

## 10 Storage

Hello and welcome to this “Cisco on Cisco” seminar on storage-area networking. I'm Phil Lauden, a Cisco IT Storage Manager and your host for the show. The theme of our show today is the Cisco IT storage story starting with why and how Cisco migrated to a storage area network and what we have learned and gained from our SAN migration in the last three years. It's my pleasure to introduce the star of today's show, Bill Williams, who is the Manager of Storage Operations within Cisco IT responsible for designing and operating storage area networks within Cisco IT data centers. Bill has been with Cisco for over five years and has been a part of the Data Center Operations Support Team all that time. Bill, thanks for coming today. Thank you Phil, it's a pleasure to be here. And it's a pleasure to be able to share our story with our customers and our partners of what we've learned about storage area networking over the last three years. So sit back and enjoy as we explore Cisco IT's past, present and future of storage area networking and some of our lessons learned. Let's begin with a quick summary of our storage story.

### CISCO IT STORAGE SUMMARY

Excellent. So we begin with a paradigm that disc is cheap but storage and storage management is expensive. And this leads to all sorts of problems, especially when you couple in that growth is rampant both inside and outside of the data center as part of the business as a whole, but data center space is also a premium. So there are some trickle-down issues there. At Cisco obviously poor storage utilization represents an enormous ORI potential and keeping on top of that is a full-time job. So to that end we're creating a consolidated storage utility model based on building storage as a service. And at the bottom of this, at the very base we're building this on top of Cisco's end-to-end storage networking solutions. So our storage utility model reduces our overall TCL, provides storage when needed, as needed and at the appropriate service and cost levels.

### SLIDE 3

So let's take a quick look at recent history and then we'll go from there.

### CISCO IT STORAGE LANDSCAPE

So you see from the graph, going left to right we've actually been growing roughly 50 percent over year-over-year in terms of our actual data served and stored online. Now obviously there's some expense associated with this. Typically storage is roughly 50 percent or more of the overall data center budget and currently we support roughly 2-1/2 petabytes of actual SAN storage or raw SAN storage. Now over time we've been moving away from direct attached storage and building out our storage networks and our NAS or our network-attached storage to serve our customers and our clients. So typically we see roughly a 50/50 mix of SAN and NAS utilizing the network and network services for our storage infrastructure. Typically we also see our cost reducing over time, or lowering over time. And we're talking about roughly -- we see in 2005 timeframe, we're talking about a TCO of between three and four cents per megabyte, down dramatically from ten cents over time on the last 2-1/2 years.

### CISCO IT STORAGE DATA CENTER STORAGE ARCHITECTURE (EARLY 2001)

Now it's important to understand that in the past we've managed storage and servers as siloed pieces of infrastructure or stovepiped infrastructure. And we see here that roughly we're talking about a scenario where we've got servers and storage direct attached and possibly some tape or NAS attached storage units attached to the network but not shared according to business practices or functions. So we might have a silo in HR for example, or we might have a silo in Finance. And these resources inside the silo or inside the stovepipe cannot be shared because they're not attached to the network as a whole; they're actually just attached to the server. And then again we see from



overall standpoint that the storage itself is poorly utilized because there is no sharing and because we're not sharing that infrastructure. So historically we've seen utilization rates from as low as 10 to 15 percent, both in the CPU and in the storage space. The same goes for NAS filers, we actually have NAS filers in a number of areas outside of the Cisco data center. And we're trying to consolidate those as well to bring those back into more of a data center infrastructure where we can share the resources accordingly.

## **CISCO IT STORAGE EARLY 2001 – CHALLENGES**

Now issues with direct attached storage. Obviously when you're growing at 50 to 100 percent per year, sometimes triple digits over the last six or seven years, direct attached storage does not actually scale very well. There's a lot of hands-on work that has to be done to actually manage the storage and to manage the devices. So it becomes a management burden overall in terms of operational efficiency. Then you actually have the issue with the total number of devices expanding as well. As you see more and more poorly utilized devices we see the number of devices start to scale upwards as well and we want to reverse that trend and bring back fewer numbers of devices to manage. Obviously there are some issues with process and things like provisioning. We're dealing with sort of immaturity of the storage management software world, which I think Cisco has done some to address as well in terms of managing switches. But overall just in general because of the way devices have been managed over the past we see that they're relatively inefficient managed. There are very few efficient management tools in terms of storage management software, so a number of things, challenges in that space. Also around capacity planning, typically this is a very labor-intensive application to try to understand how much storage we're using and how much we're actually saving and those are things that require a lot of hands-on work as well. So overall we couple these with our inability to be able to provide cost visibility to our clients. And we see that we have typically a very high TCO and very poor storage utilization. So there are a lot of opportunities going back several years and sort of reversing some trends, catching up with the technology as we move along.

