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Building Consolidation Project

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Disclaimer

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Abstract

This project paper proposes a technical solution to the problem of consolidating, a company's two main Datacenters together into one single Datacenter. The project paper specifically addresses issues pertaining to the projects Local Area Networks, Wide Area Networks and Storage Area Networks.

The project paper will provide an overview concerning the requirements gathered for the project, a design to meet the requirements, a plan to implement the new designs, and provide information about the plans implementation successes and problems encountered.

Though the project lacked a common methodology, project schedule and did not meet certain key goals, the project was successfully implemented.

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Introduction

Problem Statement

Application Specific Integrated Circuits Inc. is a major International Corporation that designs and markets Computer and Communications Intergraded Circuits. Application Specific Integrated Circuits Inc. has made a business decision to consolidate its Fort Collins Harmony Design building and it's Fort Collins Danfield Manufacturing building into one central building. This central building being the Fort Collins Danfield building which is currently being expanded and remodeled, will be the new home to an estimated 300 ASIC employees and over 500 computers systems and networked pieces of equipment. This consolidation of buildings is expected to reduce the companies overall business expenses for ASIC's Fort Collins operations. Both of the Fort Collins facilities provide world wide resources for ASIC's day to day design and manufacturing operations.

Harmony Building **Danfield Building**

Figure 1

The overall problem confronting the building consolidation project is how to consolidate or merge the existing two Datacenters into a single autonomous network and at the same time keeping network and SAN services on-line, while limiting the associated downtime of these services.

Management at ASIC would like to reuse as much of the existing network equipment while still providing a high speed, high availability solution to ASIC's internal and external customers. The project plan, implementation schedules and equipment purchases will have to be approved by several internal ASIC departments including their Global Engineering Systems (GES) and Global Network Services (GNS) groups. The equipment purchases for the project will have to meet internal approval based corporate set standards.

Existing Building Network Services

Harmony Building

ASIC's Harmony facility, located in Fort Collins Colorado was built in 1998. The building has three floors and is capable of supporting 500 employees. Currently the building is underutilized and is home to only 125 employees. The Harmony building house one of ASIC's busiest data and design centers. The data and design center is a key hub of computer resources and data storage for the company. The overall Local Area Network (LAN) consisting of 6 Entersys switches connected together in a matrix topology architecture consisting of a 1gbps fiber backbone. The WAN consists of a DS3 MPLS connection connecting both the Danfield building and the Harmony building to the corporate intranet cloud.

The Data and Design Center also contains several small fragmented Storage Area Networks (SAN) which are used to interconnect its storage arrays and backup systems. The Datacenter contains two main NFS fileservers and two Engenio storage arrays which currently are the heart of the building data operations.

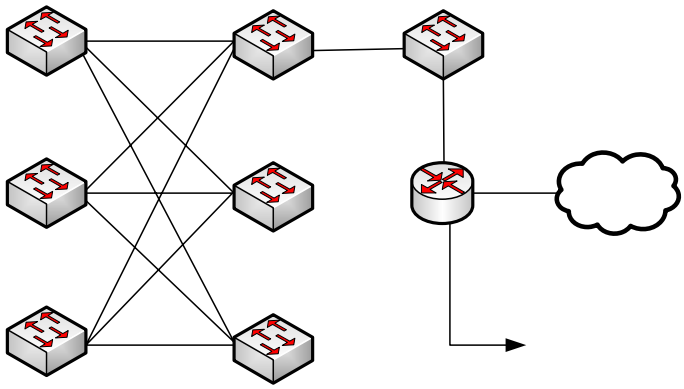


Figure 2

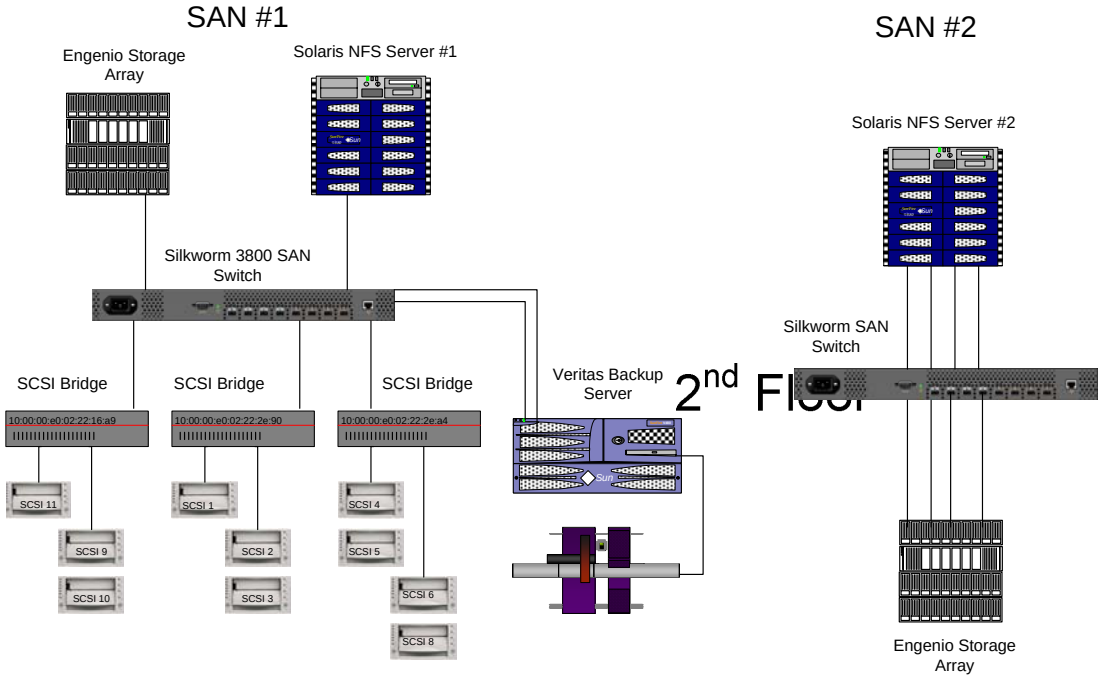


Figure 3

Danfield Building

ASIC's Danfield facility located also in Fort Collins Colorado was built in 1978. The building has three floors and is capable of housing close to 300 employees. The Danfield building has been utilized for several different business purposes throughout its history, one of which being a profitable Wafer Fab facility. Currently the Danfield building is home to a small manufacturing test facility. This manufacturing Test facility houses several different departments including Test Engineering, Reliability Engineering, Failure Analysis, and Product Engineering departments. The buildings existing network is a small LAN consisting of three Cisco brand switches and an assortment of other brands of network switches.

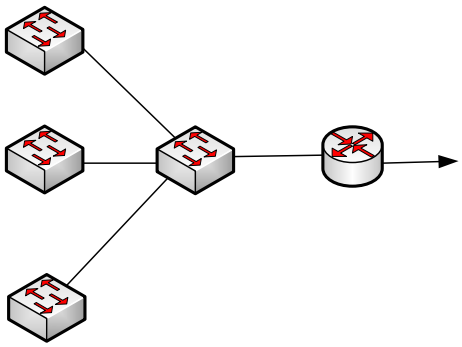


Figure 4

The Danfield building also contains two Engenio brand storage arrays for the storage of mission critical test data and their associated servers. There is also a small backup server which is used to backup this data with.

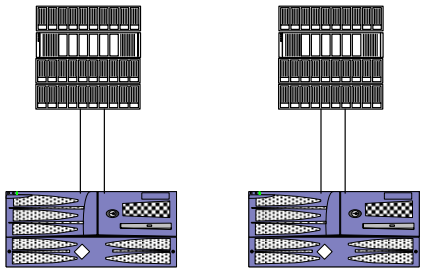


Figure 5

Overall Project Goal

The overall goal for the project is to consolidate or merge both the Harmony Datacenter and Danfield servers into a single Datacenter, while enduring a minimum amount of downtime. The project will also involve providing a higher level of communication speeds between the data servers and compute servers in the data center. The network backbone will be designed to provide a high level of availability where possible. All data cabling and fiber connections in the existing Danfield building will be replaced with new cabling. The Storage Area Networks will be combined into a mirrored SAN environment, providing a higher level of availability and provide a common data backup solution for the central Datacenter. The completed mirrored SAN design will also provide a building block structure for the implementation of a high availability clustering solution for the buildings NFS services.

