere between 30 and 50% savings in operation optimization so the our support costs have decreased dramatically.

Variant 2 where we look at here, this is the campus environment. This is the group 1 sites if you will and obviously it's a centralized wireless LAN solution, variable number of AP's, typically more than 100 AP's per building, the schematic on the right hand side of the slide there is implying that you have multiple buildings per cluster and each cluster is supported by 2 cat 6k chassis and N plus N number of controllers. Not only that but the clusters is then grouped into a mobility group so you can actually support roaming between these buildings so you can roam between buildings in the cluster and you can roam between clusters the mobility group. And obviously your management capabilities are supported by the wireless control system.

### San Jose clusters and Mobility Groups

*Oisin MacAlasdair:*

This is a simplistic map of the San Jose campus and hopefully it goes to somehow to explain this in a more straightforward manner, if we look at the colored globes or blobs there on the screen, they're effectively showing how you can regroup multiple buildings per cluster. So if we look at cluster A, B and C in red on the right hand side of the screen, each one of those clusters is supported by a set of 2 cat 6K chassis with N plus N number of WiSM modules but because they share the same color, they are also in the same mobility group so we support seamless roaming between those, between buildings of all the same color. Now it's also been we've been quite careful in the way we've designed insofar as we look at cluster A, B and C, they are actually quite a bit separated physically from clusters 1, 2 and 3 so even though we don't support seamless roaming from cluster A to cluster 2, the fact is that they're so far away then the road from each other than the changes are that someone would roam between those is pretty small and the same goes for site 5. So what we've done in this circumstance is you can see in the San Jose campus we have a total of 7 clusters. Seven clusters, each cluster supported by Dual Cat 6 K and chassis with multiple N plus N as a linked WiSM modules.

### Campus design detail

*Oisin MacAlasdair:*

Campus design, this campus design detail, this slide goes into slightly more detail and it than the two previous slides but we can see at the bottom there is an upper building basis that the AP's are connected directly obviously to the access layer switches where for actual data connectivity and the power of the Ethernet and the switches themselves obviously then connected to the distribution or the desktop gateway and those in turn are connected to what we call the cluster gateways so the buildings within the San Jose campus and the \_\_\_\_\_ technology part of campus in North Carolina, the Reading campus in the UK, the Bangalore campus in India, the new multi-million dollar campus we've recently opened in Bangalore, they all follow the same access layer topology or design where multiple buildings are connected to clusters where our model of following the desktop architecture or topology has fitted quite nicely, it's like handing log if you will so at the campus

desktop cluster gateway is where we actually hang or install our dual cat 6K WiSMs, that wireless aggregation point if you will. So the AP's obviously register with the wireless LAN controller, the WiSM controllers are \_\_\_\_ L3.

### Medium to large Field Sales Offices-Variant 2

*Oisin MacAlasdair:* At the medium to large field sale offices, this is quite simple architecture in reality, it's the centralized wireless solution as ever and typically between they say 5, 6 access points all the way up to 98, 99 access points and it is in these locations where we use 2 resilient or in some circumstances like Tokyo, 4 resilient appliance based access points or controllers so the 4404 or the 4402, the different variants and the management as ever is broadened by the wireless control system. Now one interesting challenge that we did encounter is of course with 7,000 access points across the globe we needed to use multiple wireless control systems so we've got a wireless control system per theater so we have a wireless control system that was dedicated to support the access point or access points and the controllers in the Asia Pacific region, one that supports the EUEM or the European and Emerging Markets theater and one that supports the Americans.

*Julie Nordquist:* What's the reasoning behind that?

*Oisin MacAlasdair:* Well initially when we first began to deploy the solution in mid 2000 – mid 2005, about mid to late 2005 and the wireless control system wasn't capable of supporting up to 6,000, 7,000 AP's. With the latest release of wireless control software and I'm not sure yet the unified wireless LAN solution software version 4.1 which was recently released and we've seen the introduction of a concept called the WCS navigator and that gives me a single portal now so I'll know I have a single point where I can go to access my multiple WCS servers. Historically or previously the engineers would need to realize oh, what if I'm going to support the Asia Pacific, if I'm going to go and do some management or some reporting or some troubleshooting or some analysis of Asia Pacific network, they would need to go to a very specific control, wireless control system. Now we have a single point of management if you will.

*Julie Nordquist:* Oh that's terrific.

*Oisin MacAlasdair:* It is, it allows cross cat reporting, it's really made our lives pretty easy or easier I should say.

