THE DIGITAL RANCH: CLOUD PROJECT

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The Digital Ranch

15 year Anniversary!

- June 9, 2011 marked the 15th Birthday of TDR.

"2010 Leading Providers of the Western United States"
-Forbes magazine

15 YEAR ANNIVERSARY

The Digital Ranch

What does The Digital Ranch do?

Offers services in:

1. Web Development
2. Custom Software
3. Managed hosting

THE DIGITAL RANCH

Web Development
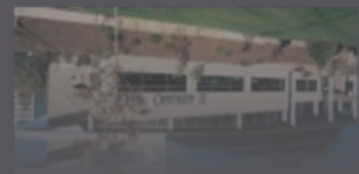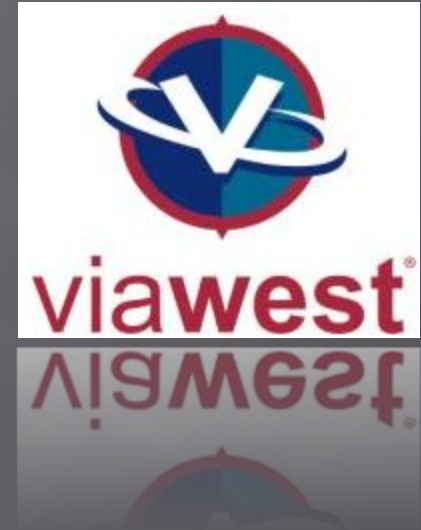
- E-Learning

- E-Commerce

- Search Engine Optimization (SEO)

Custom Software

- Unique library of tools

- Solutions for the ever-changing nature of today's information

- Fully customizable functionality

Managed Hosting

- Data Center
- Website Hosting
- Virtual Servers
- Managed Infrastructure
- Colocation
- Dedicated Servers
- IT Support

Cloud Project

- The Cloud Project is to create a Microsoft Windows IIS 7 Cloud (farm) and a SQL 2008 R2 Failover Cluster. This project consists of four main parts:

    1. Diagramming and documenting the architecture of the plan.

    2. Deploying the IIS and SQL clouds using The Digital Ranch's equipment (hardware and software).

    3. Test the Cloud

    4. Create reports and documentation regarding the overall findings and success of the project.

Cloud Project

▫ Diagramming and documenting the architecture of the plan. (Original Diagrams)
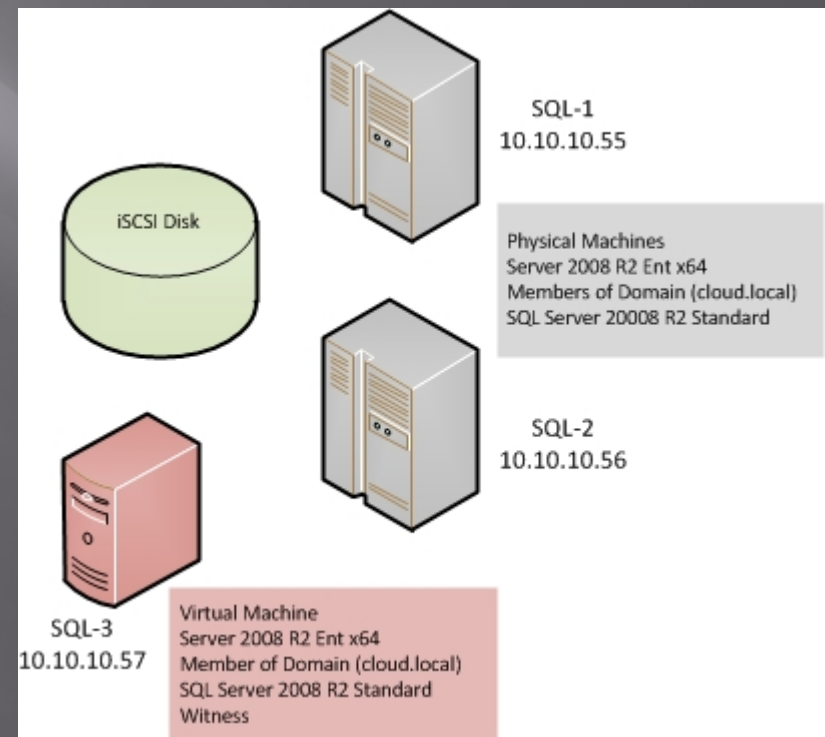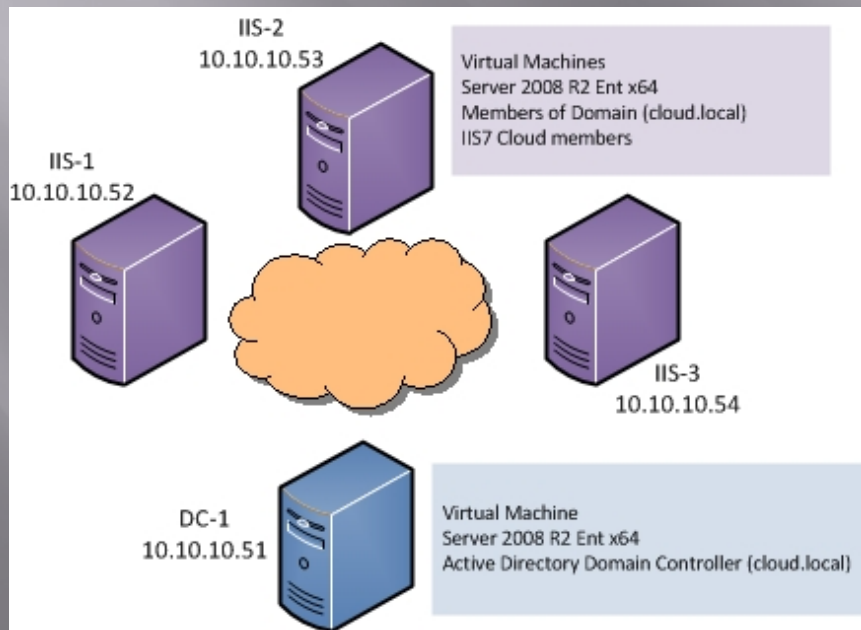
Cloud Project

- Deploying the IIS and SQL clouds using The Digital Ranch's equipment (hardware and software).

  IIS – 7 Machines (3) = Virtual

  Domain Controller = Virtual

  SQL Machines (3) = 1 Virtual, 2 Physical

  SAN = 3 Virtual Drives
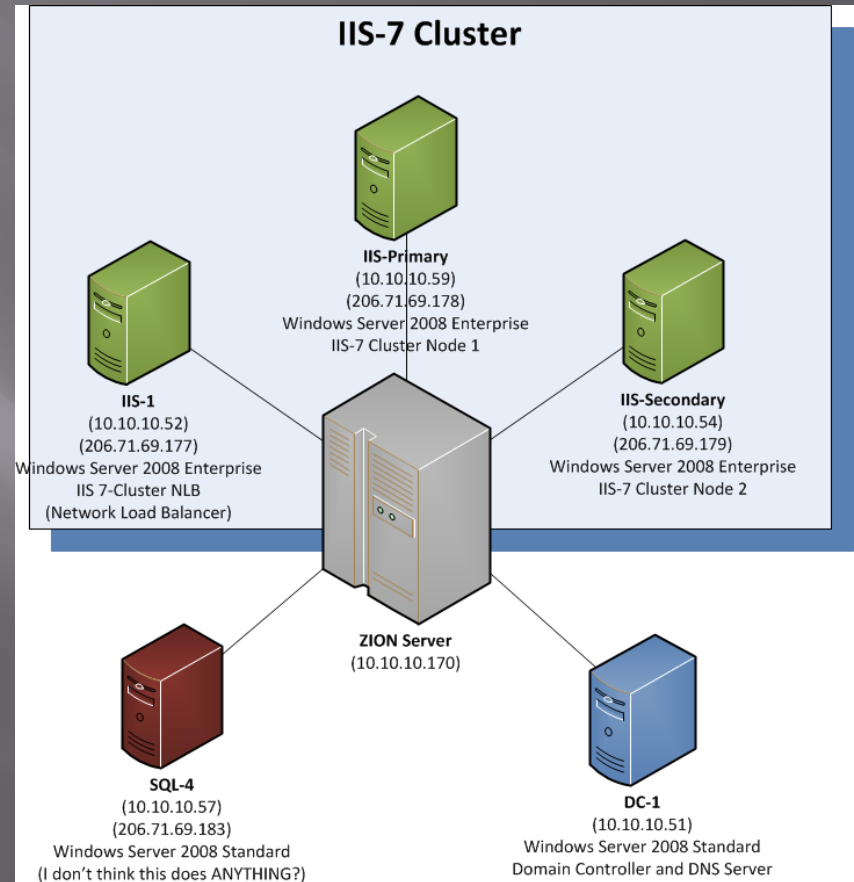
Cloud Project

▫ Test the Cloud

Examples:

1. Pull nodes from the IIS7 cluster and test for availability and any delays. The goal is to have zero downtime.

2. Pull a node from the SQL cluster and test for database availability. The goal is to have zero downtime.

Cloud Project

* Create reports and documentation regarding the overall findings and success of the project.
    1. Updated documentation after the infrastructure is setup and tested.
    2. Steps taken for setting up the IIS7 cluster and SQL cluster with any hints or issues found during setup.
    3. Test results and any recommendations based off of the tests.
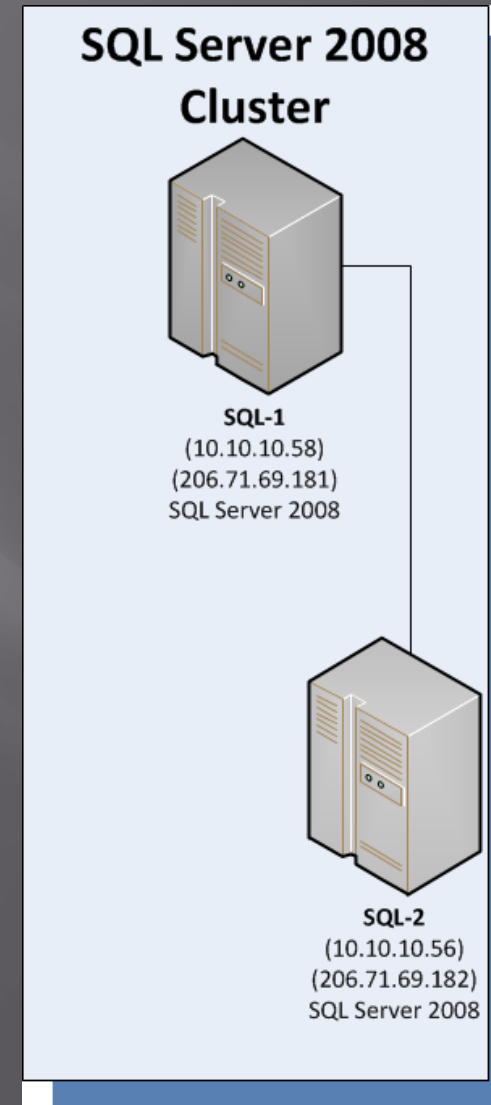   4. Recommendations on physical deployment for commercial use using diagrams and logical reasoning.

Virtual Machines

- Zion
  - Core 2 Quad (Xeon) Processor, 8 GB Memory
- The IIS 7 cluster requires either all 64 bit or all 32 bit OS's.
- All of our operating systems are 64-bit

IIS-7 Cluster

IIS-Primary
(10.10.10.59)
(206.71.69.178)
Windows Server 2008 Enterprise
IIS-7 Cluster Node 1

IIS-1
(10.10.10.52)
(206.71.69.177)
Windows Server 2008 Enterprise
IIS 7-Cluster NLB
(Network Load Balancer)

IIS-Secondary
(10.10.10.54)
(206.71.69.179)
Windows Server 2008 Enterprise
IIS-7 Cluster Node 2

ZION Server
(10.10.10.170)

SQL-4
(10.10.10.57)
(206.71.69.183)
Windows Server 2008 Standard
(I don't think this does ANYTHING?)

DC-1
(10.10.10.51)
Windows Server 2008 Standard
Domain Controller and DNS Server

Physical Machines

- SQL-1
  - Pentium 4 Processor, 5 GB Memory
- SQL-2
  - AMD Athlon X2 Dual Core, 3 GB Memory
- Having the same hardware is not essential
- The SQL OS's are also 64 bit

SQL Server 2008 Cluster

SQL-1
(10.10.10.58)
(206.71.69.181)
SQL Server 2008

SQL-2
(10.10.10.56)
(206.71.69.182)
SQL Server 2008

ZION Server

- Virtual machines used for ease of use, not necessarily recommended for actual deployment
- Windows Server 2008 Datacenter Edition needed to run more than 4 virtual machines
- Hyper-V allows the management of 4 virtual machines (VMs)
  - Three machines for IIS-7 Cluster
  - DC-1 Active Directory Domain Controller
  - SQL-4

Virtual Machines

- Each VM is allocated 1024 MB Memory and 20 GB hard drive space

- Each machine was added to the Cloud.local Active Directory

- Each machine was also given a static IP address both for Remote Desktop Protocol as well as clustering convenience.