## **CISCO IT STORAGE UTILIZATION AND THE STORAGE LIFECYCLE**

Now I don't want to spend a whole lot of time sort of laboring over the different types of utilization. But I think that it's important to understand, with the storage lifecycle and storage lifecycle management or managing a piece of storage equipment through timelines, this ultimately really talks about our overall storage utilization and our strategies for managing storage utilization. So we'll just begin with the physical storage on the left. We're actually talking about the storage when it arrives at the shipping dock or the loading dock. And so typically we look at this like a supply chain and managing from supply on the left-hand side to demand on the right-hand side. So in terms of physical storage it's fair to say that we're 100-percent allocated at that point because this is what we had bought, it's what we purchased, it's what's there when we open the crate. Now in terms of configured and addressable storage, these are metrics that we have to keep an eye on in terms of how we configure it for our business processes. So the types of RAID that we use or mirroring and there's a loss rate there at that point in terms of our ability to actually use the storage that we have onsite. So it's overhead, like for example Rate 1 would be 50-percent overhead. So once you've configured that then you're already at a 50-percent utilization rate. Exactly, exactly. And those are things that we have to keep in mind. It doesn't mean that it's not used, it means that this is what we have to do to it to make it ready for use and it's the cost of doing business ultimately is what we're talking about. So going all the way to the right-hand side, when we talk about making the storage available to the application and making the storage available to the database, whether it's a file system or a database, it doesn't really matter. But how efficiently the storage presented to the data is actually used inside of the database. So when we talk about this typically we would talk about allocation efficiency on the left-hand side, which is sort of the supply chain component of it and then the utilization efficiency on the right-hand side, which is actually the demand side of the equation. So managing how Oracle or managing how file systems are using the storage that we present to them. And obviously we have some new numbers for our last fiscal year where we see that we've actually increased again in terms of our overall accumulative utilization by roughly 5 percent over the 30 percent that you see here. So cumulative is allocation efficiency times utilization efficiency. That's exactly right. Okay.

## **CISCO IT STORAGE VISION DRIVER – ROI POTENTIAL (UTILIZATION)**

Now when we talk about an ROI potential or really in terms of what we're talking about is how can we do cost avoidance? What can we put together in terms of a strategy to have some cost avoidance figures that we can use to sort of justify our investment, what we can do to actually run our business better. How do we manage our storage and what are sort of the pluses associated with doing better business or better stewardship with our storage? So we put together a model basically using the numbers that you see here in the slides around roughly a 20-percent increase in allocation efficiency, or that host utilization figure. So the model that you see here was built roughly on 1.1 petabytes of storage, so about half of where we were two years ago in terms of SAN attached storage. So we took that number, the 1.1 petabytes and then put together based on our current or then-current TCO of ten cents per megabyte. And we came up with the fact that if you run the numbers that essentially a 20-percent utilization increase roughly gets you about a 10-million-dollar return on your investment over the course of three years. So there's a lot of things that have to happen to get to that number and if you don't do those things you might see six-percent or even less utilization on the host side. And typically we figured out that the break-even number was right around five to six percent. You would see actually negative numbers in terms of your investment. So coupling it with the architecture you have to build the strategies for managing usage, managing demand, managing host allocation. Those types of things have to happen as well, but again you can't do those either if the architecture isn't built accordingly as well. Right, so if you have isolated storage, direct attached storage, there's very little you can do with boosting utilization by sharing those resources. That's exactly right. Now to that end, if you are all direct attached storage, your ROI potential is significant because you're basically starting from zero so there's a lot of room to grow. If you're built around a consolidated data center infrastructure, your ROI is going to be less and it takes more active management as well. So moving from direct attached to SAN islands to consolidated data center SANs, you see the ROI potential decrease but you also see your efficiencies increase.

### **SLIDE 9**

So let's talk about our storage vision and the strategies that we built, basic learning about two years ago.