Scope of Project

The objective of the project is to relocate all Harmony employees and all data services into the Danfield building before the April 1, 2006 deadline. All network equipment and wiring must be installed and operational before the data center move scheduled for March 28, 2006. All data services must be operational within two days after the initial move. All employees must also be able to resume normal work operations after being relocated. All data wiring and SAN designs to be completed before the six month project deadline. Maintenance period for the project will be an ongoing service through out the operational life of the network and SAN.

Special Problems Complicating Project

Special problems that could complicate this project include:

- No common project methodology between departments.
- Vendor / Contractor deadlines that will not be met.
- Changing requirements from internal customers.
- Hidden and unrealized customer expectations and demands.
- Equipment failures due to power downs and the physical move.
- Regional weather conditions for project window.
- Unrealized-Short Notice Customer Design Projects.

Project Methodology

The project will be implemented using the System Development Life Cycle (SDLC) over a period of 6 months with an expected completion date of April 15, 2006. The schedule for the project is very dynamic and ambitious in nature. This can be attributed to the limited and very short timeline submitted by management and the buildings facilities department. Included in this ambitious project are the complications mentioned above.

Project Analysis Phase

The project analysis phase was completed by collecting information from a number of sources.

These sources include internal ASIC departments consisting of:

- Customer Management.
- Facilities Department.
- Building Contractors.
- Global Engineering Systems Department – GES.
- Global Network Systems Department – GNS.

Information collected for the project included items such as:

- Building floor plans.
- MDF and IDF building locations, both existing and conceptual.
- Number of employees and data drops to be supported.
- Current numbers of data servers, compute servers and client computers to support.
- WAN / LAN Equipment and Speed requirements.
- Building Construction Schedules.
- SAN requirements.
- Equipment location requirements.
- Existing and forecasted LAN and WAN bandwidth requirements.

Building Floor Plans

The Danfield building consists of three floors, 1st floor, 2nd floor, and basement area. Each of these floors is further divided into three sub areas, east, west and far west areas. There is also a very thick cement partition wall that divides the east side of the building from the west side. Each of these areas or sections of the buildings will be assigned specific purposes. These can be categorized as employee cubes, work areas, lab work areas, and facility closets.

Danfield Building Layout

Figure 6

MDF and IDF Room Locations

Currently there are three Intermediate Distribution Frame (IDF) data closets in the Danfield building where data equipment is currently installed. Currently Ethernet cabling and fiber are pulled to each of these locations and is being used to provide data connectivity throughout the building. The IDF closets are located at key areas of the building to provide Ethernet cabling well within the required copper Ethernet cabling length requirements of 90meters. With the additional number fileservers and data equipment which will be added to the Danfield building from the Harmony building it was necessary that an additional new Main Distribution Frame (MDF) would be built. This MDF room would act as the new heart of the overall data operations for the building. All WAN equipment and connections would be installed to this room and then distributed else where in the building

Number of Customers and Data Drops

The existing Danfield building design is currently providing data services to 90 existing employees in the building. The Harmony building is currently providing data services to 150 employees. Each of these employees has two Ethernet data ports to choose from. There will also be an additional 40 employees that will be relocated from other existing external sites to the new Danfield building. This means that the new building design will have to support at least 280 employees and their associated computer equipment. At a minimum most employees have one personal computer to work from and about 1/3 of these employees also have UNIX workstation in their cube to work from.

Number of Data Servers and Clients

Currently the Danfield site has a total of 75 servers and workstations that are located in the IDF or building lab locations. The Harmony building has a total of 160 servers and workstations that are located in IDF, MDF or building lab locations. The new Danfield building will have to support at least 515 fileservers, compute servers and clients workstations after the consolidation. To better track all the servers and workstations involved in the project, a spreadsheet was created listing each piece of equipment. In the spreadsheet many pieces of information were listed including:

- Equipment hostnames.
- Number of Ethernet interfaces.
- Speed capability of interfaces.
- Media interfaces types (fiber or copper).
- Equipment locations and rack locations.
- Electrical Requirements.
- Other facility related requirements.

LAN Architecture and Equipment Requirements

Local Area Network architecture requirements were gathered from a project meeting held with internal network support personal from ASIC's GES and GNS departments. From the meeting it was decided that the new Danfield network design would incorporate the following basic design criteria:

- To incorporate a high availability fiber network backbone structure.
- To provide at least a 1gbps port speed capabilities to customers where possible.
- Dual supervisor engines per chassis to promote High availability.
- All switches to be of same vendor brand for interoperability.
- All switches to have redundant power supplies.
- Support contracts on all equipment.
- Single flat IP address space within the building.
- Reuse of existing network equipment where possible.
- All cabling to rated at least Cat6 capabilities.
- To allow for the ability of growth within the building.
- Wireless Access points to be located through the building.

WAN Architecture and Equipment Requirements

Wide Area Network architecture requirements were gathered from a project meeting held with ASIC's GES and GNS network support personal. From the meeting it was decided that the new Danfield Wide Area Network design would incorporate the following basic design criteria:

- To incorporate a high availability overall design where possible.
- Minimum connection speed of 45mbps or a DS3 rated WAN connection.
- To provide secondary VPN and Internet gateway capabilities outside of the internal MPLS corporate cloud connection.
- MPLS connections to be of such speeds as to allow for future growth.

- To incorporate multiple MPLS connections for high availability.
- All equipment to be of same brand for interoperability and compatibility.
- 7/24 - Support contracts on all equipment.

MDF and IDF Horizontal Cabling Requirements

Horizontal cabling requirements were gathered from the GES Department and with ideas from other external ASIC datacenter designs which had also dealt recently with the same type of projects. Requirements for the horizontal cabling for the new MDF and IDF locations included the following:

- Horizontal latter racks to be installed above all data servers and equipment racks within the MDF and IDF closets.
- Both horizontal Ethernet copper cabling and fiber cabling to be installed from racked patch panels to key locations within each MDF and IDF. These would be anchored to ladder racks.
- Wire management to be used to channel cabling to racks and servers
- Provide enough network ports, both copper and fiber to enable future growth without installation new cabling.
- Proper and easy to read labeling on all SAN cabling, ports and patch panels.
- All patch panels to be installed in the racks and provide both functional and cosmetic wire management.
- All patch cords will meet at least cat6 rated standards.
- Horizontal cabling to meet cat6 rated standards where feasibly possible.

Storage Area Network Requirements

The Storage Area Network requirements were gathered by the key members of ASIC's GES group.

Some of the major requirements for the SAN design of the project include:

- All key data servers and storage arrays to be integrated into a common switched SAN environment.
- All key SAN fileservers to promote self backup capabilities over SAN.
- SAN final design to promote the ability to implement Veritas Server Clustering technology.
- SAN switch hardware to be from a common vendor to promote inter-compatibility.
- Must be able to implement configuration and topology changes to the SAN without interruptions in data services.
- All SAN fibre connections and components to be labeled for easy identification and troubleshooting.
- All SAN hardware to promote High Availability where possible.
- All new SAN switch and fibre channels interface cards to support at minimum 2gbs connection speeds, but prefer 4gbs connection speeds.

Building Construction Schedules

The building consolidation project schedule is centered on the Facilities department's implementation schedule. One of the major obstacles with the buildings remodeling is what to do with the current employees and equipment that reside in the building. The answer for this was to systematically relocate employees and equipment from old areas of the building to temporary locations within the building. The employees would live in these temporary locations until their newly remodeled locations were completed. At times the employees would have to endure being moved three or four times before their final location would be completed. This can be described as a type of continuing game of employee musical chairs.