ZION Virtual Machines

Clustering and Active Directory

- New, powerful computers are not required for clustering

- Windows 2008 R2 Enterprise Edition had to be used on all the computers in order to facilitate clustering

- DC-1 manages the Active Directory, which is necessary in order to integrate the machines into any normal workplace

Cloud.local Domain
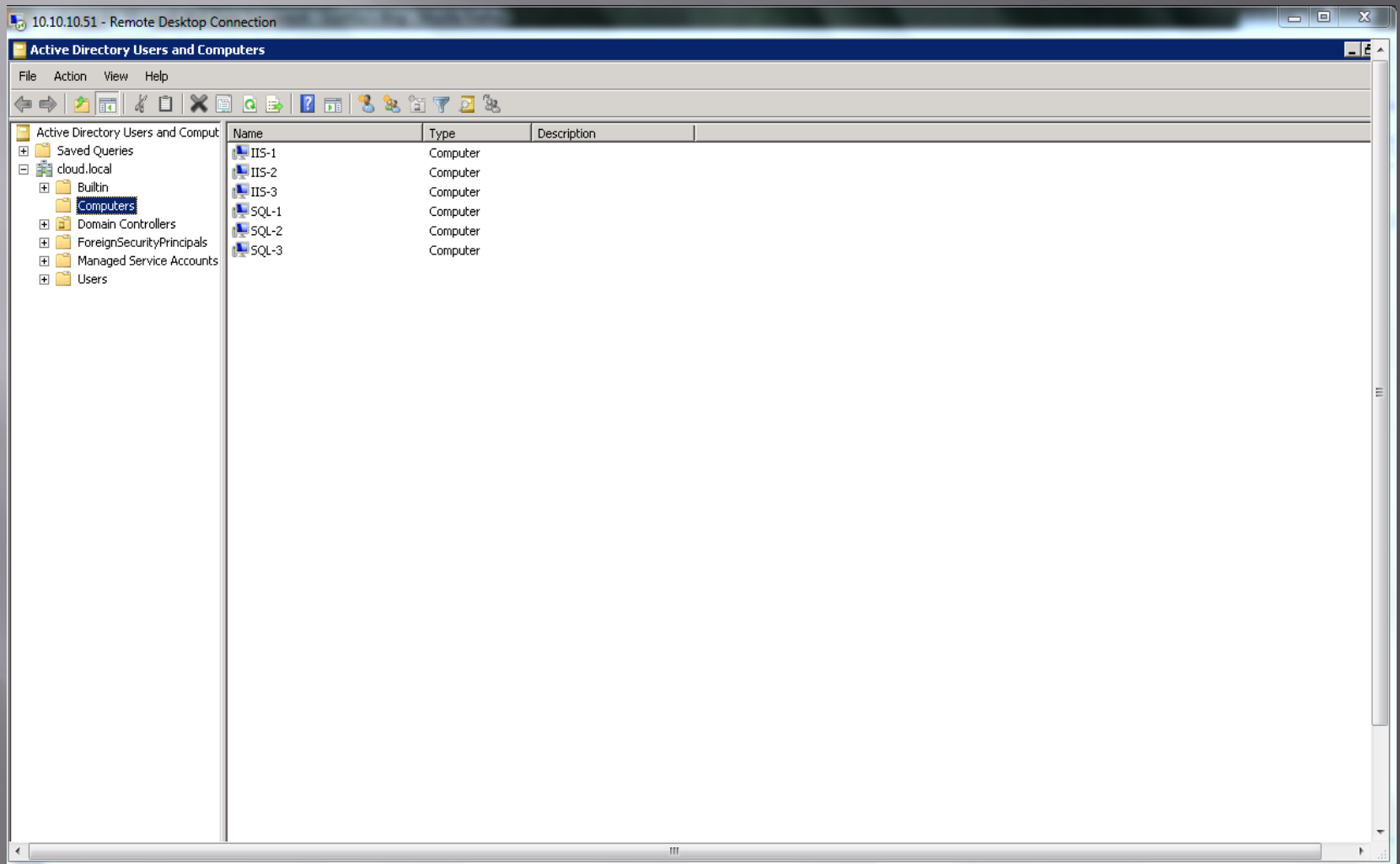
Web Farm Components

- IIS7 Servers
- Microsoft Web Farm Framework
- NLB, Network Load Balancer

IIS7 Web Servers

- Server side processing for Websites
- ASP.NET, PHP, ETC
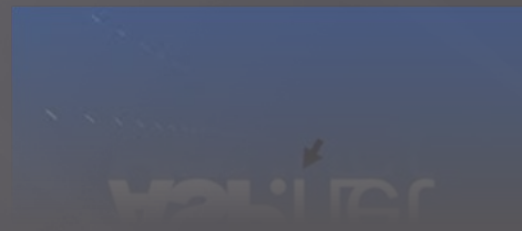
Microsoft Web Farm Framework

- Replicates website applications and platform Components to secondary servers.

- Keeps Secondary servers in sync with Primary Server

- Servers can be added and removed easily for scalability and service upgrades.

- Easily Monitor status, install updates, & Reboot

+

or

Network Load Balancer

- Allows addressing a single IP which then balances/directs traffic to each server node in the farm.
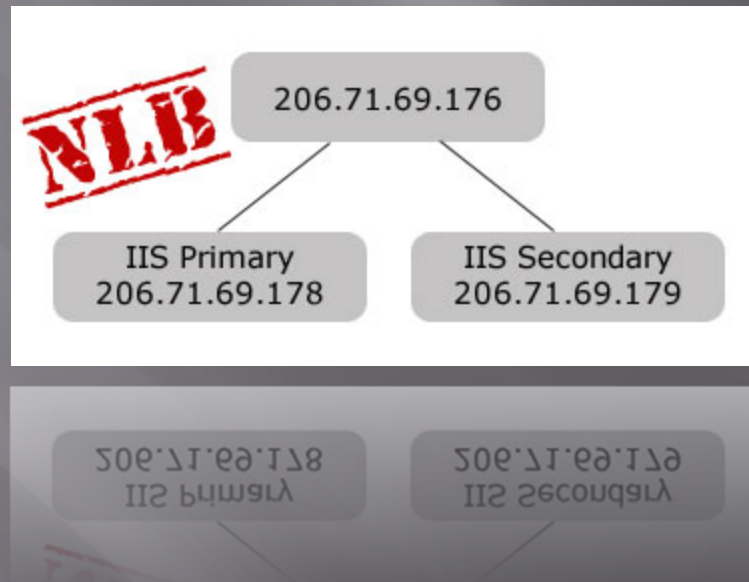
IIS 7 Server Install

- Requirements
  - Confirm you have administrative rights
  - For ease of setup, add cluster computers to the domain
  - Network settings, such as IP, have been configured
  - Updates have been installed

IIS 7 Server Install

- IIS is a server role that can be installed through the Server Manager interface.
- Click Start -> All Programs -> Administrative Tools -> Server Manager

IIS 7 Server Install

- Select Roles. From the Server Manager Menu Select Action -> Add Roles This will open up the Roles Wizard. Click Next
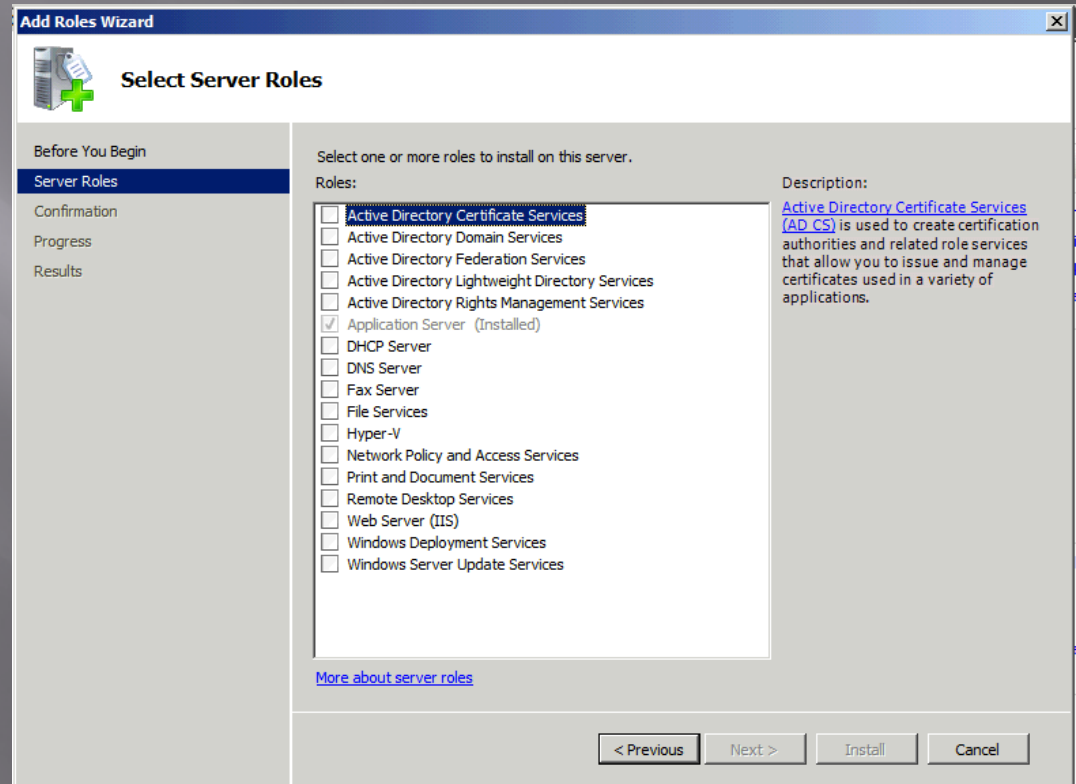
IIS 7 Server Install

- Select Additional Roles for the Web Server. Click Next
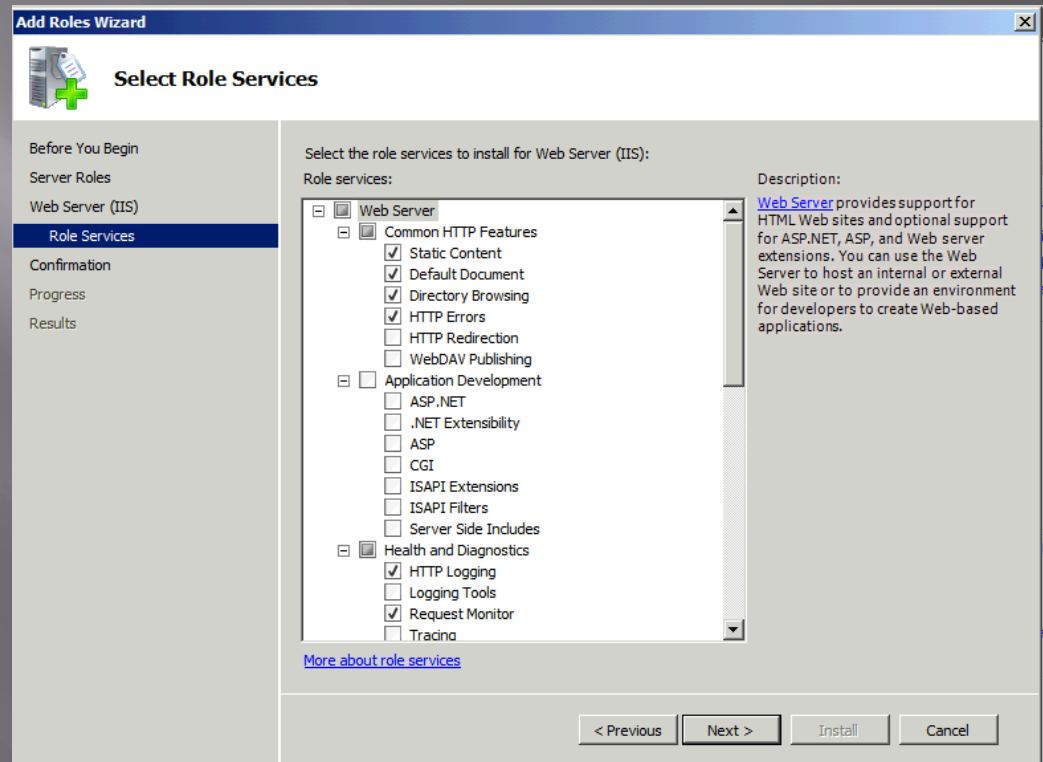
IIS 7 Server Install

- Confirm your installation by visiting http://localhost

IIS Web Farm Framework Installation

- ▣ **Requirements**
  - ▪ Installation of IIS, ASP.NET, other core components

- ▣ **Structure Design**
  - ▪ IIS-1 will act as the farm controller with IIS-Primary and IIS-Secondary acting as nodes in the farm

Microsoft IIS7 Web Farm

IIS-1
(10.10.10.52)
(206.71.69.177)
Web Farm Controller

IIS-Primary
(10.10.10.59)
(206.71.69.178)
Windows Server 2008 Enterprise
IIS-7 Cluster Node 1

IIS-Secondary
(10.10.10.54)
(206.71.69.179)
Windows Server 2008 Enterprise
IIS-7 Cluster Node 2
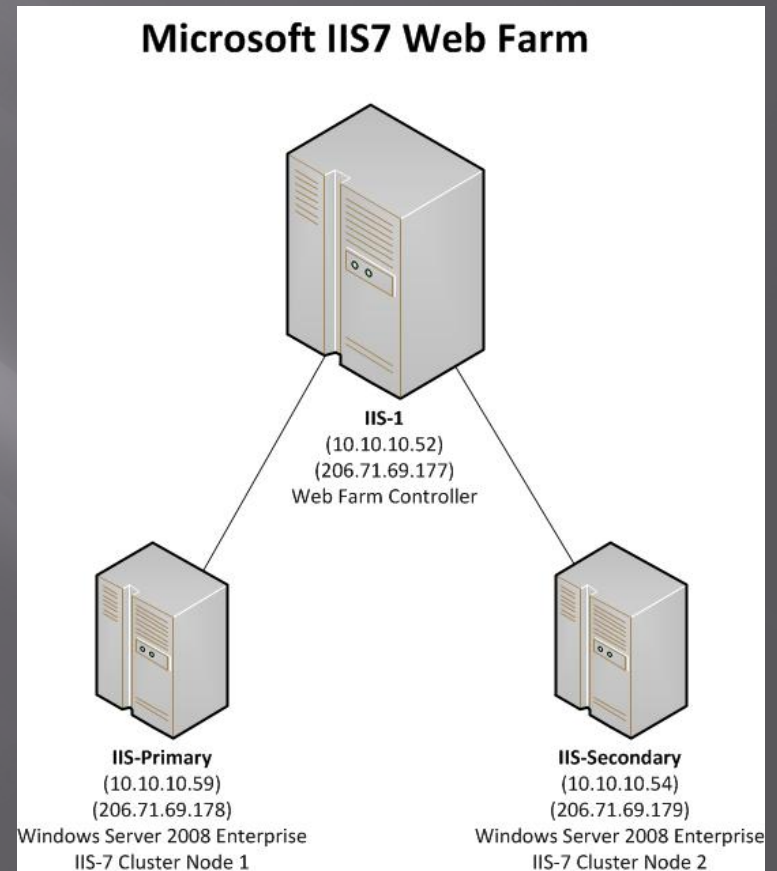
IIS Web Farm Framework Installation

- Download and install Web Farm Framework at http://go.microsoft.com/?linkid=9739157
- This is installed on your Farm Controller server or in the case of the example, IIS-1. It can be installed on any machine running version IIS7 or higher.