## **CISCO IT STORAGE EARLY 2001 – VISION**

The vision for roughly -- actually going four years ago. So going back to 2001-2002 timeframe we looked at our environment, we looked at the technologies available to us and we knew where we needed to go in terms of, these are the steps we have to take to build a consolidated network storage architecture, that storage as a utility. And we knew that we had to build these on our resources that we had -- so in terms of our people, our business processes, our software and hardware technologies that were available to us. Now the goal obviously was to consolidate, to reduce points of management and implement storage as a utility-wide service. Ultimately this reduces our TCL and increases our efficiencies over time, so let's talk a little bit about our vision.

### **SLIDE 11**

The first one I'd like to hit on obviously is people and probably the most important component.

## **CISCO IT STORAGE; STORAGE VISION ENABLER: PEOPLE**

In 2002 we switched from having a virtual team of storage managers to a dedicated team of storage managers. So in terms of a virtual team we had roughly I think ten people who were also host owners, who were systems administrators but they worked on storage roughly ten percent of the time or so. So they had team meetings but they would eventually just go back to the stovepipe and go back to the infrastructure and it was pretty much business as usual. So there was no sharing of business practices, no sharing of best practices, or sort of standards across the board. So we switched to a dedicated storage team model in 2002 timeframe, and we found this to be a huge enabler for our success over time. So essentially we took away the host ownership component, we assigned people to do nothing but storage and focus on storage management, focus on standardization and we found this to be extremely successful. Now obviously we've grown over time, we've built the team out to roughly four Project Managers, nine full-time Storage Administrators/Storage Managers. And we've found



that our operational efficiency has increased significantly. In terms of our managed storage per FTE, we're roughly 2,022 terabytes per FTE, which I think is roughly double the industry average. So I think that's significant, it's a sign that we've made a lot of good decisions over time. We still retain the sort of virtual storage team for global communications, sort of a clearinghouse model to talk with Engineering and Sales and other functions inside of Cisco so that we have some standardization across the board and we can also provide feedback to the business in terms of their products -- where we'd like to see the products go, because we are one of Cisco's largest end-users of products. And in terms of our overall infrastructure, now we've taken this same model that we've used for storage and we've built this out for the overall infrastructure. So in terms of the database and the network, we've moved away from the silo. We're actually getting all of the major components of our architecture together to have the same type of infrastructure and team to support the infrastructure worldwide and that's also been very successful.

### **SLIDE 13**

Now in terms of our processes and our software, we'll talk a little bit about this vision enabler and I think that one that we've had a number of successes with as well.

### **CISCO IT STORAGE; STORAGE SUPPLY MANAGEMENT**

And I mentioned earlier that we talked about storage as a supply chain where we manage the supply chain from end to end. Supply side is typically the component that we own and manage. And a lot of this comes down to just straight device management, so the current practice is to utilize the management tools from the device vendor, whatever vendor that might be. Then we also want to leverage a common tool internally, whether it's an SRM tool. We would like it to be a commercial package where we can actually manage all of our devices from a single pane of glass. And from one perspective we've actually done this with Cisco Fabric Manager. In terms of managing the SAN, we actually do manage MDSs, the Cisco switches, SAN switches with Fabric Manager Server from a single pane of glass. So roughly 100 devices worldwide. We manage those devices through Fabric Manager Server. In terms of storage we're still building out that infrastructure. In terms of NAS, the same thing. So in terms of network attached storage, we would like a single pane of glass. And I think that's where we're moving towards internally. There are tools on the market; I think some of them will fit the bill over time. But today the only one we've successfully done from a single window or a single pane of glass is the actual Fabric Manager Server piece managing the fabric.

### **CISCO IT STORAGE; STORAGE SUPPLY MANAGEMENT**

In terms of supply management, so managing from the application side and a lot of this is built around the tools on the market today. So storage resource management tools, SRM, we actually have to build out our reporting metrics and our framework, that's a piece that you're intimately familiar with. But essentially it's a cornerstone for building out storage as a utility. If you don't have the metrics you cannot measure and you cannot compare where you were to where you're going and so forth. So obviously reporting and metrics, building out service-level agreements, and being able to manage to those -- key for accountability and resource management. So we do have a couple of off-the-shelf products installed today. We are still attacking that problem, the supply management problem from both ends, so working from both ends of the supply chain. But essentially we have to manage our resources as best as we can with a handful of custom scripts, internal deployment of things other than spreadsheets, right? So we're going to get away from the multiple-stream model.