Requirements for the projects schedule were collected from a meeting with key members of the GES department and the Facilities group. The overall project was broken up into small phases or milestones. Each of these phases is centered on the completion of one area of the building at a time. As each of these areas or cubes is completed, network services must be on-line and available for each employee to utilize before the employee moves in. The project schedules were all centered round the ASIC's Facilities department meeting their schedule deadlines. The following schedule was submitted by the Facilities department.

- Phase 1 – 2/06/2006 – Employees move into 2nd Floor East
- Phase 2 – 2/17/2006 – Employees move into 1st & 2nd floors Far West
- Phase 3 – 3/17/2006 – Employees move into 1st floor West

- Phase 4 – 3/25/2006 – Fileservers move from IDF #2 into new MDF Datacenter
- Phase 5 – 3/28/2006 – Employees move into 2nd floor West and all Harmony Datacenter equipment moved into new MDF

Project Design Phase

Network Design, Research and Equipment Selection

MDF and IDF Closet Locations

The MDF and IDF closet locations were selected based on 90m copper Ethernet length requirements (TIA/EIA, 2006) and pre-existing closet IDF closet locations that was used in the building fro the previous LAN design. From this, it was determined there would be one newly built central MDF room and three preexisting IDF closet locations within the building. The MDF room would house all key fileservers, compute servers, LAN and WAN equipment. The IDF locations would contain user data port wiring pulled from each employee's cubes to patch panels mounted in the IDF closet. These patch panels would then connected to local LAN switches. These switches would then link up with the building LAN fiber backbone. Both the new MDF and existing IDF locations would contain 19" equipment racks that would contain patch panels and the required Ethernet switches.

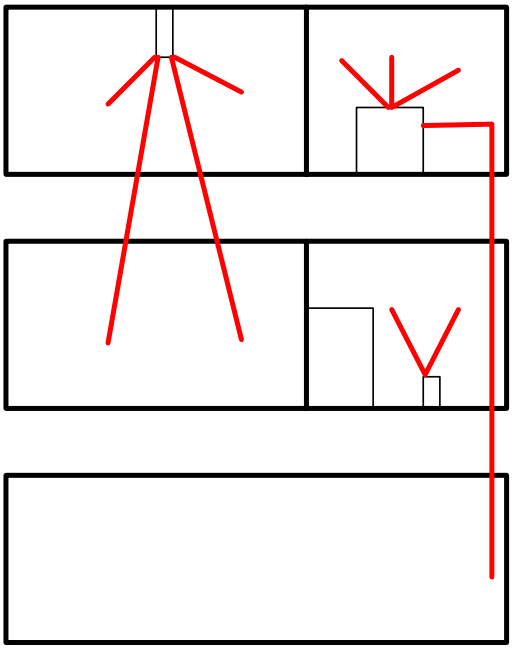
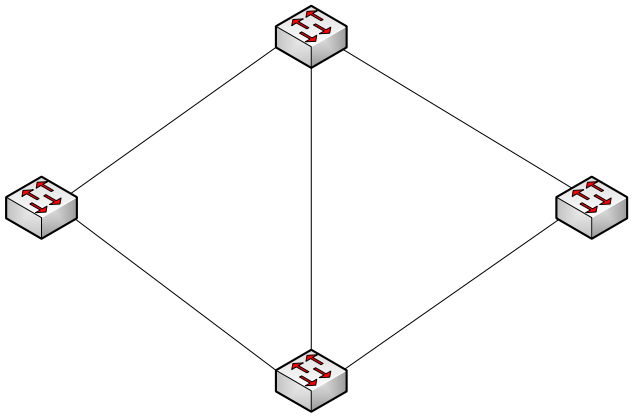


Figure 7

LAN Backbone Design

The LAN backbone design was designed around the MDF and IDF locations within the building. The backbone design would incorporate fiber cabling pulled from each IDF location to the MDF room. The design would reflect high availability architecture, but also be limited to what could be budgeted for the project.

The following design was agreed upon to provide both the high availability and the cost effective constraints which were sought after.



New Danfield Fibre Backbone Design
Figure 8

Network Connections to MDF and IDF areas

Each employee cube will have a total of two data ports installed. It was then assumed that only 1/3 of the employees would actually need both data ports patched into the switch. Using this number we could calculate how many actual switch ports would be required in IDF #1 and IDF #2. The IDF #2 location will also house additional backup servers and misc. equipment, so an extra number of copper and fibre ports would be added to the port counts. The number of data ports to be used in the central MDF location was calculated by using the inventory list, generated from the requirements phase of the project, to calculate the number of fibre and copper data ports required by each piece of equipment.

IDF

The total number of data ports required for each MDF and IDF locations for the project is as follows:

IDF Location	Total Number of Copper Ports	Total Number of Fibre Ports
IDF #1	410	8
IDF #2	284	7
IDF #3	150	4
MDF	123	22

MDF and IDF Data Ports Needed
Figure 9

Horizontal Cabling Considerations

The central location for all of the data and compute servers is the MDF room. This room will contain the key pieces of LAN and WAN equipment. An inventory of the data equipment shows that there will be thirty 19" racks of computer equipment and six worktables containing additional table top computer systems. These racks and tables will be lined up in rows to provide aisle ways that will allow access to the computer equipment both front and back. Most of the racks and tables have smaller Ethernet switches installed which consolidate the number of Ethernet connections required back to the central switch. The MDF room will contain a raised floor to allow cooling into the room to cool the equipment. Power to all the equipment will be provided from under the raised floor. It was decided by both the GES staff and the building Facilities department that the fiber cabling and copper Ethernet connections used to interconnect all the room equipment, be provided not from the under the floor but from an over head horizontal cabling system. A horizontal cabling design was needed to interconnect the computer equipment to the room's central Ethernet switch. Once the overall floor layout plan was completed for the equipment the following design was realized.

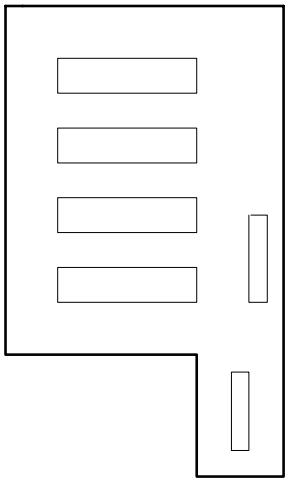
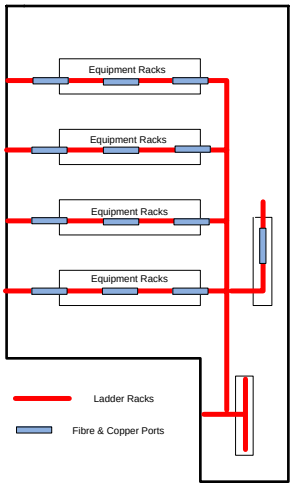


Figure 10

The horizontal cabling design will provide interconnection points to all equipment in the room and patch panels located near the room's central Ethernet switch. Based on the room's equipment layout and the number of required copper and fibre Ethernet ports, the following design was accepted the GES group and the building facilities departments. Horizontal racks would be installed above each equipment aisle way and blocks of fiber and copper Ethernet ports would be installed on the overhead racks. Each block of ports would contain 12 copper Ethernet ports and 12 fiber connection ports.



MDF Room Layout

Figure 11

Wide Area Network Design

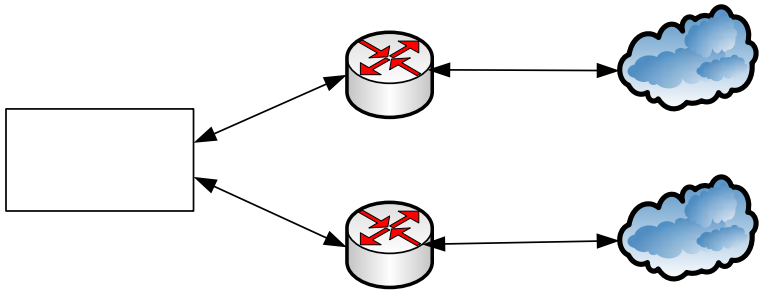
The WAN design for the project was designed from requirements gathered from ASIC's Global Network Engineering and Global Engineering Systems teams. The overall goal of the design was to provide a high availability solution to interconnect the Danfield building to the company's intranet via multiple DS3 45mbps MPLS connections. Other WAN services such as internet VPN connections and web gateway services would also be considered into the design.