BETA

IIS Web Farm Framework Installation

IIS Web Farm Framework Installation

Network Load Balancer Install

- There are few different methods to installing the NLB.

    - Using Server Manager, just click Add Feature and then select Network Load Balancing
    - Using windows server 2008 / R2 command line, by typing "*ocsetup NetworkLoadBalancingFullServer*"
    - Use ServerManagerCmd! From a command line, type "*servermanagercmd –install nlb*"

Network Load Balancer Install

- We will be using the first option by using the Server Manager interface.

  - Click start -> Administrative Tools ->Server Manager
  - Select Features. From the Server Manager Menu Select Action -> Add Feature
    This will open up the Features Wizard.

Network Load Balancer Install

- Select the Network Load Balancing checkbox and click next
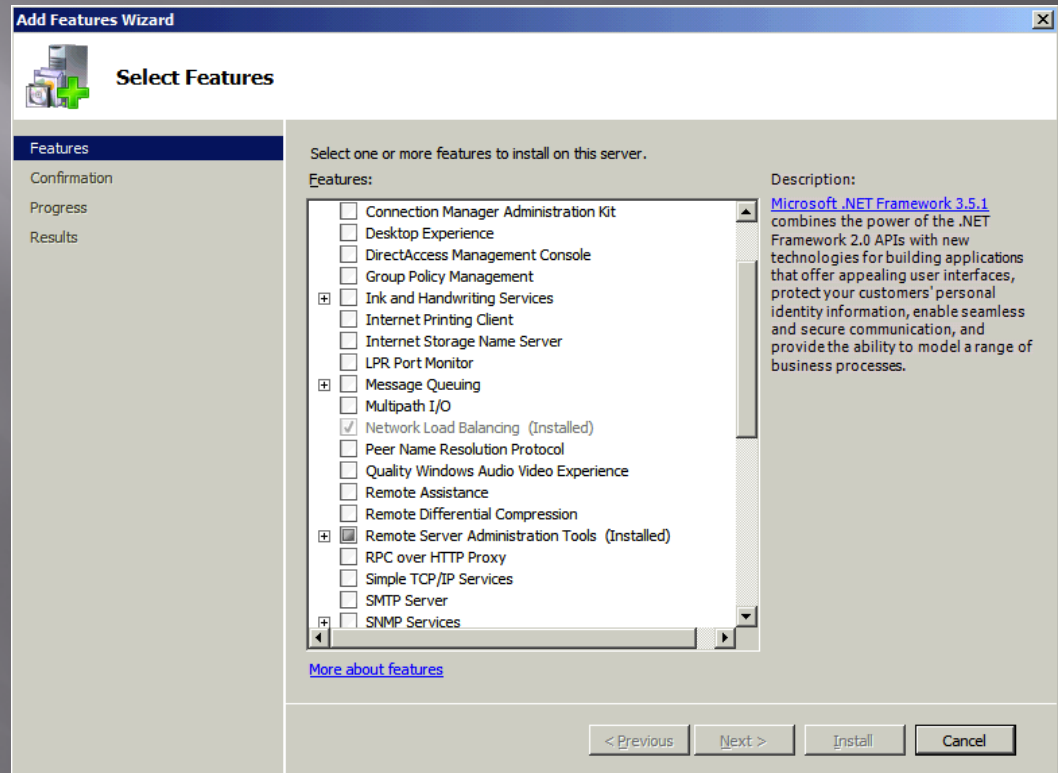
Network Load Balancer Install

- Add the Nodes/servers

- Add the full Internet name that users will use to access this NLB cluster. In our example we are using 10.10.10.204 as our NLB address.
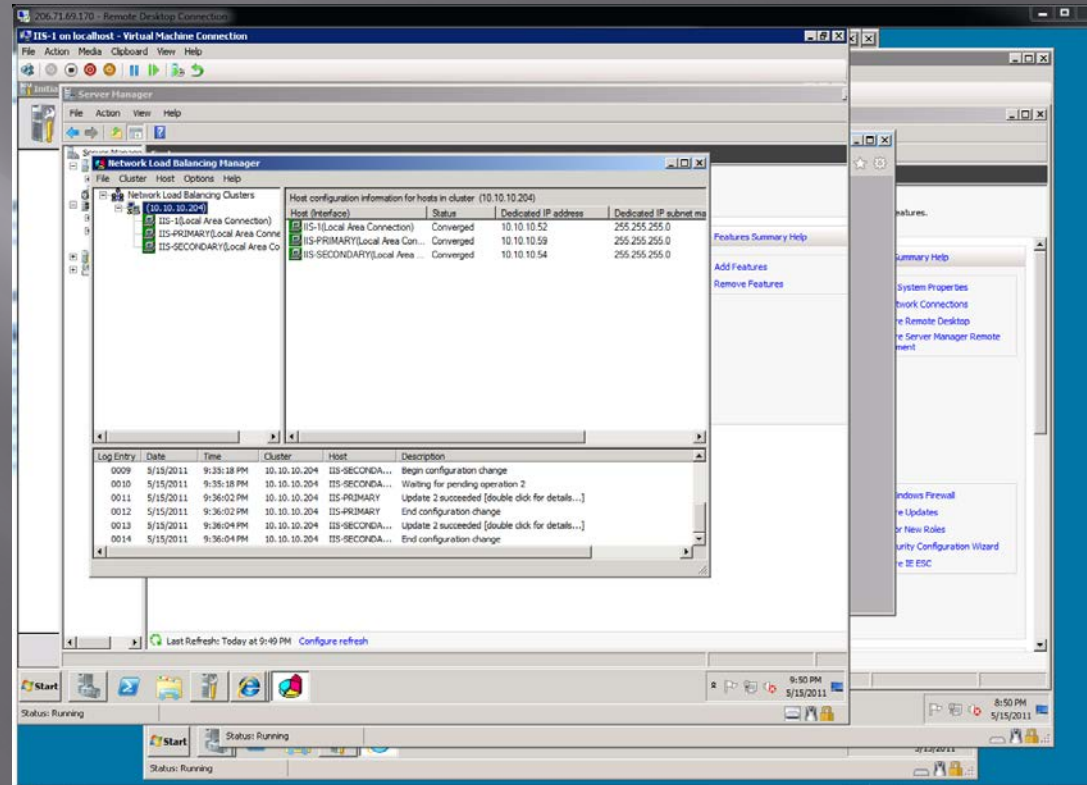
SQL Cluster Installation

SQL Cluster Diagram

- The SQL Cluster contains 2 nodes and a SAN.
- Both nodes can share the disk drives and the database, which are all stored on the SAN.
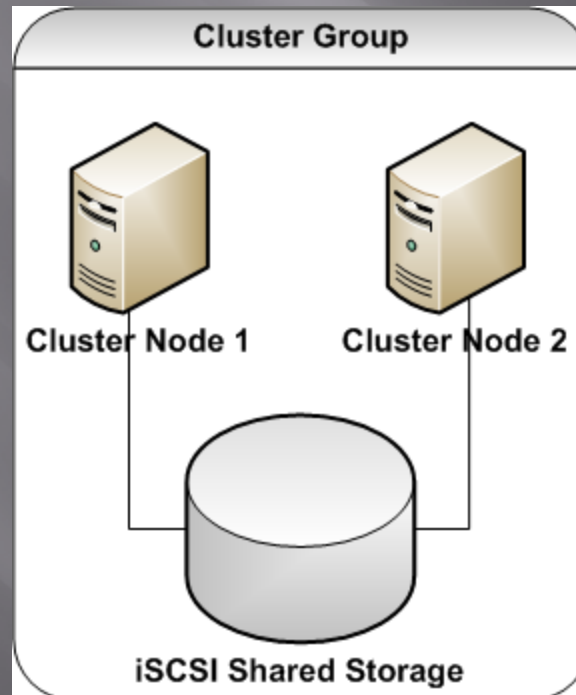
SQL Cluster Disk Drives

- Create 3 disks on the SAN and use iSCSI Initiator to connect to them.
- One for the Quorum, The Microsoft Distributed Transaction Coordinator (MSDTC), and the SQL Server Database

- iqn.2011-02.PORKCHOP:iporkchop
- iqn.2011-02.PORKCHOP:iporkchop2
- iqn.2011-02.PORKCHOP:iporkchop3
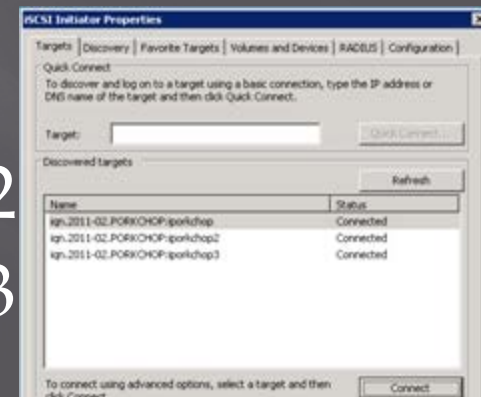
SQL Cluster Complete

- Add the Failover Clustering feature. This feature should be installed on both nodes.
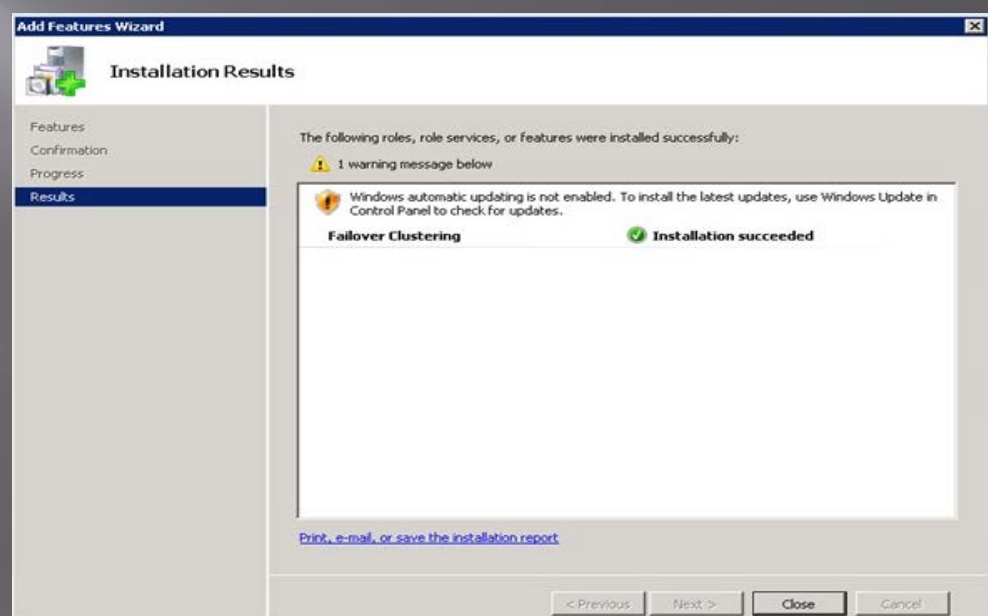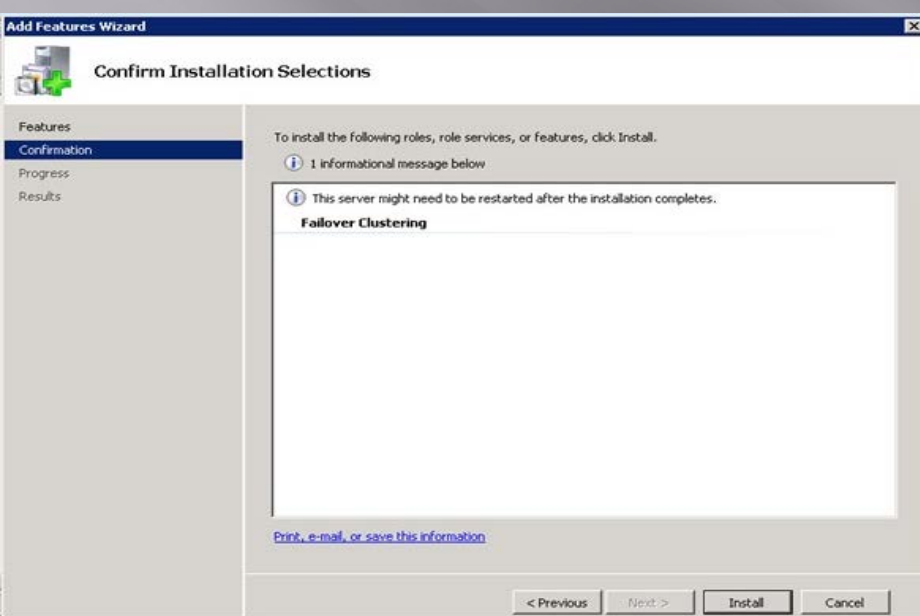
Quorum Disk

- Include the nodes and assign the cluster a name and a IP address.