### Very Small Sales Office –Variant 3

*Oisin MacAlasdair:* And finally we have the small, the very small offices variant and these are pretty straightforward in their circumstance, we probably don't even need a schematic here to show it so it's 2 to 4 access points. We never have a – we typically have a minimum of 2 AP's in support because that gives us a degree of resilience and it's a single 2106 wireless LAN controller we've adopted. Interestingly we did consider the use of – tis a configuration option when you're deploying access points, they were access points called hate-reap, for hybrid REAP, R-E-A-P or Remote Edge Access Point and that was very intriguing to us, we were very excited by the capabilities of that insofar as it allowed us to have, interrupt or centralize AP's without a local controller, however the challenge that we faced in that circumstance was and simply one of regulatory domains where we needed multiple controllers to support multiple regulatory domains so it didn't make a perfect fit and it is something we're keeping an eye on for – as the solution continues to develop.

And we also looked at the ISR or Integrated Services Riter option, there's a network module like an embed controller you can get in a network module that fits into a ISR slot and whilst we were quite excited

about the opportunity that provided us one thing that we weren't able to do is guarantee, like probably all major global multi-site enterprises and when we have many, several hundred ISR scattered around the globe, we couldn't guarantee that it was a free ISR slot in every single site so in the end we opted with the 2106 and we're very happy with that decision.

## WLAN Management

*Oisín MacAlasdair:*

We touched on management earlier, so how is our management capabilities provided? Well we have multiple WCS servers that provide management capabilities on a regional basis so we have two WCS servers in San Jose, one that manages the Americas, one that manages, and one that manages the Asia Pacific region. We'll soon be moving if you will one of those WCS servers down to Asia Pacific but we're waiting for to build that of the data center in Hong Kong and we have the WCS server also in Amsterdam that supports the EUEM region. And we also have a WCS server in Riley Technology Park, RTP which provides management capabilities for the East Coast and North and South America.

The one in San Jose, because San Jose is a large, if you will in some ways it's almost considered a theatre in itself into HQ's such a large area we have a dedicated WCS for San Jose. The other one in San Jose is for Asia Pac. The WCS and RTP, those are the Americas and the WCS in Amsterdam does on the European region and you can see we have a couple of location based services scattered across the globe at present only 2 and that's your fact we're very soon gonna expand that greatly because we are looking at the location based services capability in Amsterdam in the new data center in Amsterdam and we're also considering it for the new campus in Bangalore where, we have a location based services pilot underway in Bangalore and it's proven so successful we're going to install a 2710 location server there as well. We expect the additional location servers will come online as the client; again this is internal Cisco IT clients, as client and customer interest and demand for location based services increases.

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*Oisín MacAlasdair:*

So finally what I would like to do is spend some time just giving you an idea of support costs. It's all well and good in deploying this infrastructure and the cost of the deployment if you will, be invested by the list prices alone, it was almost \$14,000,000.00 worth of list – list full, full cost list price but I mean invested probably your in \$3,000,000.00 in vendor fees and over \$1,000,000.00 in internal Cisco IT, supporting the actual deployment, we make such a – when you make such a major investment you want to make sure you are getting your benefits from it and you also, not only that then you have to consider what are the support costs so we are – when we are presenting or when we've talked to some of our major customers in the past, they always seem to be quite interested in well you've talked about operation optimization, how much, what is your TCR, how much does it actually cost you to support.

## Support calls

*Oisín MacAlasdair:*

On average in Cisco at the moment we have a support call burden of around 1,500 calls per month and normal hours it's usually slightly bit lower at the moment, on an annual basis, we at the moment our average has increased slightly because we did have a spike 6 months ago when we changed the back end authentication model so when we look at the annual, normalized averages surrounded by 1,200 maybe 1,300 to 1,500 calls per month.

We have 50 to 60,000 active wireless LAN users so when we undertook this voice, not the voice of the clients, of the subsequent survey, 97% of our Cisco employees reported that they used the wireless LAN on a

regular basis and we defined regular basis as several times per month. So 50 to 60,000 active users is quite a high number and remember we also mentioned that 42% of employees so over 20,000 users say they use it as their only or primary access medium so we have a huge number of users on the wireless network all day, every day and we consider those numbers, that's approximately about, just over a third of a call per employee per annum or if you will .03 of a call per month. So the actual support calls are much lower than one would expect if you were considering this. Some of this I suppose to be fair is probably because the technology isn't mature, technology and the availability is very, very, very high with NexGen wireless LAN. We've seen in the dramatic increase or in service availability and a reduction in service impacting incidents.