The current WAN design (See figure 2) used an incoming DS3 MPLS connection to Harmony. This connection is then fed into a Cisco router, switch and finally fed into the Entersys switches. The Danfield WAN connection (See figure 4) was actually a dedicated T1 connection to the Harmony building which then connected to the MPLS cloud through the Harmony's DS3 connection.

WAN throughput data was gathered to determine average traffic rates and spike traffic rates for a period of time. It was found that the average traffic rate in and out of Harmony was to be 18mbps, with peak traffic rates at about 25mbps. On the Danfield's

T1 connection to the Harmony building it was found to have an average traffic rate of 900kbps, with a peak connection rate of 1mbps. With this information in mind a group meeting was held with the ASIC's GES and GNS groups to design a new WAN solution that would meet with everyone's approval.

The following new WAN design was realized and agreed upon from the meeting.



New Danfield WAN Connection

Figure 12

Wireless Network Access Design

The wireless access design for the building will provide all users seamless wireless access points throughout the building. (See Figure 13) The wireless design will consist of positioning wireless access points at six key positions within the building. Currently the GES department has eight Cisco Aironet AP1220 access point hubs to use for the project. The Cisco AP units are able to provide connectivity indoors from 90 – 400 feet (Aironet, 2006). This coverage will be more then ample to cover the first and second floors with wireless access. After installation there will be continuing monitoring in respects to coverage. Additional units will be deployed as needed if additional coverage is required.

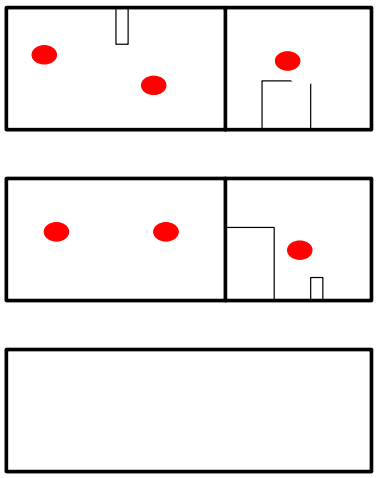


Figure 13

Selection of Network Equipment

With the basic WAN and LAN design realized the selection of the proper network equipment was the next step in the design phase. ASIC company policies for the purchase of new LAN and WAN equipment had made a corporate decision to purchase all WAN and LAN equipment from Cisco Networking Systems. The decision to purchase all new networking equipment from the same manufacturer promotes component compatibility, with better support considerations, and greater cost savings for purchases.

With this in mind the subject of reusing existing network equipment from the previous two networks was made very simple. Only three Danfield Cisco chassis, a 6509, 6506 and a 5509 switch chassis would be considered for reuse. All other existing legacy network equipment from both buildings would be abandoned.

An additional LAN / WAN design meeting was held to discuss the selection and purchase of additional Cisco network equipment to complete the consolidation project. Representatives from our corporate Cisco vendor and ASIC's GES group reviewed the LAN and WAN design and a recommendation from the vendor on what equipment to purchase was made. The recommendation was to purchase two additional 6513 switch chassis with newer dual 720 supervisor engines.

These switches would be used for the heart of the LAN, being located in the MDF and IDF #2. The 720 supervisor engines with the 6513 chassis would offer a single 20 gbps backplane for slots 1-7 and a dual 20 gbps (40Gbps) backplane for slots 9-13 (Supervisor, 2006). These backplane speeds would be more then ample for handling multiple 1gbps server/client connections using Cisco 6748 10/100/1g 48 port blades and Cisco 6148 fibre 24 port fibre blades.

The dual 720 supervisor engines in combination with the version 12.2 Cisco IOS firmware would offer high availability failover in event of an engine failure. IP Routing could also be preformed by the 720 supervisor engines. This feature in combination with Cisco's Hot Standby Router Protocol (HSRP) could also provide additional fault tolerance, in the event one of the two 6513 switches were to fail (HSRP, 2006). This would keep a portion of the building up and running while repairs could be made.

Additional supervisor engines would also be purchased for the existing 6509 and 6506 switch chassis. This would provide them some additional level of high availability in the event one of their supervisors was to fail. The existing 5509 chassis already contained two supervisor engines, so no supervisor would be needed. Additional copper and fiber Ethernet blades would be purchased based on the final design.

Final Overall Network Design

The final LAN design could now be assembled from the previous pieces of requirements and design information.

The following final LAN design was realized:

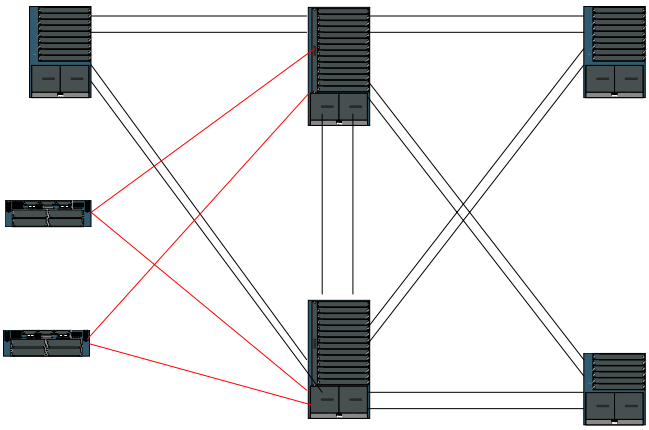
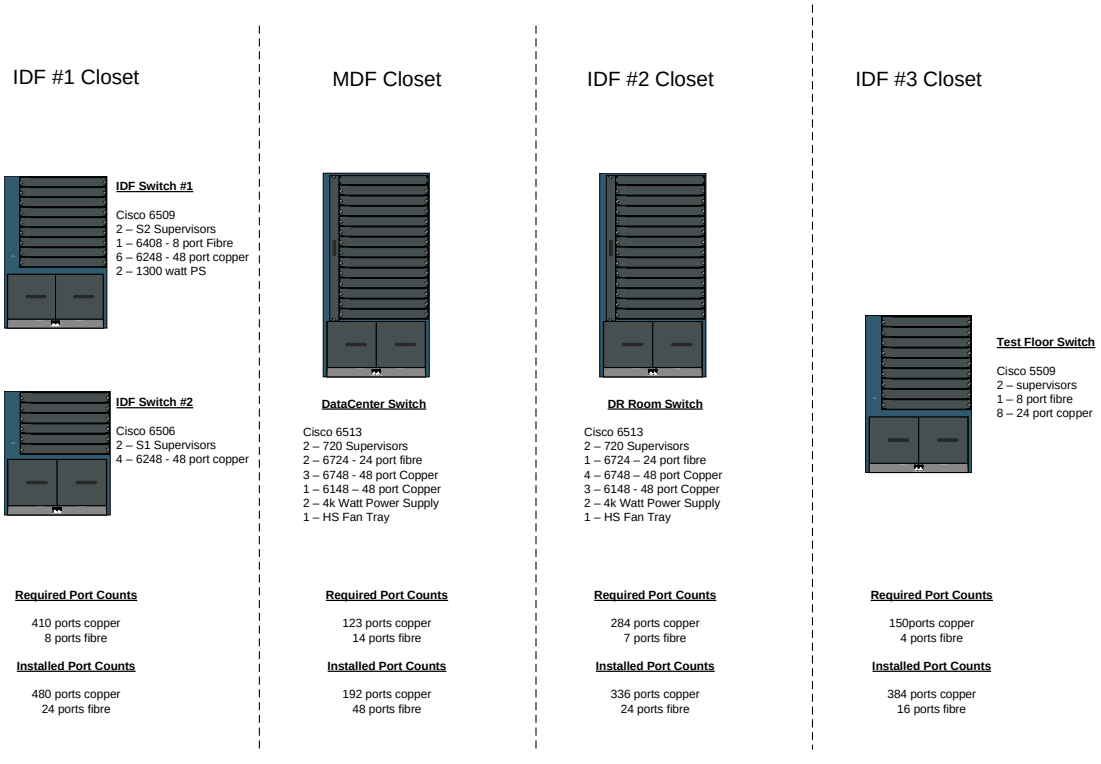