- Configure the Quorum according to the number of nodes (2 nodes).
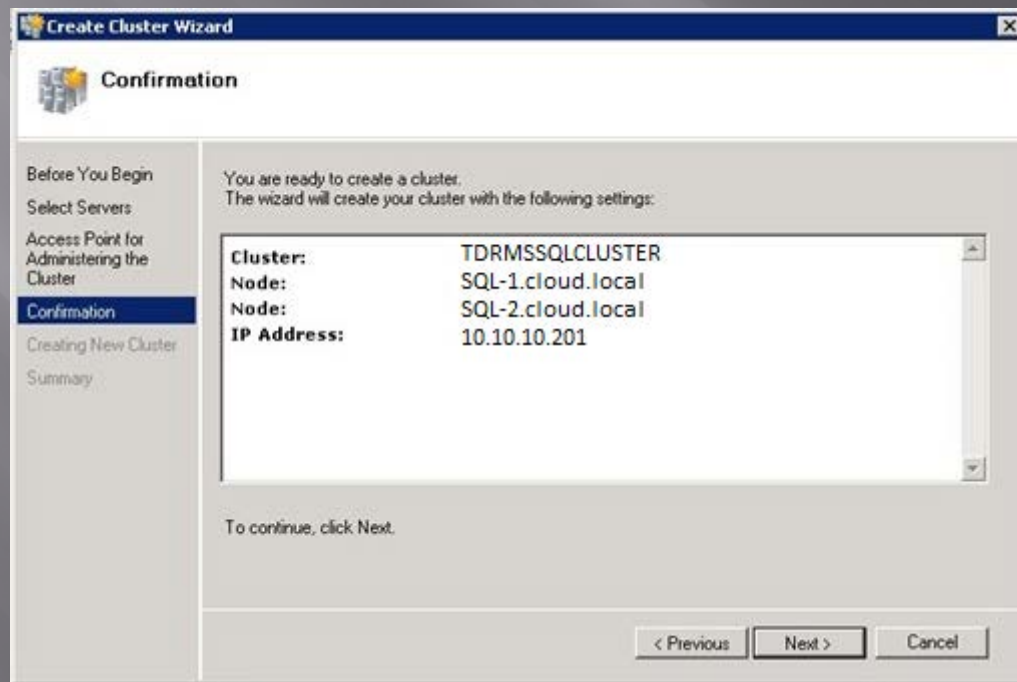
MSDTC Disk

- The Microsoft Distributed Transaction Coordinator (MSDTC) is used by SQL Server and other applications when they want to make a distributed transaction between more than one machine.

- The basic concept is that machine 1 starts a transaction, and does some work. It then connects to machine 2 and does some work. The work on machine 2 fails, and is canceled. The work on machine 1 needs to then be rolled back.

Database Disk

- While configuring the SQL installation be sure to select the available disk for SQL Server 2008 to use. This will store the database.

Installation Complete!

Add a Node

- Add the second node to the cluster by selecting Add a Node and follow the configuration wizard.

- Be sure that the configuration is the exact same as the original node.
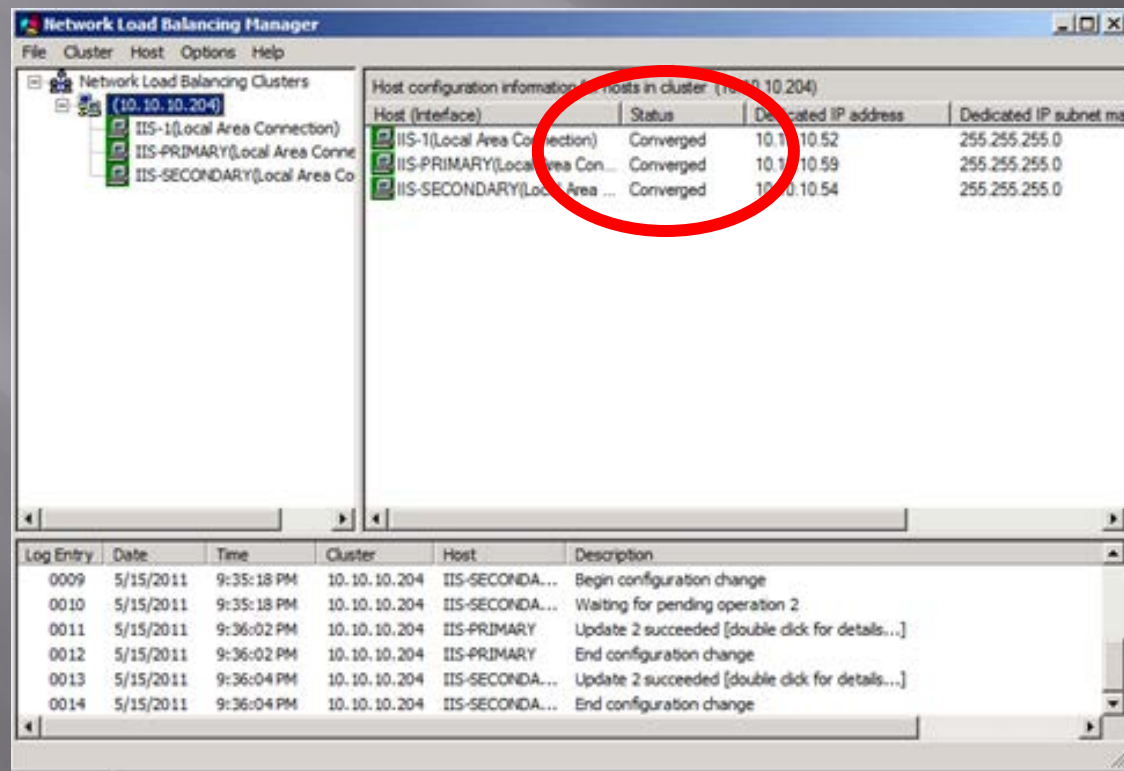
TESTING AND PROVING FUNCTIONALITY
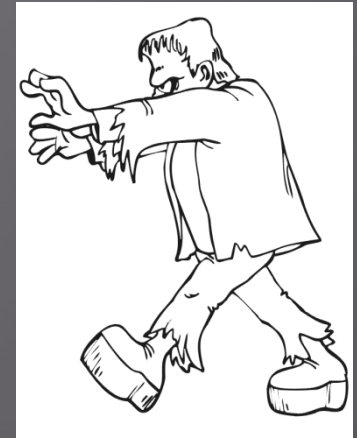
It's Alive!!!

Phase 1: Ensure that IIS 7 cluster nodes are syncing properly

Phase 2: Ensure that SQL Server 2008 cluster nodes are syncing properly

Phase 3: Testing redundancy, outages, and uptime

Phase 1: Ensure that IIS 7 cluster nodes are syncing properly

- **Load the default IIS 7 website in IIS-Primary**
  - We set IIS-Primary as the primary IIS-7 Cluster Node. We then loaded the default IIS 7 webpage onto IIS-Primary and waited for the website to mirror onto IIS-Secondary.

# Website Changes on IIS-Primary

DEFAULT IIS WEB PAGE   WEB PAGE AFTER ALTERATION

Website Changes on IIS-Secondary

- IIS-Cluster only allows changes on IIS-Primary (set at Primary Node in IIS Manager) onto the other nodes.

- Any and all changes made to the website must be changed in IIS-Primary.

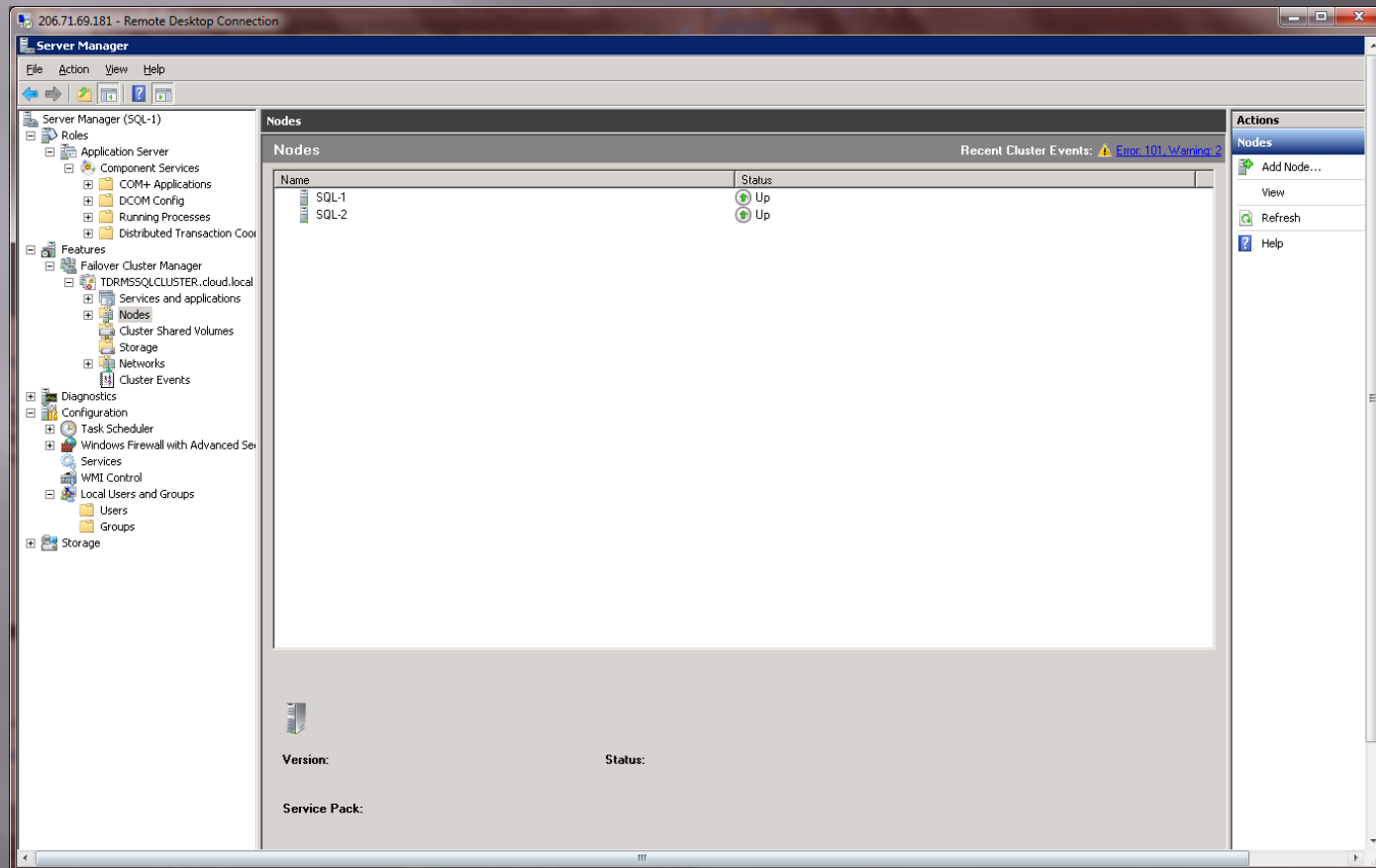- Any changes made to the webpages in any other node other than the Primary Node will be overwritten