Early I mentioned that we had service sales goal of 75% reduction, in reality when we did the analysis, it proved to be a 90% reduction unless you have a full case study video that goes into the video that goes into the benefits of the wireless networking solution, the NexGen wireless LAN solution that is available on the Cisco on Cisco web site and the URL we'll finish with it in a few moments. But just to give you an idea like the support costs have decreased dramatically and we're very happy with the support burden at the moment.

You have – every support call has a cost.

#### Global WLAN Case load

*Oisin MacAlasdair:*

We can see here the cases per month, as I said we have a 50 – on average of like 1500% and up to 1500 cases per month, we can see a dramatic spike in our cases of June of last year and this obviously caused such the alarm bells running in an IT organization \_\_\_\_\_ cause that and we did some analysis we found that one of the greatest challenges in supporting a wireless LAN is obviously client management. You're taking quite often the most overlooked and challenge but it's also the large or most challenging one. Supporting the infrastructure by comparison is pretty easy, especially when you look at something like the unified wireless LAN solution. With the AP you literally, it's almost plug and play and the controllers take 90% of their day to day configuration and management away from the IT, that IT engineering staff so most of your actual support burden tends to fall to the end users and that's typically along the basis of and problems with authentication people can or configuration.

So we saw quite a significant spike in middle of last year and we did some deep diver, some root cause analysis, we found a lot, most of that was related to configuration changes in a back-end authentication store that hadn't been, hadn't filtered down correctly or successfully to all of our clients and profiles, the client profiles so it basically created a cause or created the need for an employee or user to ring the helpdesk and they were told well you need to configure, reconfigure you client and the lessons we learned from that of course is to let the dust settle when you make changes to the back-end authentication store and models and to ensure that you do have a clear communication plan with all your, with all your users and this is something we do undertake but it's you know sometimes we were so keen to make the changes and to deploy the new client which were in the process of doing so that we probably experienced a spike that we could have avoided. But it's still giving us a, still on an annual basis we're still only talking about 1,500 calls per month.

*Julie Nordquist:*

So the spike was an anomaly –

*Oisin MacAlasdair:*

Oh absolutely, yeah, yeah.

*Julie Nordquist:*

But you've got lessons learned out of it.

*Oisín MacAlasdair:*

We most certainly have lessons learned from it and we solve approximately 77%, just under 80% of our calls are resolved by front line support so have a three, actually a four tier support model. Tier 1 is the GTRC or the Global Technical Resource Center, that's our internal helpdesk. Tier 2 is our IT operational support staff so these are network engineers that are tasked with maintaining the operational integrity of the network infrastructure. Tier 3 are the actual design team, the team that lead with designing the actual solution and then tier 4 which we rarely, rarely get to, is the actual, the B or the tack in most of our audience will be familiar with the tack and yes, we are customers a tack also.

We typically want to set ourselves a target of the 90% case closure by frontline helpdesk and we haven't reached that target yet so I think there's some improvements for us to do, we're at 77 which is not necessarily a bad number but I, our target is 90%. Once we get the second line support, typically to go from tier 2 to tier 3 to tier 5 it's only about a 5% case escalation so it's very, very rarely that we actually get, without a handful reach tier 3 and very rarely indeed we got a case was escalated tier 4 and that's the occasional problem that we need to tack the actual business unit themselves involved and quite often sometimes esoteric so configuration issue.

*Julie Nordquist:*

What do you think would, what needs to happen in order for you to get to that 90% target?

*Oisín MacAlasdair:*

Well we have a strategy in place for what we call operation optimization and the biggest thing is user communication. I can't emphasize enough the importance of user communication. We also define what we call the FAQ's or Frequently Asked Questions which we give to the GTRC, the helpdesk agents and those define the top 10 or top 20 most common questions and the users log a case for and when a user logs a case the GTRC agent will say okay well I know it's this issue and he has an answer or script to follow that will resolve that issue and what you need to do therefore is continually or on a periodic or a regular basis, let's say no continual but on a regular basis, analyze the cases that are called, that are submitted to your helpdesk and see how the, are you seeing a recurring problem that your GTRC agents are not familiar with or don't have a –

*Julie Nordquist:*

An FAQ for -

*Oisín MacAlasdair:*

An FAQ or in the knowledgebase \_\_\_\_\_ the knowledgebase we have \_\_\_\_\_, in this case you just make sure that you document the resolution, you can also want to take again, never underestimate the importance of client communication so we have a regular what we call IT news or My IT News, these are regular updates we give to all of our employees globally and they cover all technologies within IT and if there is a tips and tricks for example that you tell your users 'did you know' for example, this is if you encounter this problem you can resolve this. We also have internal web sites and we have users can go for self-help so there's a services portal where people can go to the wireless services, wireless LAN services page and they can get access to the FAQ's themselves if they don't want to call the GTRC and access to the instructions how to configure their client for home use, how to configure their client for hotspots, typically one in the same, and those kind of issues so it's a case of how do you reduce your support calls, well education, it's pretty obvious when you stop and pause and think about it for a moment. How do you reduce people logging calls cause they need time the person or user or an employee makes a support call, it costs money so and people make calls because they need some help or they need education; how do I fix this, how do I configure this. So the more education, the more information you can put at your users fingertips the better and the more you can reduce your actual support

burden.