Figure 14

The two recycled Cisco chassis would be placed in IDF #1. This would be an ideal area for the switches to be deployed. These two switches will provide more then enough data ports to meet IDF #1 requirements. (See figure 15) The switches would only be processing simple employee network requests such as mail, web, and print services. Both of these switches would have redundant fiber connections to both the MDF and IDF #2 switches. Each of these redundant connections would be shared across both of the switches supervisor engines. This will provide continuing access to the LAN in case of one of the fiber posts or supervisor engines were to fail. The Cisco 6513 chassis will be

IDF #3 5

installed in the MDF and IDF #2 areas. The two units would be linked via a 4 line 1gbps ISL trunk. There also would be a single ISL trunk link connecting the two switches together as a backup link in case the main trunk would fail. The Cisco 5509 chassis would be placed in IDF #3. This area contains older and slower types of computer equipment. This switch would not be processing heavy network traffic. Redundant links would also be placed from the switch to the MDF and IDF #2 6513 switches. The building incoming DS3 lines would be linked to the MDF and IDF #2 switches. Internal LAN routing would be performed the on the MDF switch. With Cisco's HSRP services IDF #2 would take over routing in the event of a major failure on the MDF switch. Table 15 gives a break down of each switch and the hardware which be installed into each unit.



Danfield Network Equipment

Figure 15

With the final overall design completed a list of networking equipment to be purchased was compiled. The list was submitted to the corporate Cisco vendor for a detailed purchase quote to be created.

Contractor and Materials Selection

A contractor for the installation of the cabling and racks was selected. ACME Cabling Solutions Inc. based out of Denver was selected due to its long standing good relationship with ASIC and its outstanding reputation within the city for successfully completed large and medium sized projects. ASIC's GES team met with ACME Cabling Solutions and submitted their project plans and requirements to them for a quote on the project. ACME Cabling agreed to the projects requirements and its overall design. Materials for the project would be bought from System Y networking and cabling products. Systems Y's line of products offers a wide selection of materials to choose from. Systems Y products were attractively priced and offered a very successful history of within the networking community.

SAN Design and Consolidation

The overall design challenge for completing the new SAN was how to interconnect and integrate all the fileservers, storage equipment, and backup equipment together to fulfill the requirements gathered for the final design. This would involve converting the point to point fibre channel configurations into a switched SAN environment. The SAN had to provide a high availability design and also provide a design that would be allow the implementation of Server Clustering.

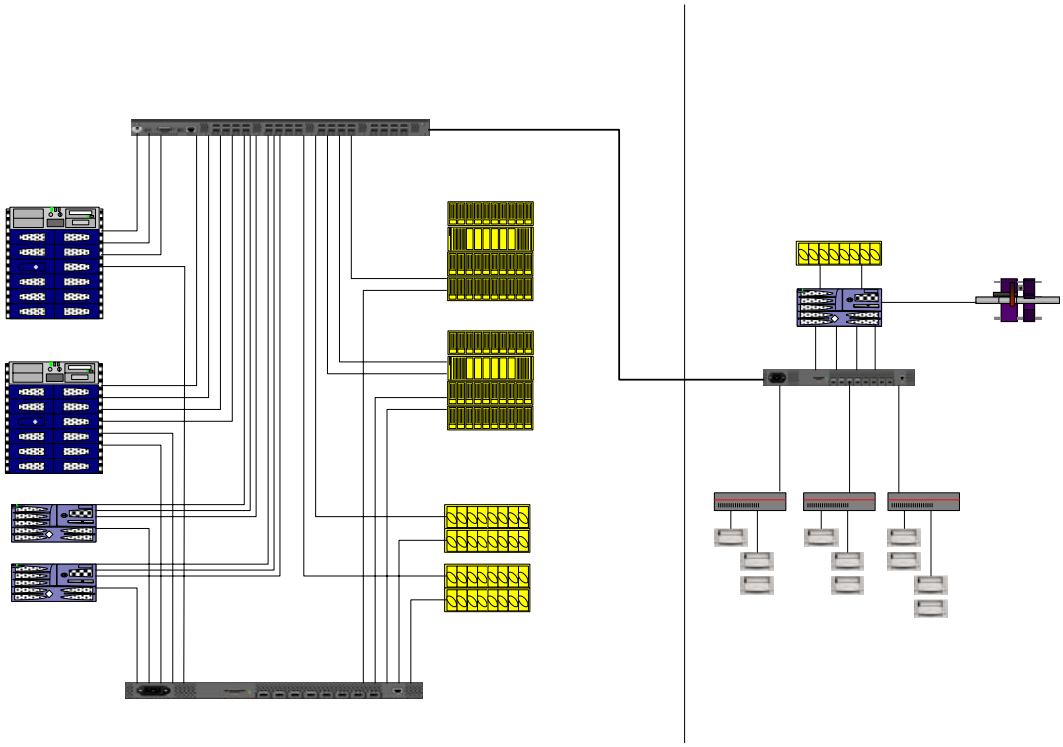
The equipment involved with the new SAN design includes four Engenio storage arrays, four SUN fileservers, one SUN Netbackup server, two Brocade switches (3800 and 4100) and three fibre channel bridges used for the SCSI tape drives.

The first task was to decide on a switched SAN topology to use for the design. The choices that were considered for the topologies were a cascade, mesh, multistage, and mirror. One of the requirements for the design was the ability to implement SAN changes without interruptions to data services. With this aspect in mind a mirrored SAN topology was selected for the projects design. The mirrored SAN topology would enable the staff to work on one side of the SAN at a time without interrupting any data services. It would also provide the ability to test new SAN configurations while limiting the chances of interrupting data flow.

Equipment placement would be the next consideration in the new SAN design. All the storage arrays and fileservers would be placed into the new MDF room. The backup server and bridge equipment will be placed upstairs in the IDF #2. Based on the number of connections needed between the fileservers, storage arrays and the remote locations of the backup equipment it was determined that an additional SAN switch would be needed to complete the project. An additional Brocade 4100 switch would be purchased to complete the project. The two Brocade 4100 switches would be placed in the MDF and the Brocade 3800 would be placed upstairs in IDF #2. With this design the

backup portion of the SAN could be worked on at anytime without interruptions to either side of the mirror.

Taking all this into consideration the final SAN design was realized:



Danfield - Final SAN Design
Figure 16

The new SAN topology and design was reviewed by ASIC's GES department for meeting the requirements of the design. The design was accepted and the purchase of the additional Brocade 4100 switch was approved.

Budget and Purchasing Considerations

Primar

Project costs for the GES department's portion in the building consolidation project centered around the cost for the buildings new network cabling, the cost of the additional network equipment and the additional SAN switch. Quotes for the additional equipment and the new cabling for the network came in as follows:

Costs for Building rewire:	$250,000.00
Additional LAN/SAN Equipment:	$225,000.00
Project Total Cost:	$475,000.00

The project's total costs were submitted to ASIC's management for project approval. The funds for the project were approved with no objections.

Planning Phase of the Project

Overall project schedule

Project planning started in October of 2005. A crude timeline schedule was released by the facilities department to the GES department. This would enable GES to start to prepare their own project plan and schedule.