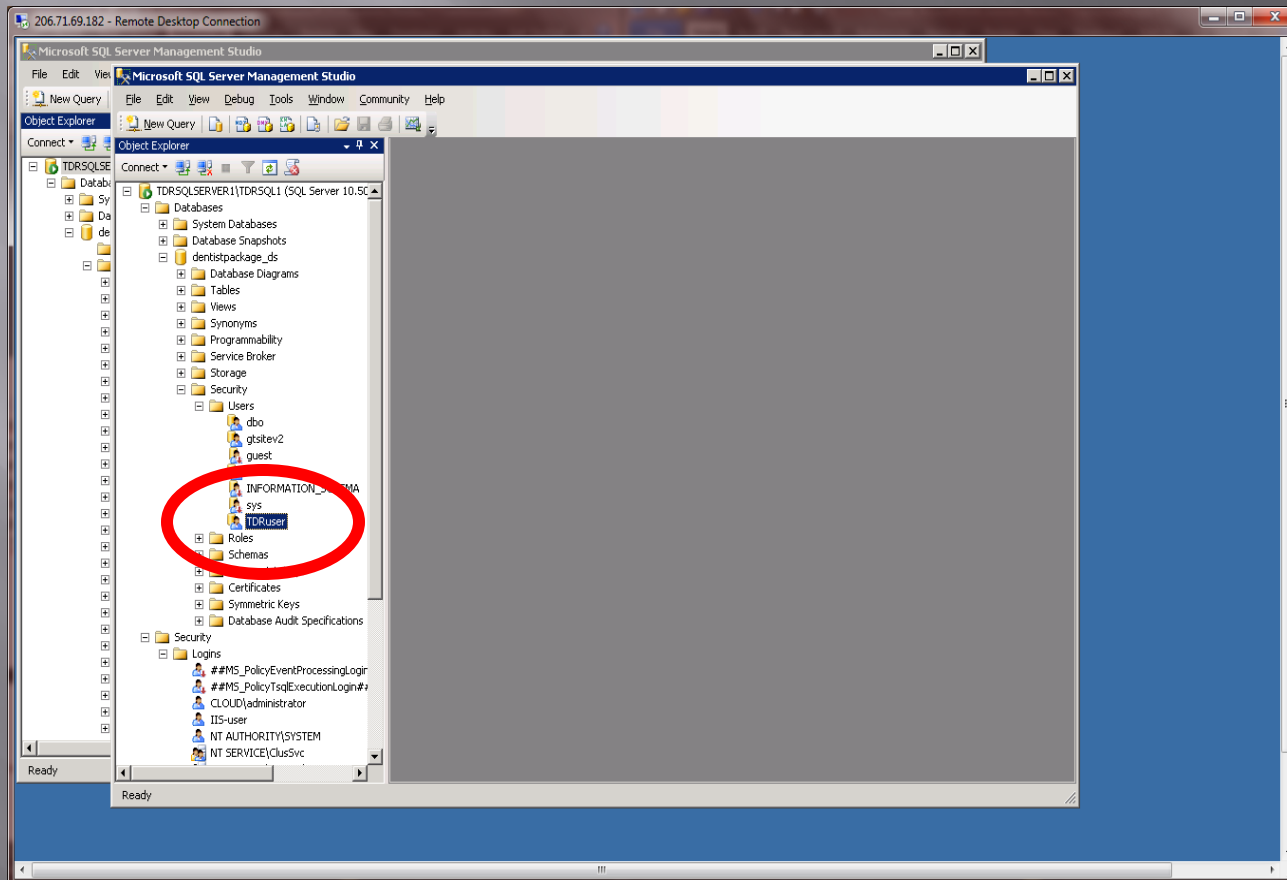Moral of the Story – ONLY MAKE CHANGES ON THE PRIMARY NODE!
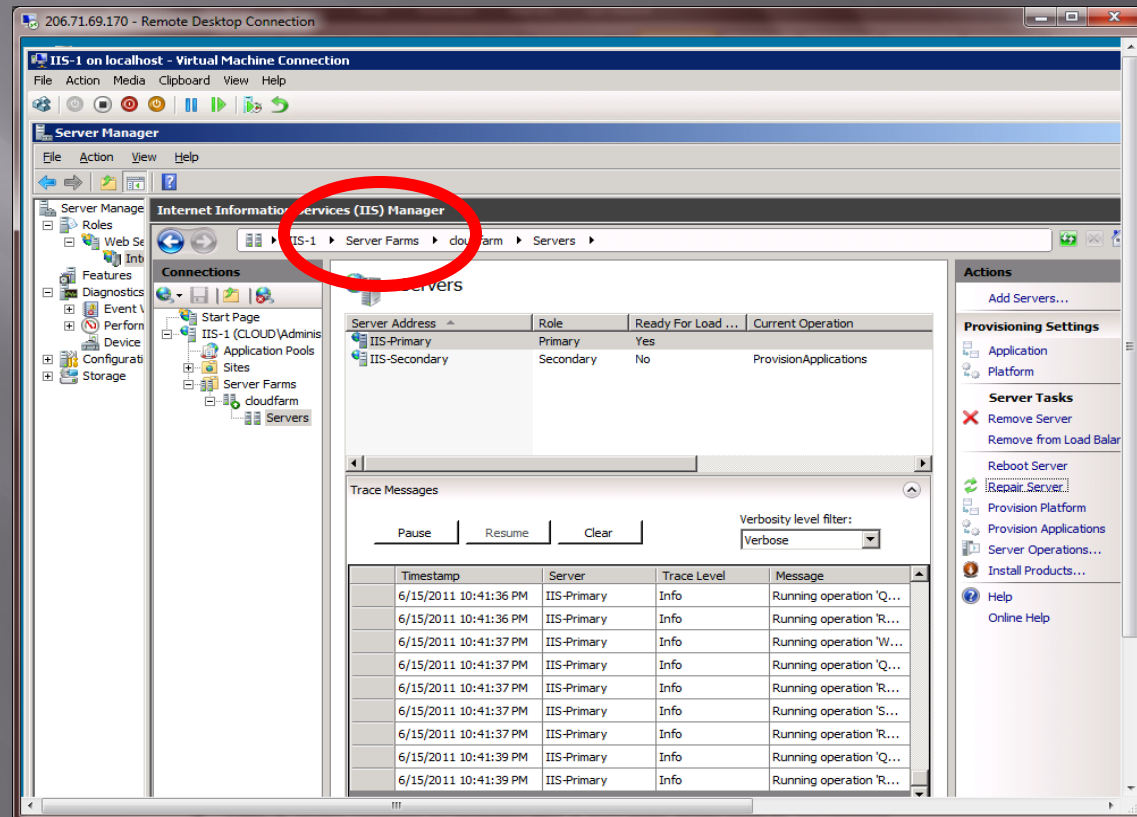
Demo

- Website Changes & Sync

Phase 2: Ensure that SQL Server 2008 cluster nodes are syncing properly

Changes Made to SQL-1

- We created a SQL database user of TDRuser on SQL-1. Within seconds it had synced over to SQL-2.

# Changes Made to SQL-2

- We made changes to a column header in the SQL database on SQL-2. We thought it would be overwritten like the IIS Cluster.

- However, the change was updated on SQL-1!!!

- Changes to the SQL database can be made on either server within the cluster. There is no 'Primary' SQL server in the cluster.

Database Original on SQL-2

- We changed CountryName to CountryName12345
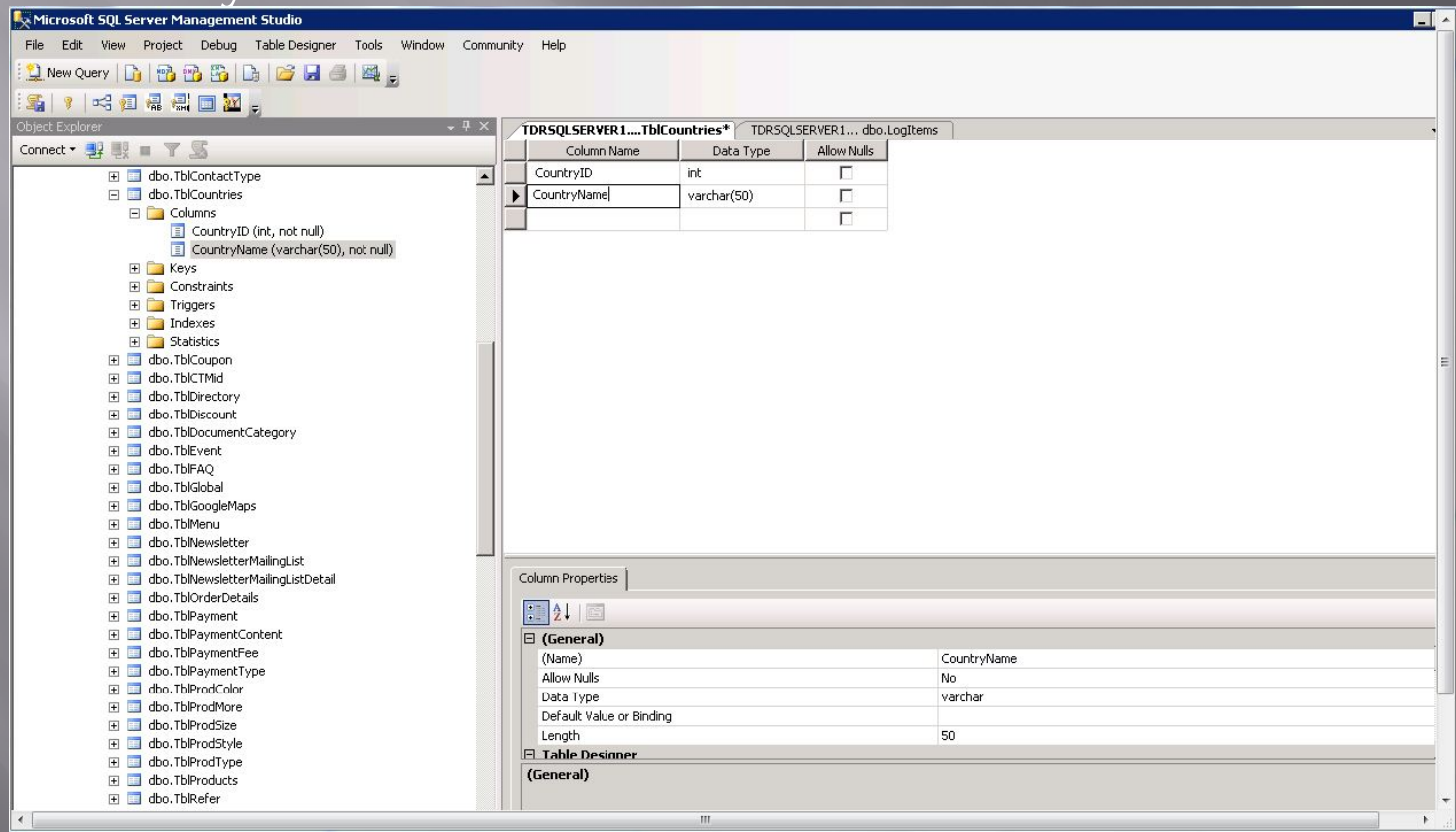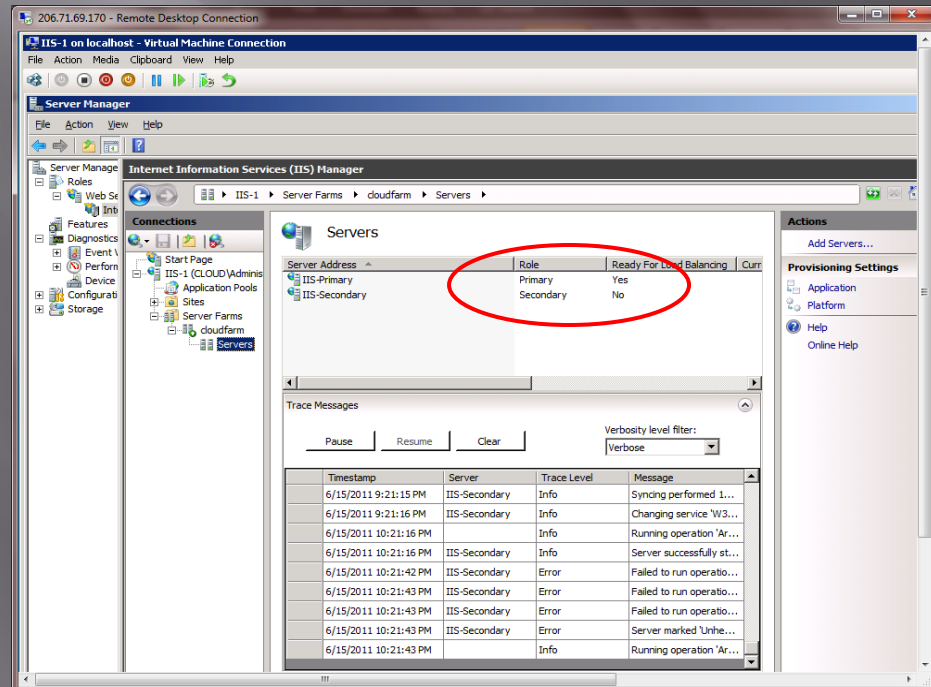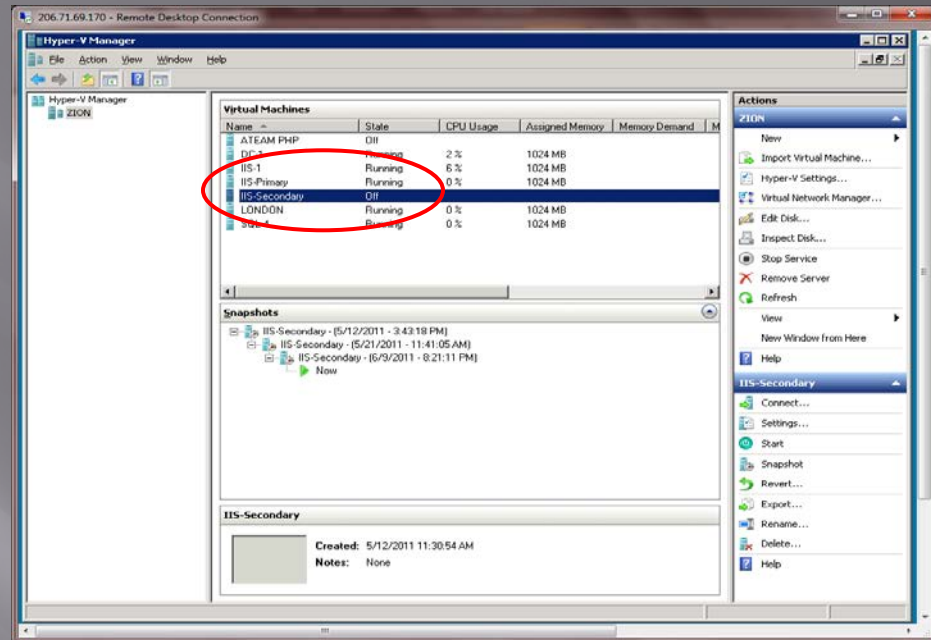
Database Changed on SQL-1
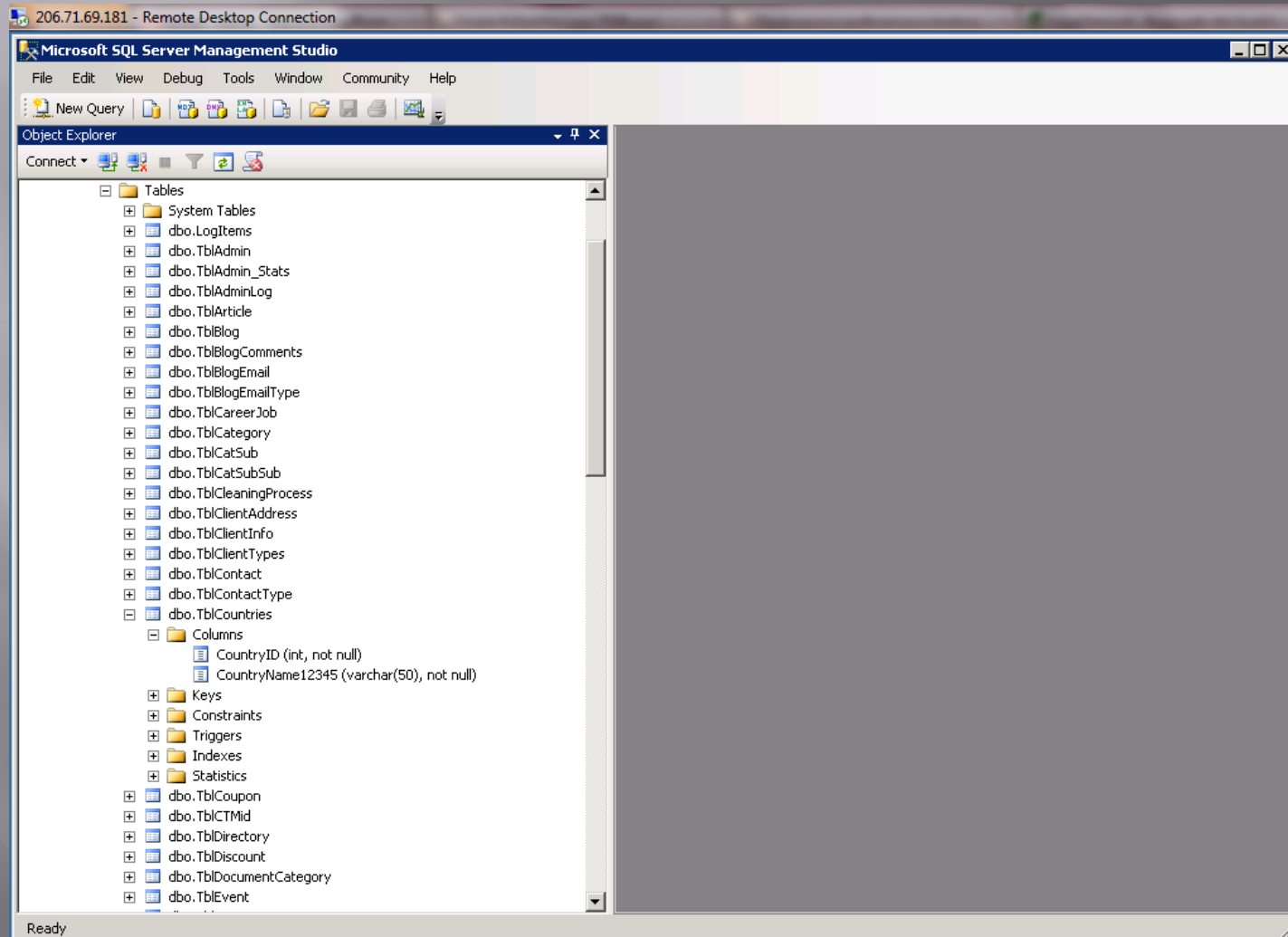
Demo