## 2<sup>nd</sup>/3<sup>rd</sup> line support

*Oisin MacAlasdair:*

Second line support as I mentioned earlier, that's the tier 2 and tier 3 support, that's provided by our team, I think 3 ½ FT or full time equivalent staff across the globe. That's about a team of 7 to 8 individuals but none of them are dedicated to Wireless 100% of the time so yeah it's typically 50% of a what we call an SME, or subject matter expert or someone who becomes an expert of through the wireless technologies in that particular area. When we add the 50% here and the 50% there we come to about approximately 3 ½ full time equivalent engineers and actually that number has begun to or decreased, we talked about an operation optimization of 10% with the set ourselves as a target we've actually accrued a real world optimization of anywhere between 30 and 50% and again we go into more detail in this in our Wireless LAN benefits case study and the other, the accompanying baud which is also available on the Cisco and Cisco site. And the team is globally distributed so we have the IT operations staff that's a tier 2 support if you will and we have then the global field services which are a outsourcing partner or they also provide operation support and then we have the vendor resources who are available in typically where there's on resource demand and finally we have the actual design team itself if you will and they're scattered across the globe, my cell phone based in Perth, western Australia so probably one of the most, smallest and remote Cisco offices in the globe but we also have experts in Israel and in San Jose and in Raleigh Technology Park so we have a globally distributed team with SME's or Subject Matter Experts in each theater so if a problem does have to be escalated past tier 2 to tier 3, we don't have to necessarily wait the 24 hours or the 12 hours until the you know for the people in the U.S. or the people in Asia Pac are available. There's an actual, typically a subject matter expert available in each theater.

## Cost of Support

*Oisin MacAlasdair:*

So what does this actually cost? What is the cost? Well typically when we're looking at the cost of support from front line user support perspective there's a, we set aside the cost at \$25.00 per call, so that takes into account the number of cases a typical agent can handle in a month or a year and the cost of their, you know with providing the with equipment and hiring and salary etc. So when we look at the number of cases, 1500 cases per month or that's approximately 18,000 cases a year, that gives a cost of \$450,000.00 in front line support.

Three and a half FTE, well when we're budgeting a project we adopt a cost of 36,000 per quarter or 144,000 per annum so 3 ½ FTE we're talking about just a little over \$500,000.00 in second and third line support. So this gives us a total of just under \$1,000,000.00 per annum. That may sound like a lot of money in reality when you consider you've got 50 thousand 50 and now this number is increasing every week actually and when you have 50 to 60,000 active users that's only an annual support cost of just over \$19.00 per user. So if we were to adopt a charge-back basis which typically actually Cisco IT does not, we have a global IT services budget and but we do do some what we call CFP, Client Funded Projects but we don't charge for this \_\_\_\_\_ sort, in the model we've adopted in our deployment and services provision because we have an underlying budget and we applied the services. Wireless networking is considered a foundational service so and you just don't have –

*Julie Nordquist:*

I know I rely on it –

*Oisin MacAlasdair:*

Exactly well 50% of our users rely upon it exclusively and so but where we need to adopt a charge-back model you know the service will pay for

itself with simply or 19, say 20 bucks per annum so it really has become an optimized service, it is not, it's very, very cheap to support in comparison and the benefits have been very, very, very large and self evident to not only to us as an IT organization but also to our user population.

#### To learn more about Cisco IT experience

*Julie Nordquist:* Well that's all the time we have for now. Thank you so much for being here Oisin.

*Oisin MacAlasdair:* Thanks Julie, it's been my pleasure.

*Julie Nordquist:* For additional information on Cisco's next generation wireless LAN or to learn more about other Cisco IT experiences with Cisco technologies and solutions, please visit the Cisco and Cisco web site at the URL you see here now. This web site gives you access to more than 100 case studies and operational best practices on a variety of Cisco deployments.

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*Julie Nordquist:* We'd like to thank our viewers for spending time with us and being interested in the global technology seminar series. We hope you've enjoyed this program. See you soon.



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