### **CISCO IT STORAGE; STORAGE SUPPLY MANAGEMENT**

In terms of demand management and supply management again around storage virtualization. So this is a key component going into 2006 and 2007. I think anybody who looks at the market today will be hard-pressed to find something that doesn't talk about virtualization. And obviously the issue is, "What are we talking about when we talk about virtualization?" And I think you'll probably see different things from different vendors. Ultimately the goal for storage virtualization is to lessen the burden of managing the supply component. So by that I mean dealing with migrations and dealing with sort of data mobility and the ability to make migrations transparent to the host. So

ultimately what happens when we move or refresh two to three hundred terabytes of data per year, we're talking about anywhere from a hundred to three or four hundred hosts impacted by that. So we need to be able to make that painless to our end-user and painless to the people that are actually doing the work. So storage virtualization, key concept take-away there is that is a key enabler for data mobility. So the main thing is with virtualization the host doesn't have to take an outage to see the new storage. Exactly, exactly. And this becomes more and more critical as we virtualize the host as well. When we talk about having lots and lots of data spread across many virtual hosts, we need to be able to make that as seamless as possible as well because the numbers of hosts impacted then again becomes almost exponential. Right, so you could have 20 or 30 hosts per physical host and now you're impacting that many more -- Yeah -- Virtual hosts with the storage change. Exactly, absolutely. So we've been partnering with our Cisco partners as well. You yourself have been involved in the data projects for those as well. So we see this as a key in it for sort of the tail end of FY05 or this calendar year. Early part of next year, I think we'll see a lot of traction in that space.

### **CISCO IT STORAGE; STORAGE DEMAND MANAGEMENT**

Now demand management, I mentioned earlier. So again moving from the right-hand side of the supply chain, we're talking about sort of managing the service level. Again managing the services themselves and adding in a layer of abstraction so that we can actually measure our performance and actually perform to our goals as well. So you see a number of our services listed here. There are seven primarily focusing this year on provisioning and on capacity and performance management around reporting. So these are key for us to be able to communicate in a timely manner how well we're managing our storage supply, how well we're managing our demand supply and how well we're provisioning. So our time to provision, our TTP is a critical metric for our team to be able to actually go back and report to the business that we have provisioned X-number of terabytes. You know, under the wire, we want all the processes to be repeatable. And long-term we would like to be able to make this sort of a rote process -- which anybody can do provisioning based on a certain set of standards. And that's the only way we're really going to be able to get our services to be mature and repeatable and highly performing over time. One of the things that we're using to address this is a project that you've been working on as well, is the storage recovery project, which again manages utilization from internal to the application. So building out a portal that we can actually see on a day-to-day or an hourly basis, where our metrics are going, up/down, hopefully everything up, at least not TCO. But hopefully all of our performance metrics and our utilization numbers are going up and trending in the right direction. So we're talking not necessarily about always having the best performance. We're talking about having the appropriate performance for the SLA. That's correct. And that's what makes the metrics a little bit trickier. That's correct and so there are number of things that have to happen there, primarily a partnership with the business. If we have a justification of why something may in this particular instance need to cost more then that's something that everybody has to agree to going forward. Right. And often if it makes sense for the business, it's worth it to spend more. In terms of disaster recovery or HA or things like that, we just have to make sure that they match up. Right. So you don't want everybody requesting triple-A-grade storage, the fastest, the best, and the latest. There will be room for people who can use something that's not -- That's correct. -- at that high end. That's correct. Obviously we want to make sure that it fits the requirement. And I think often what we see is the requirements are unclear or unspecific. So we need to make sure that we're actually matching our services to the actual requirements of the customer.

### **SLIDE 18**

Obviously this is dependent on the architecture, the hardware, and the network underneath it. So let's talk a little bit about this vision enabler hardware.

### **CISCO IT STORAGE VISION ENABLER: HARDWARE STRATEGY**

You see another timeline here going back to the early part of 2001, and essentially I've already alluded to this. But we've moved from direct attached storage and sort of siloed network attached storage to overall to SAN islands and then to a consolidated data center SAN. So today basically we want every piece of storage on the network. So whether it's fiber channel or whether it's IP, iSCSI, network attached storage, we match the requirements of the device to the requirements of the application. And you see essentially it's been a four-year process to

move away from these sort of direct attached silos and to SAN islands, which ultimately were really only marginally more efficient than direct attached storage. At this point today, I think we're actually doing very well in terms of our overall strategy and implementing the hardware that we believe to support our overall guideline. Obviously it's built on the MDS platform as well.