- SQL Database Change & Sync

Phase 3: Testing redundancy, outages, and uptime

- Test 1: Removing IIS 7 Cluster Nodes

- Test2: Removing SQL Cluster Nodes

- Test 3: Adding Non-configured Servers to the IIS Cluster Farm

Test 1: Removing IIS 7 Cluster Nodes

- ✓ We first verified that both IIS 7 Cluster nodes were online and ready for load

- ✓ We then turned off the IIS-Secondary VM, effectively pulling its power cable

- ✓ This then removed IIS-2 from the servers "Ready For Load Balancing"

The Web Page Had No Delays

IIS-REPAIR?!?!?!

When we then attempted to restart the VM for IIS-Secondary, the VM came back online but the IIS 7 'cloudfarm' did not re-add the VM back to 'Server Ready for Load' pool. We had to manually go into IIS-1, the cluster NLB, and select 'Repair Server' for IIS-Secondary. Within 30 seconds the server was repaired and added back into the IIS cluster.
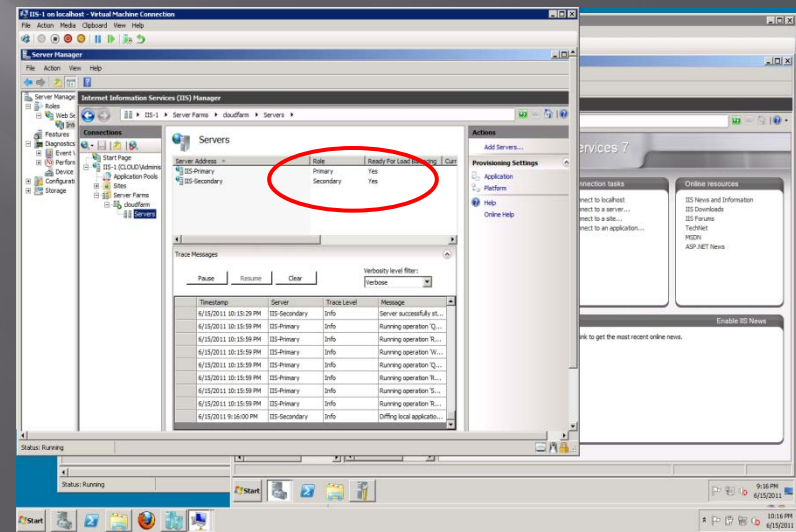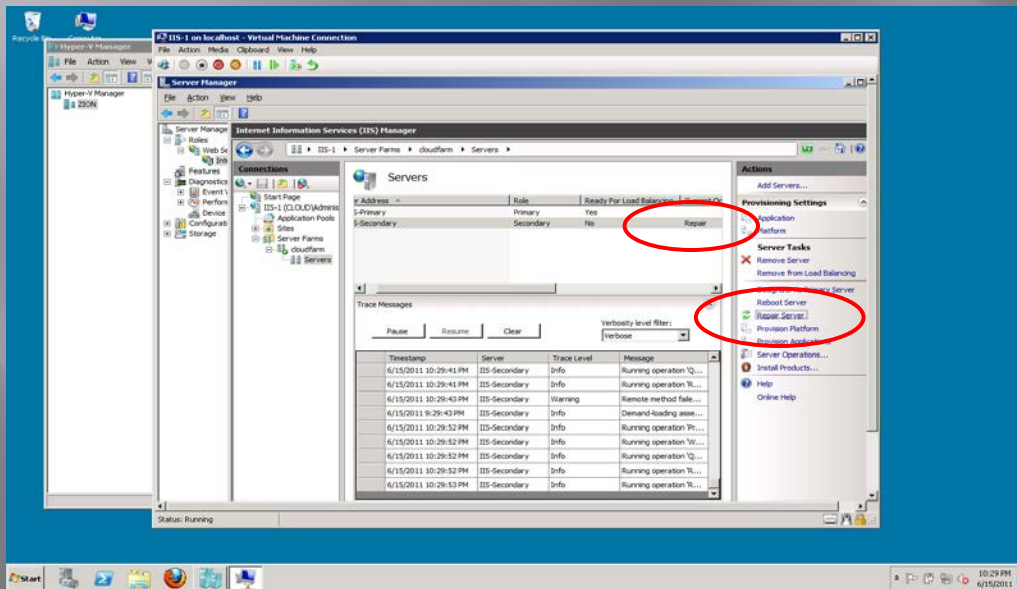
Test 1: Removing IIS 7 Cluster Nodes- Part 2

✓ We then turned off the IIS-Primary VM, effectively pulling its power cable

✓ This then removed IIS-1 from the servers "Ready For Load Balancing"

The Web Page Had No Delays

IIS-REPAIR?!?!?!

Demo

- IIS-7 Cluster Failover

Test2: Removing SQL Cluster Nodes

- Following the same test methods as the IIS cluster nodes above, we removed SQL -1 from the cluster

- We rebooted SQL-1, and waited for it to drop from the SQL cluster
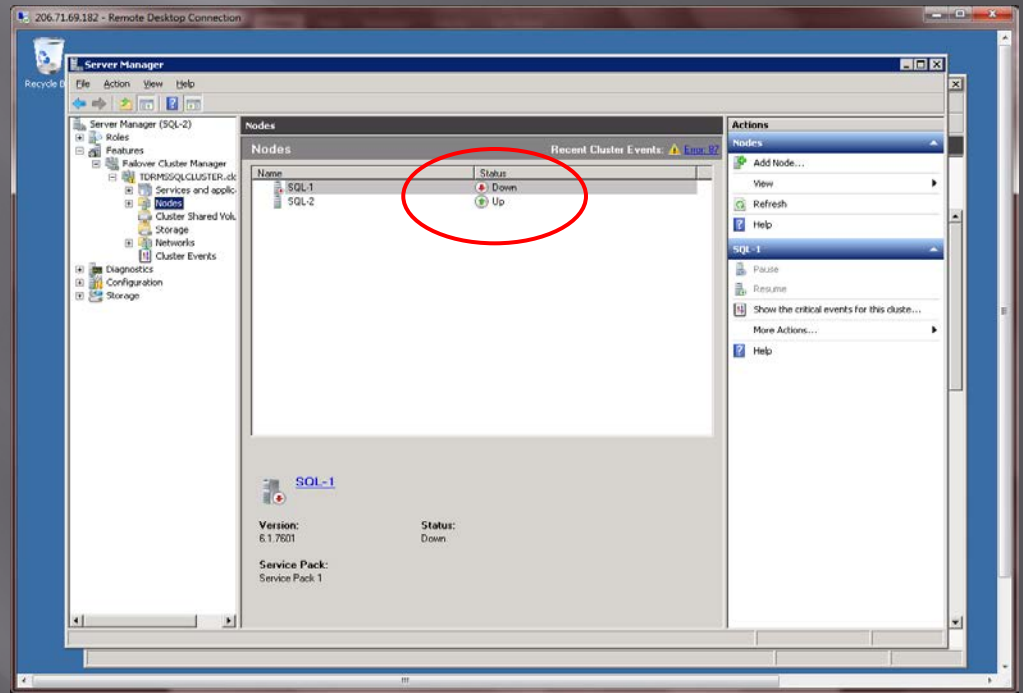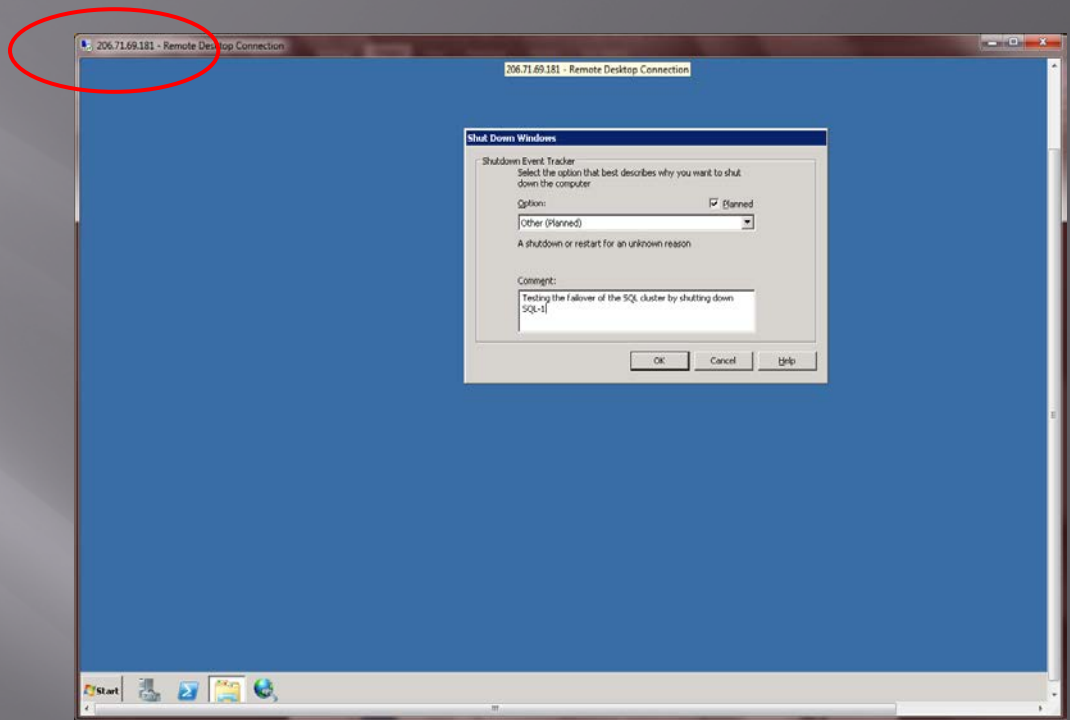
Here we can see that the SQL cluster is still 'Up' and enabled while SQL-1 is 'Unavailable'