The following Gantt chart was assembled by the GES department:

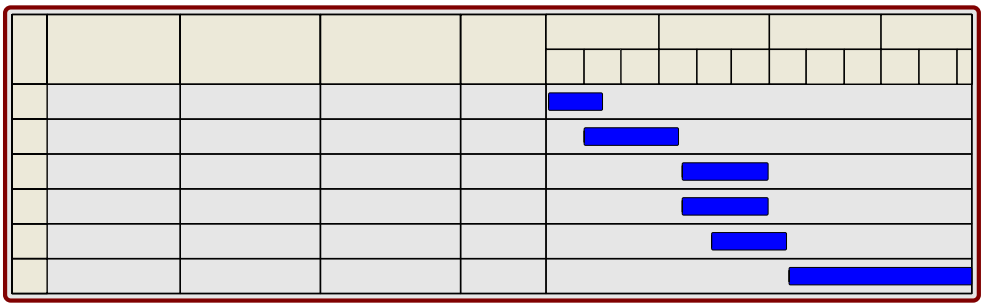


Figure 17

The projects planning and designing phases could be carried out well ahead of the actual buildings remodeling start date. The GES group could set firm dates for the beginning and ending of these phases of the project.

The construction, testing and implementation phases of the project would have to be done in parallel of each other. This was due to the projects overall ambitious and aggressive schedule. Unfortunately, there was no firm schedule submitted from the facilities group for the beginning and ending dates for each section of the buildings

rebuilding. The closest estimates for dates of completion were sketchy at best. (See Scheduling Requirements) This was one of the projects biggest problems to overcome and deal with. The GES group decided to adapt more of a methodology to deal with the scheduling problem. The final maintenance phase of the project will continue for the rest of year giving the GES group more then ample time to address any design or implementation flaws.

The Network Switches and Backbone

The network equipment would be received in early January 2006. The two Cisco 6513 chassis would be assembled, powered on, and connectivity tests performed. The switches will be linked into the original network for temporarily to complete the testing. After the testing phases were completed one of the Cisco 6513 switches will replace the original Cisco 6509 switch located in IDF #2. This would free up the Cisco 6509 switch to be rebuilt and the addition hardware could be installed into it. Testing could then be completed on the unit. Once this unit was completed it would be used to replace the IDF #1 Cisco 6506 switch. Again, the IDF #1 switch would be rebuilt and the additional hardware installed into it. The switch would then be reinstalled into IDF #1. The buildings original backbone fiber optic cabling would continue to be used until new the fiber cabling can be installed and tested. The Cisco 5509 IDF #3 switch would stay in place as is. Once the MDF room was completed the final Cisco 6513 switch will be installed and linked into the buildings network.

WAN Connection

The original WAN connection in the Danfield building was a T1 connection to the Harmony building. Both the Danfield and Harmony‘s data traffic was routed through the DS3 connection to the companies MPLS cloud. Both the T1 and the DS3 connections had to remain in place until one or both of the new Danfield DS3 WAN connections were in installed and operational. The GNS group assured both the Facilities and GES groups that the new lines would be in place and operational before the final data center move March 28, 2006. Once the new connections were in place the original T1 and DS3 connections would be severed. Again, no firm date was provided from the GNS group for the installation of two new DS3 connections.

Horizontal Cube Wiring

The horizontal cube wiring would be another challenge with no firm schedule to adhere to. One section of the building would be targeted at a time. The targeted section of the building would be demolished. The old wiring from the cubes to the IDF locations will be completely removed. The area will be remodeled, new cubes, phone and data cabling installed. Once the cabling is installed, speed tests can be completed on the cabling and the wiring can then be patched into the targeted IDF switch. The area will then be ready for the employees to move into. The new horizontal cabling would be installed in parallel to the old horizontal cabling. This will help in the progressive switchover from the old cabling to the new cabling as the employees are moved.

MDF Room

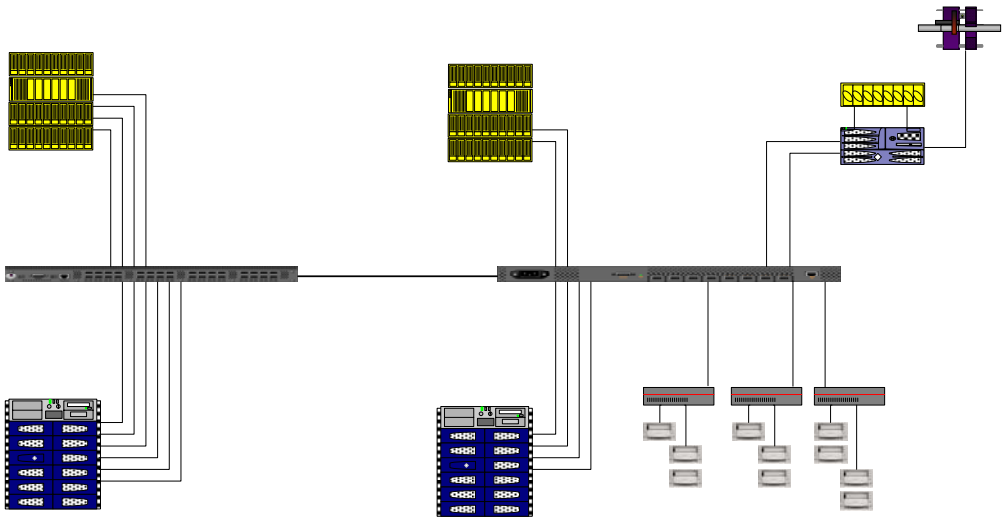
Construction on the new MDF room would start in February 2006. The facilities department estimated a completion date of March 20, 2006 for the new MDF. The fiber backbone, horizontal racks and cabling would also be completed before March 20, 2006. This would leave just enough time to install the new MDF switch and complete testing on the new cabling. The existing Danfield fileservers will be moved into the new MDF room on March 25, 2006. This would act as preliminary test as to whether the new room was ready for the final Harmony data center move on March 28, 2006.

SAN Considerations and Planning

The SAN integration design will be a huge challenge to complete at once. There would be significant risk of prolonged downtime if everything did not go exactly as planned. The final SAN design involves not only hardware changes to the fileservers, but also significant software configuration changes. There could also be significant problems with moving the key fileservers and equipment from the Harmony building to the new data center in the terms of hardware failures and damage to the equipment during the moves.

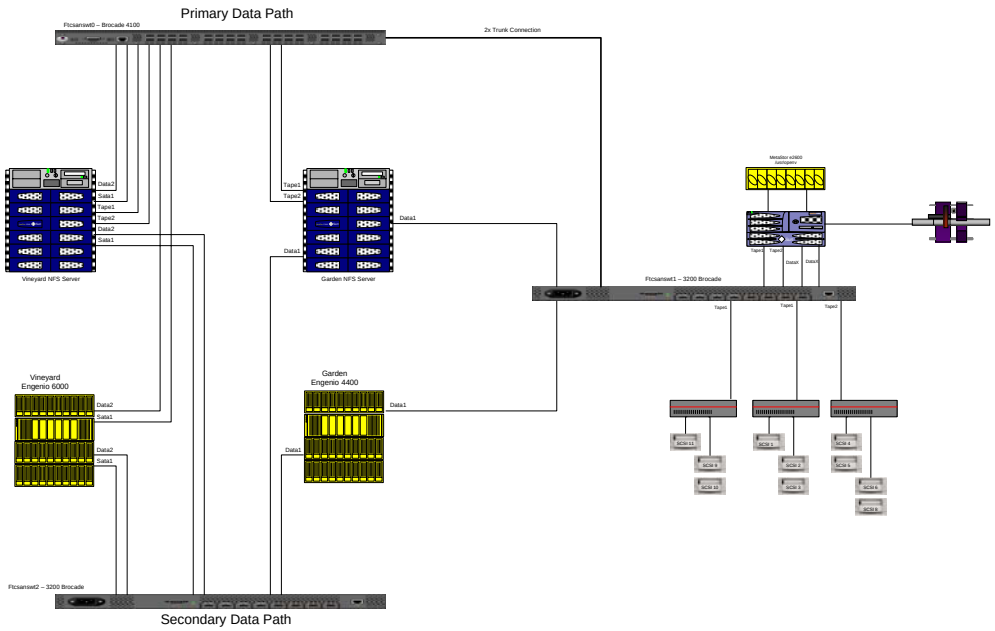
The SAN fileservers and equipment will be moved into the new Datacenter with no modifications to their overall SAN architecture. This will limit the amount of possible problems the GES group would deal with during and after the fileservers move on March 25 and 28.