### **CISCO IT STORAGE SAN CONSOLIDATION/MIGRATION TIMELINE**

Now this is just another way of looking at this. Ultimately we're talking about a five-year horizon, which we see on the left-hand side. We see the silos going from direct attached silos to, in the 2002 timeframe, to sort of SAN islands. And by SAN Island, I mean sort of fixed switches in the middle of a handful of hosts and a handful of storage devices. So ultimately SAN islands were used sort of as a stopgap measure to increase our port density to allow us to provision storage a little bit faster. But what we found was that moving through fixed switches for an environment as large as ours actually became more of a management headache than just the direct attached storage. So -- Because whenever you had to add more switchboards, you still had a similar issue as when you have to add more connectivity hardware to a host. Exactly. It's just you're relocating the problem. That's exactly right. So over the course of 2001-2002, I think we deployed roughly 50 to 60, maybe 70 SAN Islands worldwide -- Amsterdam, San Jose, and RTP, North Carolina. In 2003 obviously the MDS product line was announced and released. And so this was sort of our Phase 2 of our overall structure in moving towards the consolidated data center storage utility model. So 2003 or early part of January 2003, we deployed the first few MDSs here in Research Triangle Park. Through 2004 timeframe, and we actually began to sort of tier-out our storage. So moving away from the SAN islands to sort of a consolidated data center SAN approach and tiering that across our platforms. So you see here we built out a gold, silver, and bronze. We're still sort of tweaking those, the numbers that would be associated with those tiers. But ultimately the component that stayed the same was the MDS at the center of that.

### **CISCO IT STORAGE SAN CONSOLIDATION/MIGRATION TIMELINE**

Now critical for us as part of the data center SAN model is linking the data centers. And so obviously the MDS has the added benefit of being able to run multiple protocols in a single platform, a single chassis. So we've linked our data centers using FCIP on the IPS blade. And overall, so at 2004-2005 timeframe we've linked San Jose, RTP, and Amsterdam and I think some of our other development data centers as well on the other side of the globe. This is how we've managed to manage our fabric through a single pane of glass, using this infrastructure. We've also built some of our replication strategies across FCIP as well. So we'll talk a little bit more about some of the added benefits in the MDS. But in terms of our overall timeline these were the components necessary to get us in poised for storage utility model.

### **CISCO IT STORAGE VISION CATALYST: STORAGE CONSOLIDATION I, II, AND III**

Along the way in order for us to sort of more efficiently manage our storage and for us to sort of reduce the numbers of devices that we had to manage, while we were rolling out the MDSs we actually went through several phases of storage consolidation. So talking about physical consolidation really in the data center and using this as a strategy to again reduce the number of devices managed but also to reduce the stress on the data center itself in terms of actual physical space, in terms of facilities, in terms of power as well, which we were just talking about before the show. Those types of things, I think are critical for the overall strategy for the data center infrastructure. And most of the customers that I talked to have been through at least one or two phases of consolidation. I think it's important to understand the amount of work that's involved with that. But reducing the number and increasing sort of the footprint in a single tile in the data center but sort of reducing your expansion outward. So we're actually putting larger devices, more eggs in one basket ultimately, but a better architecture overall. So as I mentioned earlier, we've actually consolidated roughly two to three hundred terabytes per year over the last three years and you see the numbers here. In terms of ROI, typically double-digit ROI every year. Greater than 50 percent ROI on investing in new capital, at the same time pulling out the SAN island infrastructure and removing direct attached storage. So building in, at the same time we're pulling out, we're putting in the MDS. So this has been a significant win for us as well as also reduced maintenance cost over time, reduced the strain and stress on the data center. So the key ... for us, consolidation over time.