SQL-1 Down

SQL-2 Ownership of Disks

We then powered on SQL-1 and waited for it to rejoin the SQL cluster automatically. It did without any errors or without having to be 'Repaired' like the IIS cluster nodes.
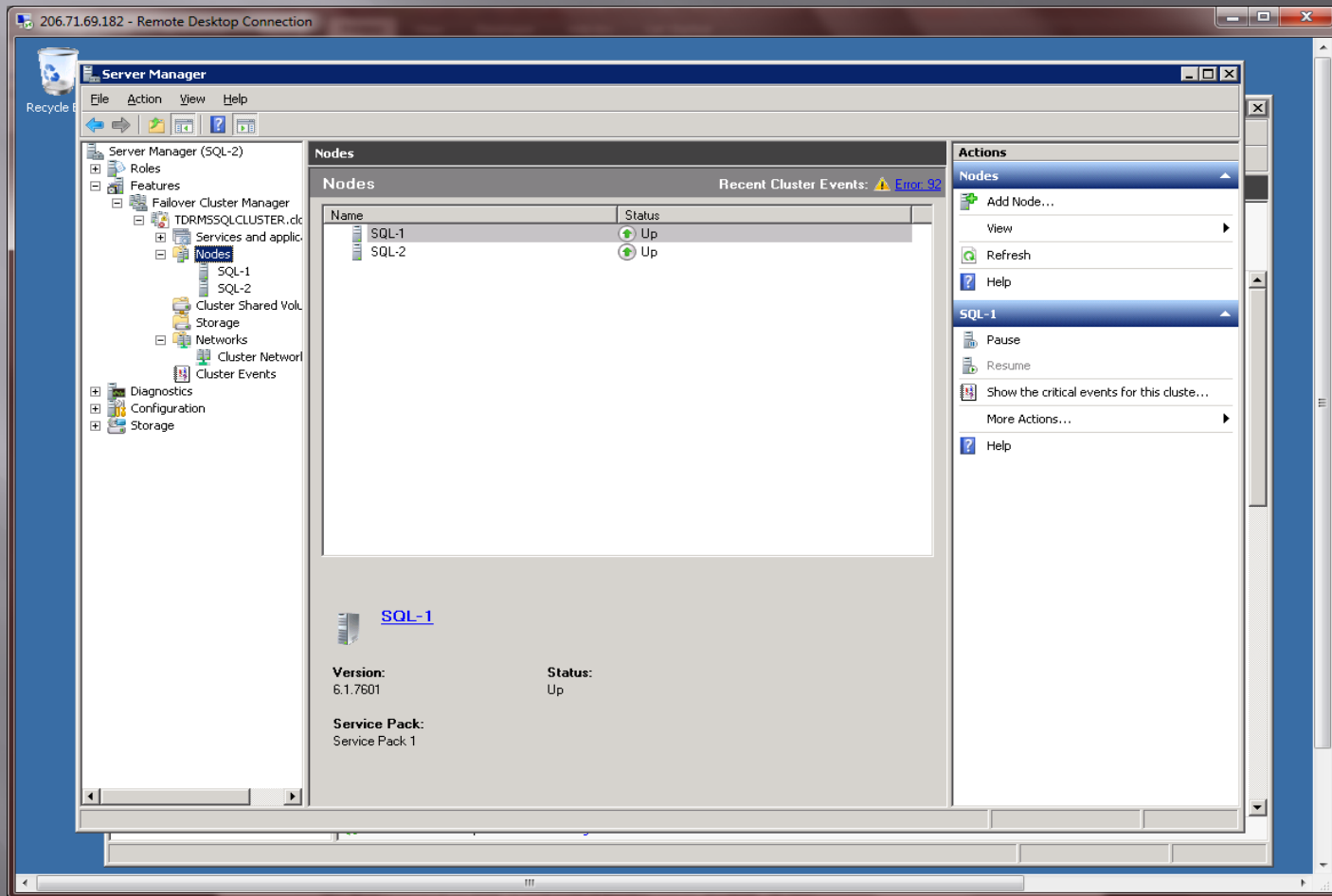
Test2: Removing SQL Cluster Nodes- Part 2

- We then followed the same procedure as we did while removing SQL-1, but this time we removed SQL-2 from the cluster.

- We had the same results as with removing SQL-1!!
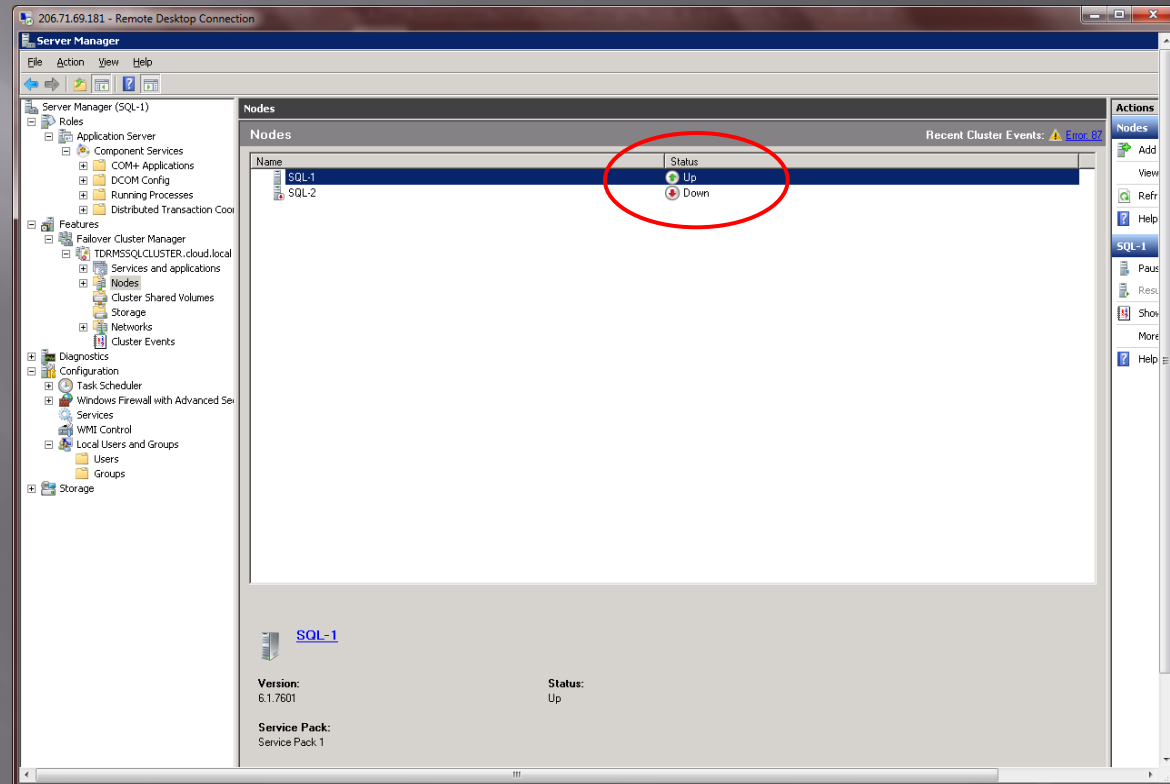
SQL-2 Down

SQL-2   Recent Cluster Events: ⚠ Critical:84, Error: 68, Warning: 2

Summary of SQL-2.cloud.local

SQL-2 has 0 applications/services.

Status: Down
OS Name: Microsoft Windows Server 2008 R2 Enterprise
Version: 6.1.7601
Service Pack: Service Pack 1
Manufacturer: To Be Filled By O.E.M.
System Model: To Be Filled By O.E.M.

System Type: x64-based PC
Processor: 2.15 GHz
Total Physical Memory: 3 GB
Total Virtual Memory: 6 GB
Page File Size: 3 GB

Name	Status	
Network Connections		
SQL-2 - Local Area Connection ⬇ Unavailable		Network: Cluster Network 1

SQL-1 Ownership of Disks

SQL-1   Recent Cluster Events: ⚠ Critical:84, Error: 68, Warning: 2

Summary of SQL-1.cloud.local
SQL-1 has 2 applications/services.

Status: Up
OS Name: Microsoft Windows Server 2008 R2 Enterprise
Version: 6.1.7601
Service Pack: Service Pack 1
Manufacturer: Dell Inc.
System Model: OptiPlex 745

System Type: x64-based PC
Processor: 2.93 GHz
Total Physical Memory: 4.94 GB
Total Virtual Memory: 9.87 GB
Page File Size: 4.94 GB

Name	Status	
Disk Drives		
⊞ 🖴 Cluster Disk 1	🔼 Online	
⊞ 🖴 Cluster Disk 2	🔼 Online	
⊞ 🖴 Cluster Disk 3	🔼 Online	
Network Connections		
⊞ 🖥 SQL-1 - Local Area Connection	🔼 Up	Network: Cluster Network 1
Services and Applications		
🖫 SQL Server (TDRSQL1)	🔼 Online	Other
🖎 TDRMSSQLCLUSDtc	🔼 Online	DTC

Once SQL-2 was rebooted and came back online, the SQL cluster once again added SQL-2 back to the cluster without having to be prompted and without 'Repairing' the server.
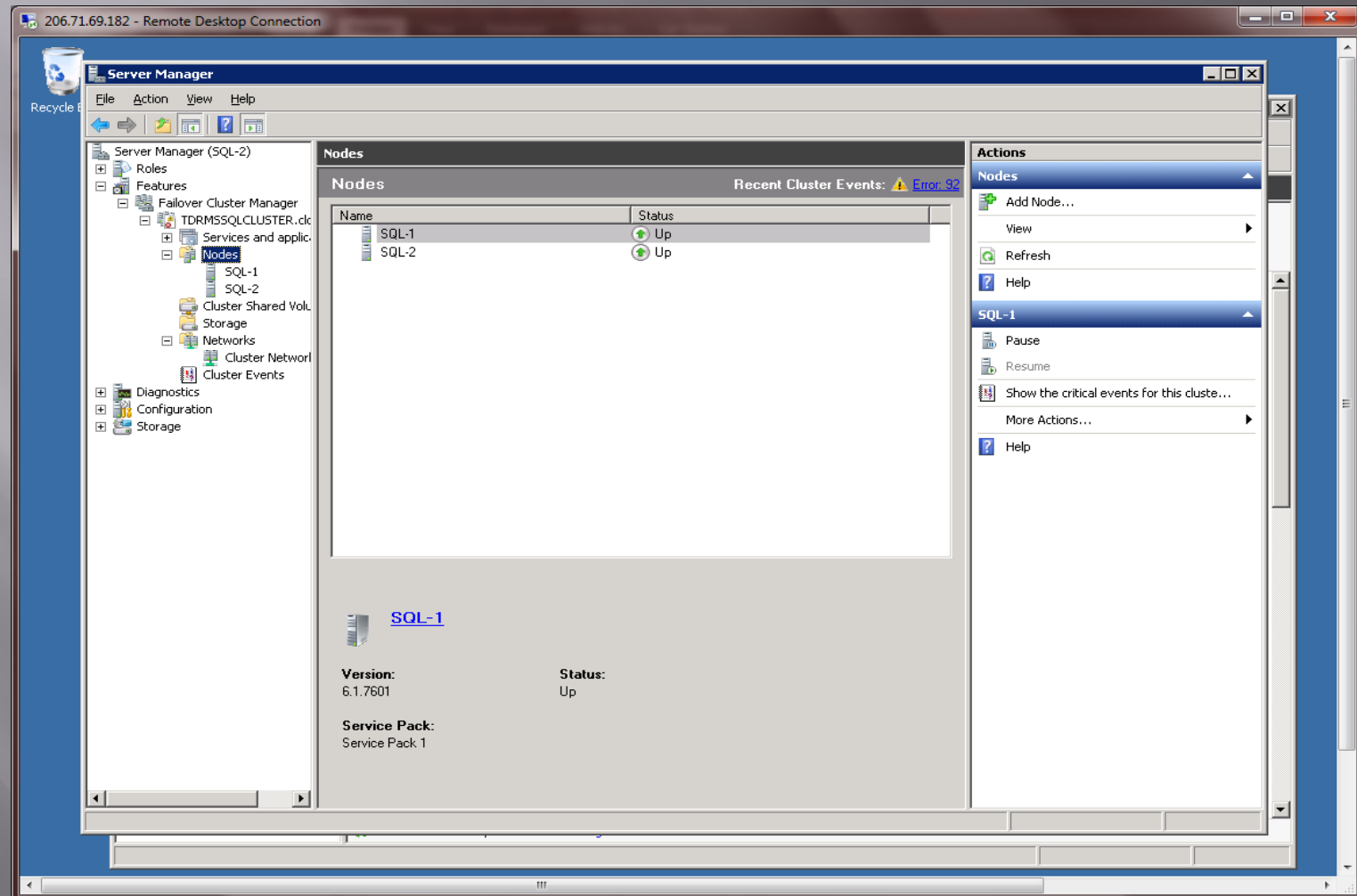
Demo

- SQL Cluster Failover

Test 3: Adding Non-configured Servers to the IIS Cluster Farm
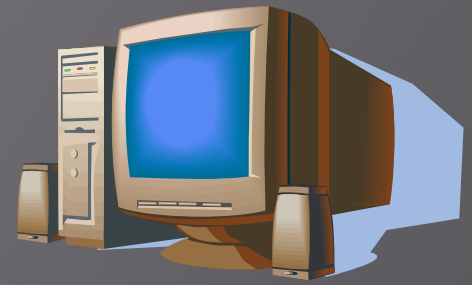
- We wanted to see what would happen if we took a non-configured server and added it to the IIS 7 cluster.