The SAN design changes will be accomplished after the Datacenter moves and implemented over three different planned phases. Each of the phases would involve small changes to the hardware and software configurations to limit risk. These implementation phases would be done over a two week time period during April 2006.



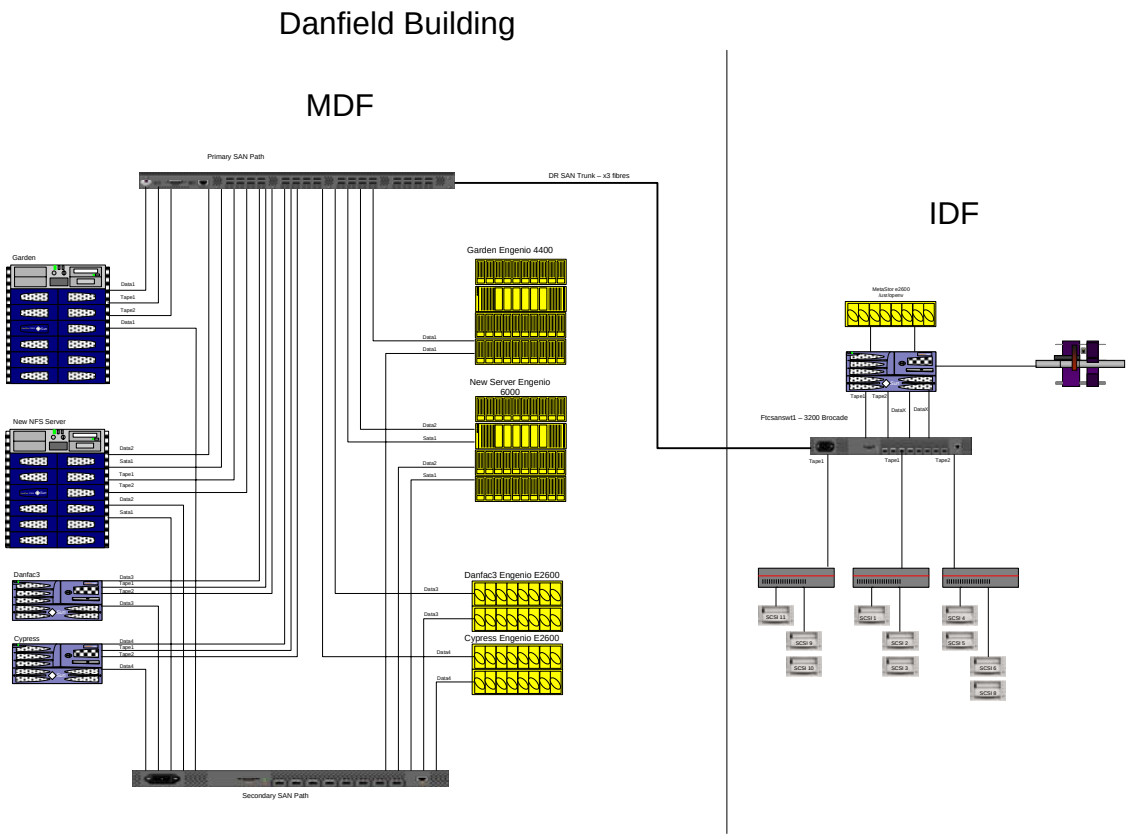
SAN Design Phase One
Figure 18

Phase one (Figure 18) will involve integration of two of the key fileservers and the main backup server onto the same single SAN. The Brocade 3800 would be pulled offline and the firmware upgraded. The Brocade 3800 would then be redeployed in IDF #2 during phase two.



SAN Design Phase Two
Figure 19

Phase two (Figure 19) will involve severing the single SAN into a primary and secondary SAN network. The Brocade 3800 will then be installed in IDF #2 upstairs and connected to the primary SAN by a two line ISL trunk.



SAN Design Phase Three
Figure 20

Phase three of the project will involve integrating the two remaining fileservers into the SAN. This final phase of the project would then complete meeting the overall requirements for the SAN part of the consolidation project.

Construction and Testing Phases of the Project

The Network Switches and Backbone

The purchased Cisco network equipment was delivered complete by end of month January of 2006. The two Cisco 6513 chassis were assembled, powered on, and configured.

One problem that was encountered during this process involved the newer Cisco 6724 fibre port blades not being detected by the 720 supervisor engines. This was quickly tracked down to the 720 Supervisor Engines being shipped with an older firmware code installed. The shipped firmware code was version 12.2.18 sxd6. The latest firmware at this time was 12.2.18 sxf2. Once the firmware was updated the 6724 fibre port blades were detected correctly and the basic configurations for both 6513 switches were completed.

After the basic configurations were completed on the switches, they were tested for link speeds and interconnection speeds. The switches preformed as there current specifications indicated they should.

The Cisco 6513 switch which was targeted for installation in IDF #2 was now complete. This switch was then installed in place of the 6509 Cisco switch that was currently running in IDF #2. The switch was connected into the existing Danfield fiber backbone with no problems encountered. All existing network clients were then patched into the new switch. The switch was then continually monitored for any problems that might have to be addressed.

IDF #2 Cisco Switch **IDF #3 Cisco Switch**

Figure 21

The Cisco 6509 switch that was removed from service was now ready to be rebuilt with an additional supervisor engine. The chassis was cleaned and the additional engine installed. Due to memory limitations the firmware was not upgraded. The newly rebuilt 6509 chassis was then ready to replace the 6506 switch in IDF #1. The 6506 switch was removed from service and the rebuilt 6509 installed and placed on-line. The 6506 switch underwent the same rebuild as the 6509 switch. When this was completed it was reinstalled in IDF #1 next to the 6509 switch.

Employee Cubes

Construction and Testing Phase

Construction of the employee cubes started late January 2006. The newly remodeled cubes went up without any problems. The contractors and Facilities departments worked very hard to meet the planned scheduling for each of the employee

mini-moves. As the cabling was installed to the newly remodeled cubes, each line was terminated at both the cube and the patch panels located in each IDF. After the cabling was installed labeling was applied. Each line was then tested for being correctly wired to the jack the patch panel, and then speed tests were performed. The speed tests were performed with a high speed 1gbps data tester. The tester would store the results for every line tested in the building for review at a later time.

Cube Wall Data Ports

Figure 22

The Wan Connections

Construction and Testing Phase

The two DS3 WAN connections to the building that were to be installed before the end of March deadline did not go as planned. The GNS department had not made early enough arrangements with the telecom provider to get the installation completed before the datacenter move. The new installation dates for the DS3 lines are September

2006. To compound the problem, once the datacenter was moved at the end of March, all equipment would have to be cleaned out of the Harmony building. This would mean the only WAN connection to both buildings would have to be shutdown, leaving the Danfield building without any WAN connections to the company's intranet.

The GES department being confronted with this problem had to scramble for a solution. To be without a WAN connection would mean disaster for the project.

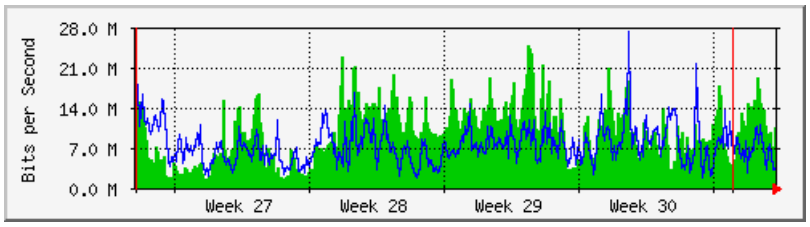
The GES department contacted local WAN and Internet communications provides to try and find a solution to the problem.