## **CISCO IT STORAGE WHY CISCO IT CHOSE THE MDS 9509 SAN SWITCH**

Now I mentioned why -- or we talked about some of the added benefits in the MDS. And I think, you know, a lot of these are sort of self-evident but high availability, increased availability. Now those are things that any business can't live without. I think it's important to understand that, you know, the consolidation strategy is a component as well. We'd not have been able to consolidate as many devices as we did onto a fixed-switch platform. So the director class switch has solved a lot of problems for us in terms of our ability to consolidate multiple-switch fabric switches into a single chassis. Overall in terms of our ability to reduce cost MDS is a key player there because ultimately what happens is we've got an opportunity to put multiple protocols in the same box as well. So the ability for us to use FCIP or SCSI in a single device, along with our fiber channel network has been a significant win for us, again reducing the numbers of devices and then long-term our ability to provide intelligent network services for storage. And we'll talk a little bit more about that later. But the ability to actually provide an interface for things like SAN Tap, or our ability to actually do replication or continuous data protection through the same chassis. And we talked about virtualization as well. So virtual SANs enables us to manage multiple physical SANs through a logical interface or logical device mapping. So in terms of us having -- and we'll see some key examples in a few slides, but in terms of us having multiple devices on the floor managed logically in a single physical device. And I think that we've see reduction in our managed devices I think somewhere between six or seven to one over time. So that actually helped preserve the isolation that we had when we were stovepiped between the different business functions. That's a good thing. We don't want any single failure to impact multiple functions but we now no longer with ESAN technology need the separate physical devices. That's exactly right, that's exactly right. So overall we were able to sort of preserve the mentality or the business criticality of certain types of environment and still take that and make it transparent to the user that they may be sharing the same switch with another group that might be on a different tier. So ultimately this has gotten us to where I think we need to be in terms of our ability to provide the same class of service while still reducing our overhead.

## **CISCO IT STORAGE PRE-MDS (CONSOLIDATION PHASE I) ERP LOB (JAN, 2003)**

So let's talk a little bit about some specific examples. And we'll focus primarily on the initial MDS rollout, which was the January 2003 timeframe, so basically first product, first customer ship. And you see from the slides here we're talking primarily about our ERP, enterprise resource planning, and environment. And you see a number of storage devices here and you see these are grouped logically. These are physical discrete SANs grouped logically in the SAN island. So physical devices not shared between the two. So for example we see manufacturing, disaster recovery or we see ERP-11-I development, data warehousing. So all of these devices are physical, discrete units built on fixed switches. So each one of these SANs is a separate SAN and we're not sharing any of the devices attached to that. So you can see how we still have sort of this many-to-one concept where ultimately we're not sharing the devices and we still have sort of poor utilization. So a quick snapshot of where we were in January 2003 timeframe.

## **CISCO IT STORAGE ERP MDS INITIAL DEPLOYMENT**

Here is a close-up. We'll zoom in on just the 11-I development SAN island. So we see on the right-hand side a dual-fabric SAN with a couple of fixed switches attached to a single storage device. In the left-hand side we see another dual-fabric SAN with four fixed switches. I think a total, we're talking about roughly 150 to 200 terabytes of storage here in this environment. And again these are all physically discrete SAN islands.

## **CISCO IT STORAGE ERP MDS INITIAL DEPLOYMENT (STEP 1)**

And so overall as part of our migration strategy, we actually removed one-half of the fixed-switch infrastructure and replaced that with the MDS. So putting the MDS in the middle of this sort of interoperable with the overall fabric infrastructure. And then after about I think about three weeks we actually replaced the other channel as well.

## **CISCO IT STORAGE ERP MDS INITIAL DEPLOYMENT (STEP 2)**

It's important to note that all of this was done online with no interruption of service. Dual fabrics. Dual fabrics. So you took down one path at time, multi-pathing kicked in, the host never saw an outage. Exactly. And so ultimately what we see is those two SANs were reduced to a single SAN with a dual fabric. And then we've actually gone a step further in the next phase where we reduced all of those physical discrete SANs...

## **CISCO IT STORAGE ERP MDS INITIAL DEPLOYMENT – CONSOLIDATION PHASE 2**

...into a single dual-fabric-switch switched infrastructure here with only four switches. So we've taken out roughly I think it went from a ratio of about 20 to 4 in terms of the overall fixed switches. So our entire ERP infrastructure just built on a handful of switches. So I think this was a significant win for us overall, validating what we knew to be true -- was that these SANs were the way to go in terms of our ability to actually support the business increase availability and it was actually a key win for us.

## **CISCO IT STORAGE CISCO SAN SWITCH DEPLOYMENT – BEST PRACTICE AWARD**

We did win best practices in storage management at S&W a year ago, or sorry, two years ago now, 2004 timeframe. Today we're actually using roughly over 9,000 MDS ports worldwide. And we've deployed this, as I mentioned earlier with our two petabytes of SAN storage. So a tremendous uptake, tremendous usage of the product internally, and it's been significant, huge successes for us in terms of our ability to go forward with our overall strategy.

## **CISCO IT STORAGE SAN CONSOLIDATION PHASE 3 (JANUARY, 2004)**

Just to focus a little bit further on our long-term plans, so going back just in more recent history to looking at our SAN consolidation overall in terms of remaining phases. We see here an architectural diagram of RTP. So where we are today in our Research Triangle Park North Carolina. We're replicating between data centers here. So roughly just about 1-1/2 kilometers over dark fiber using fiber channel. And so we've linked this infrastructure and Building 5 with the infrastructure in Building 7. So hosting either data center can share storage across that infrastructure. So that's critical for us to be able to support our overall development infrastructure. So for 11-I, for example, numbers of copies of database is significant. Being able to actually share data across any number of hosts in Research Triangle Park, so across the two data centers.

## **CISCO IT STORAGE MDS 9000 IP STORAGE MODULE (FCIP, ISCSI)**

In terms of, I mentioned earlier our ability to do this also long-term using iSCSI or FCIP, so focusing on usage of the IPS blade inside the MDS. So we've actually been using iSCSI in RTP for roughly a year over that infrastructure that we just saw a few minutes ago. And long-term I think -- we'll also see a slide here talking about our overall strategy for HA and linking our data centers in San Jose to RTP.

## **CISCO IT STORAGE SAN CONSOLIDATION PHASE 4 (OCTOBER, 2004)**

So real briefly, we'll see RTP on the right-hand side, five and seven, which we just talked about, and then San Jose on the left-hand side. Two data centers there where we're talking about -- we've got primary and a secondary data center in San Jose linked over CWDM, and MDSs linked over CWDM using FCIP. Then over the long-haul from San Jose to RTP, we've actually linked the MDSs there using FCIP and asynchronous replication over our network. So over our long-haul network. So our ability to actually copy data from San Jose to RTP through the same infrastructure that we're using worldwide with the IPS blade and using the technologies available to us today. So again going back to increasing availability and providing increased classes of service.

## **CISCO IT STORAGE NAS CONSOLIDATION**

I mentioned consolidation quite a bit just a little while ago. So to talk about a similar but different example around network attached storage consolidation. So again we talked about the silo; we talked about the stovepipe. We're really talking about devices that are sort of stranded

or poorly utilized and we're not able to share those resources across the board. So again talking about specifically network attached storage, we're consolidating in the same fashion that we see consolidation of direct attached and SAN island storage, and looking at consolidating in the remote data centers. And a couple of examples here.

### **CISCO IT STORAGE CISCO REMOTE FIELD SALES OFFICE (FSO): CURRENT ARCHITECTURE**

We're doing it over a wide area of file systems, a wide area of application services. And just a couple of sort of proof of concept ideas here that we've used in the past and I think where we'll see sort of long-term goals around data center consolidation and remote office, remote field sales offices. So we see a couple of types of scenarios where either the storage is actually accessed remotely. We might have a remote field sales office and they are backing up, say for example, to a remote data center. Or we might have another type of remote field sales office where they actually have their storage locally where folks would come in, dock their laptops and drop off to their PowerPoints or their spreadsheets or what have you. And so in each type of scenario, there's a performance hit on the network either way, so backing up to the primary data center or accessing this data remotely.

### **CISCO IT STORAGE CISCO FILE ENGINE: WIDE-AREA FILE SERVICES (WAFS)**

And I think that we found in a number of scenarios here in specific, in Ukraine and Berlin where we found that we could have significant performance increases over the WAN by deploying the actual sort of the WAFs devices or the WAZ devices in terms of an overall strategy for increasing our IO and consolidating the number of devices. So either case, pulling the storage out of the remote data center and pulling that back to the data center, and then increasing the performance through the device. Or putting a device there to increase the ability to backup, you know, a certain amount of data in a set amount of time. Just in terms of our overall ability to reduce the numbers of devices managed, this is significant for us. So we're looking at the file engine series to do that as well, sticking with the same thing with consolidation throughout the enterprise.

### **CISCO IT STORAGE FILE ENGINE: PRELIMINARY PERFORMANCE**

We see here the specifics. So roughly I think it was roughly 80-percent increase in our overall I/O performance in one of those scenarios. And in terms of our ability to read or write files remotely, I think it was almost transparent to the users. So in terms of the user experience, either significant improvement or when we pull the data back, it was actually transparent. So I think that we'll find a number of remote field sales offices going in this direction over the next or in the course of the next year or two long-term.