A local Internet communication provider was located locally by that could provide a DS3 wireless Internet connection to the Danfield building. This would perhaps give a short term solution to the problem. The speed of the wireless data connection were of great concern, it needed to be fast enough to handle the overall buildings communications needs.

The 'emergency' wireless WAN connection was installed and went online April 10, 2006. An additional DS3 connection was pushed through the Telecomm provider unexpectedly in May 2006 by the GNS department. This was one of the better moments in the WAN side of the project. This additional bandwidth was much needed to correct the over saturated wireless connection.

The DS3 connection provided enough bandwidth to get by until the final installation of the two permanent DS3 installations.

As of August 5, 2006 the single DS3 connection has had an average of about 15mbps with peaks of about 28mbps.



Current Danfield - DS3 Traffic
Figure 23

MDF Room

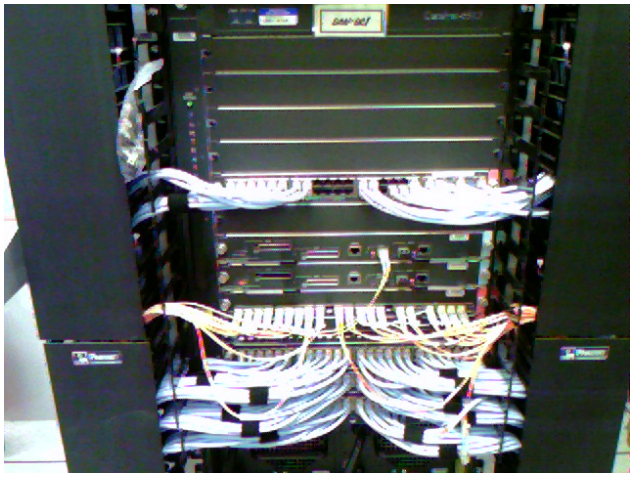
Construction and Testing Phase

Construction on the MDF room started in February 2006. The room had to be build from the ground up.

Construction to the new MDF was completed in this order:

1. Walls and doors installed.
2. Cooling ductwork installed.
3. Under floor and wall electrical wiring installed.
4. UPS and Air cooling handlers installed and turned on.
5. Raised floor installed.
6. Horizontal Racks installed.
7. 19” WAN/LAN racks installed.
8. Power applied to room.
9. 6513 Cisco switch installed.
10. Horizontal cabling installed.

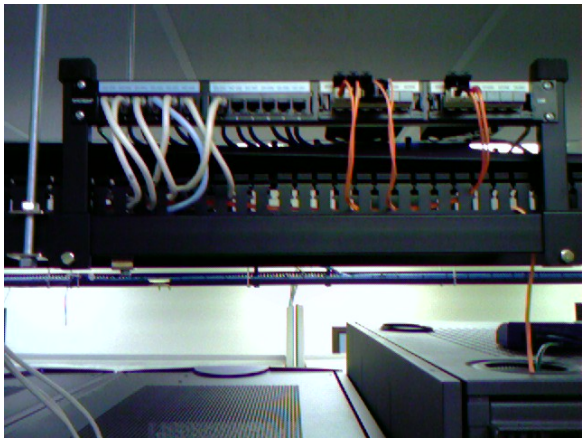
Once the horizontal cabling was installed both the copper wiring and the fiber was tested to a 1gbps limits. A number of fiber connections failed speed tests, these were re-terminated and passed without further problems.



MDF 6513 Cisco Switch
Figure 24

The horizontal racking design for the room was very successful. The horizontal patch panels appeared to be very sleek and clean looking. The 1" cable management which also installed would hide the network cabling installed to the patch panels from each of the racks and tables.

The MDF room was ready for use on March 18, 2006.



MDF Horizontal Patch Panel
Figure 25

Data Center Move

On March 25, 2006 it was time for the data servers which were currently installed in IDF #2 to be relocated to the newly completed MDF room. The moves included two of the main Danfield fileservers and their Engenio storage array counter parts. The moves went without problems. The moves were completed in less then two hours.

On March 28, 2006 began the Datacenter moves from the Harmony building to the MDF room. A new set of network configuration files were installed on all the fileservers and the fileservers and all associated equipment was powered down. All equipment was then wrapped in plastic sheeting and packed for moving.

Equipment movers began moving all key infrastructure fileservers first. This provided the GES ample time to concentrate on installing, powering up, and addressing any problems encountered by these machines first. No problems were encountered and the machines

were up and online in less then 6 hours. The remaining fileservers compute servers and workstations were moved and installed into the new MDF room with only minimum problems. After four days of hard work, all machines had been moved out of the Harmony building and into the newly remodeled Danfield building.

Connectivity tests were performed by the GES group to ensure that all equipment could be reached by ASIC remotes sites from around the world. These connectivity tests all proved successful and the datacenter was then deemed up and running.

SAN Network

Phase #1 of the SAN redesign was completed with the initial Harmony datacenter move on March 30, 2006. No problems were encountered with the redesign. The backup related equipment was installed in IDF #2. The fibre channel connections were then back hauled to the MDF by way of the buildings spare fibre backbone.

All fibre channel cables and interface cards have been identified and labeled. In additionally a current cross reference listing of all World Wide Names to interface card have been collected and posted.

The SAN has been closely monitored for traffic bandwidth problems and for TX/RX errors.

Phase two of the project has been delayed from being implemented twice. These delays were caused by key company projects that could not be interrupted. Phase two of the SAN redesign has currently been schedules for Late September 2006.

Project Summary

Current Status of Project

Currently the project still has several areas of the building yet to be completed. The Danfield buildings new front lobby has been plagued by construction delays. The new lobby should be ready for data cable installations by the end of August 2006.

The building's two new DS3 connections for finishing the buildings WAN connection has also been plagued by delays. The building's emergency DS3 connection is looking more like a long term emergency solution then a short term one. The new date for the installation of the permanent DS3 lines has been quoted to be sometime in September 2006.

SAN changes pertaining to phase two and three are still looking good for the September 2006 datacenter PM. Current GES staff are very anxious to get this side of the project completed. These delays in the SAN redesign have not created any major problems in providing data services to the company's internal customers.

The LAN is being closely monitored by network monitoring software. The monitoring software has pin pointed several problems, which have been identified and corrected. These problems are attributed to configuration problems on the Cisco switches.

Did the project meet overall goals

Overall, the project as a whole has been completed with successful results. The project had no uncorrectable failures during its implementation.

All of the key objectives of the project were met and completed. .

- ASIC's employees were able to move into the newly remodeled Danfield building with little or no impacts in their day to day activities or their active design projects.

- Implementation of the new building network was successfully completed and continues to provide the employees with faster connection speeds within the building.

- The Datacenter move from the Harmony building to the new Danfield building was successfully carried out with no unforeseen or prolonged interruptions to corporate data services.

- WAN services, though not complete, continue to provide unfaltering intranet connectivity.

Lessons Learned from the project

There were most certainly lessons to be learned from this project. Some of these lessons could be contributed to unforeseen scheduling problems, communication issues between departments and an overall lack of completing assigned tasks.

The lack of an overall project methodology and/or schedule was one of the biggest problems that the ASIC GES group had to overcome and endure. This one common issue caused significant problems throughout the entire project. Problems relating to miscommunications, unforeseen and changing requirements, confusion between groups, wasted time, wasted money and maintaining common goals were but a few of the problems which could have been avoided or minimized. A project of this size should adopt a common project methodology that encompasses all departments involved in the project. This can only help all inter-related departments open an effective level of communications, planning and implantation schedule for the projects successful conclusion.

Several key, high priority tasks associated with the WAN installation were dropped by an internal department. This demonstrates the need in future projects for checks to be made on key tasks for completeness. In your planning, always address the possibility of failure for each item in your plan. Have a backup plan in place to solve any issues that might arise from failure or delay.

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