### **SLIDE 37**

So just to recap a little bit what, I think that we've done our job and I think we've done it well. Obviously we have a long way to go overall in terms of our management strategies, especially on the demand side of the equation. But let's just recap where we are today.

### **CISCO IT STORAGE COST SAVINGS RESULTING FROM MDS CONSOLIDATION**

I think it's hard to argue with the fact that we've improved our availability. A number of the migrations that you saw were done online with no impact to the user. Again our ability to provide multiple protocols in a single chassis, I think has saved us a significant amount. I think over time roughly 25 percent in terms of operational efficiency around not only multiple protocols and reduced number of devices but the actual ability, as I mentioned earlier for us to support to roughly 225, 222 terabytes per administrator. So all of this is sort of built on the MDS consolidation platform. Again long-term, moving to our intelligent SAN fabric services model in terms of our ability to provide virtualization and continuous data protection through the SANTap API. So I think that in terms of our overall strategy, we've reduced costs on the order of roughly 25 percent overall. But long-term thinking, so you know another year or two out I think we're going to see that number increase even more so. So really we're sort of in Phase 3 of the overall data center virtualization component. And I think that again it's been very successful for us.

## SLIDE 39

I think we have some -- do we have some questions? Yeah, we put together some questions that customers have asked us about this topic in previous sessions. We have a little time left and I'd like Bill to answer a few of them. Great.

**Q.** Okay, first question, what's driving all this data growth?

**A.** Okay, fair question. And I think it depends first off on sort of the company that you're in or the line of business that you're in. But Cisco is really ultimately not very much different from our customers. I think number one and number two would probably be SOX and HIPAA, the Sarbanes Oxley Act or the HIPAA Act in terms of medical information and medical insurance data. Compliance. Compliance. Compliance. Primarily regulatory compliance and I think in the financial space, the FCC and folks like that have sort of set the bar very, very high for banks after 9-11. So I think a lot of this data growth obviously is regulatory. I think a lot of it also goes back to sort of the lifecycle management question we were talking about earlier. I think that we really are focused on integrating our processes with the business and really -- so I think that putting together a compelling story around what data is worthwhile to us and what data can be stored offline or purged ultimately. So a lot of copies of data and kept around forever because you're afraid to get rid of them. That's it primarily. And that's the same story that I hear from all of our customers as well.

**Q.** Right, all right next question, it seems like storage is cheap these days, so what's the big deal if our data grows at 100 percent?

**A.** It's true, raw storage costs are cheap. And I think that over time in the last I think five to six years across the board in the industry, the actual device, the storage device, has reduced almost 100 percent. And I think that it's very hard to tell people that, you know, this is cheap in terms of actual cost if you were just going to go out and write a check for it. But alternatively what we see is the cheaper it is the harder it becomes to manage because it proliferates and it spreads sort of like wildfire. So without an actual strategy of managing that storage, your operational costs can go through the roof. Not to mention the fact that the more of these devices that you have, the potential for I would say human error or device failure and things like that to impact a business is significant. So we believe that the fewer devices the better. And it actually keeps that sort of managed-terabytes-per-administrator number very high and it also keeps the business running fairly smoothly.

**Q.** All right, next question, what do people mean when they talk about information lifecycle management, ILM? Does Cisco have an internal ILM strategy?

**A.** Sure, so internally we are putting together a strategy around how we manage things like email and how we manage things like personal data and laptop data and financial data. And so overall I think it would be fair to say that there aren't sort of canned solutions out there that you can just go and drop into place. I think it takes a lot of work and it depends on the business itself. Information lifecycle management is essentially an excellent start, I think. But ultimately what it comes down to is managing your processes to the business processes and determining together as part of the business what the value of the data is. And you match the value of the cost of the storage to the value of the data. Exactly, exactly. All right, well thank you, Bill. I'm afraid that's about all the time we have for questions today.

## SLIDE 40

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### FURTHER STORAGE RESOURCES

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## SLIDE 42

I'd like to thank the viewers watching for spending this time with us and for being interested in what the global technology Seminar Series is all about. We hope that you've enjoyed the show and that it has helped answer some of your questions about supporting storage networking. And thank you, Bill, for spending this time with us and sharing with us your expertise and your enthusiasm for storage networking. Thank you, Phil. It was a pleasure to be here, and I hope that all of our partners and customers have enjoyed this as well. And we hope that you've enjoyed the show. See you soon.



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