- We were hoping the cluster would configure the new node to be an IIS Server, replicate the settings, and then cascade the web site onto the new node. Essentially, we were testing to see if the IIS 7 Cluster would do all of the work once we had the cluster created.

- SQL-4
  - Windows Server 2008
  - No Applications
  - No Roles
  - No Features
  - Windows Updates Completed
  - Originally a 'backup' for SQL-3
  - Member of the domain cloud.local

"Add Server"

1. We accessed IIS-1, the NLB for the cluster, and selected "Add Server" on the right hand column.
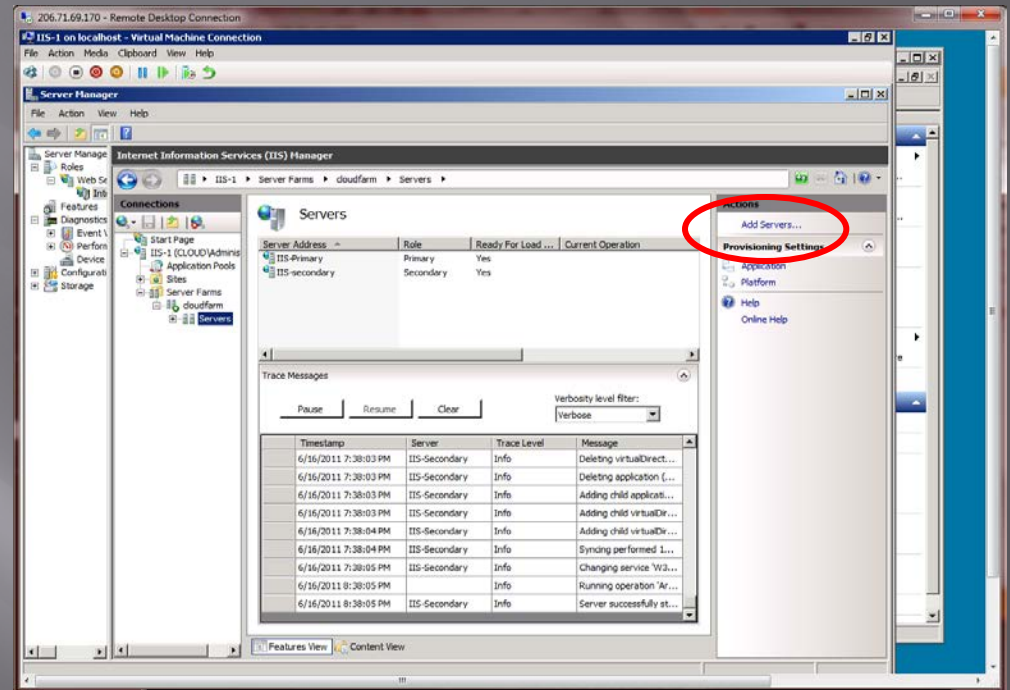
2. We then enter the name SQL-4 into the dialog box and searched for it on the domain.
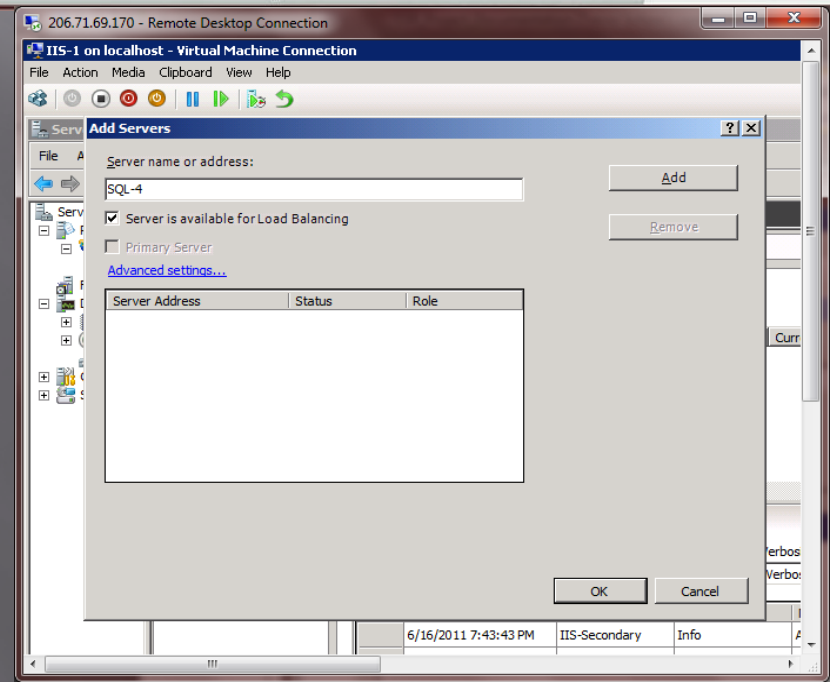
Once SQL-4 was located, we were able to select it from the available servers and click 'OK'. We were hoping the server would then be added to the IIS-7 cluster and the replication of the configurations files and website should proceed.
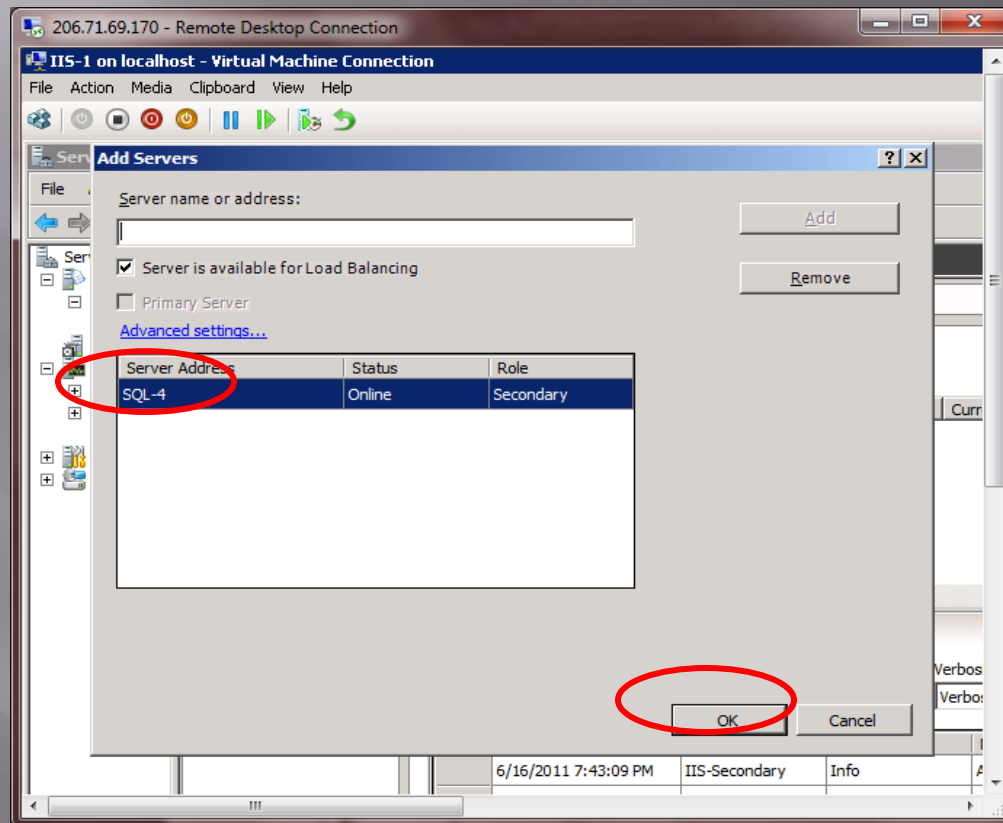
Ideally, once we select 'OK', the cluster should add the new node and begin configuring the server to be like IIS-Primary and IIS-Secondary…

We were wrong.
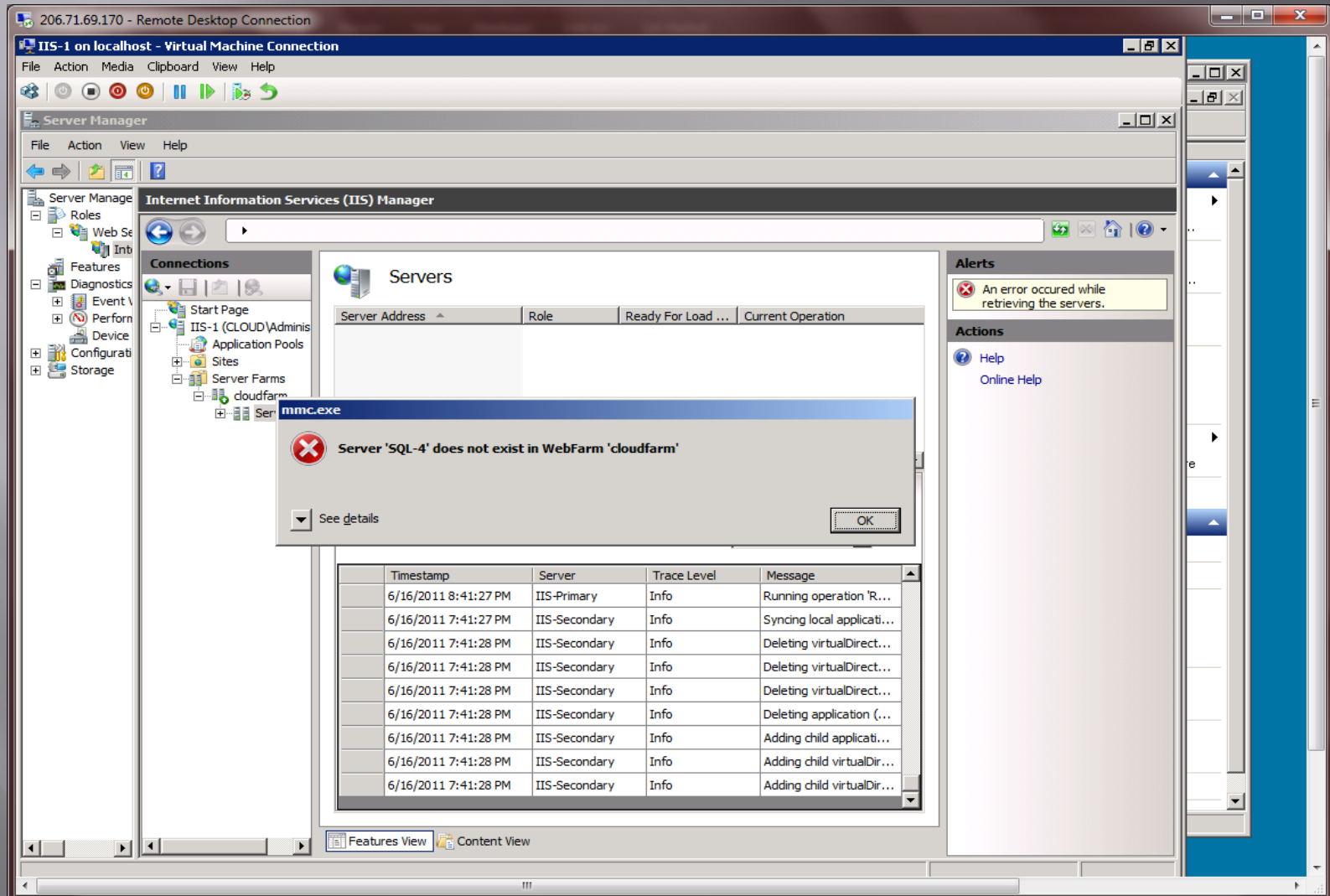
Server 'SQL-4' does not exist in WebFarm 'cloudfarm'".

- The IIS -7 Cluster cannot add a new server to the cluster that does not have IIS Server added as a role previously.

- Sadly, the cluster is no longer available in IIS Manager and the status of our other server nodes has disappeared.

- We were unable to perform any action on the IIS services without receiving the notification alert that "Server 'SQL-4' does not exist in WebFarm 'cloudfarm'".

- Interestingly, we are still able to receive the dentistpackage website without delay or error pages
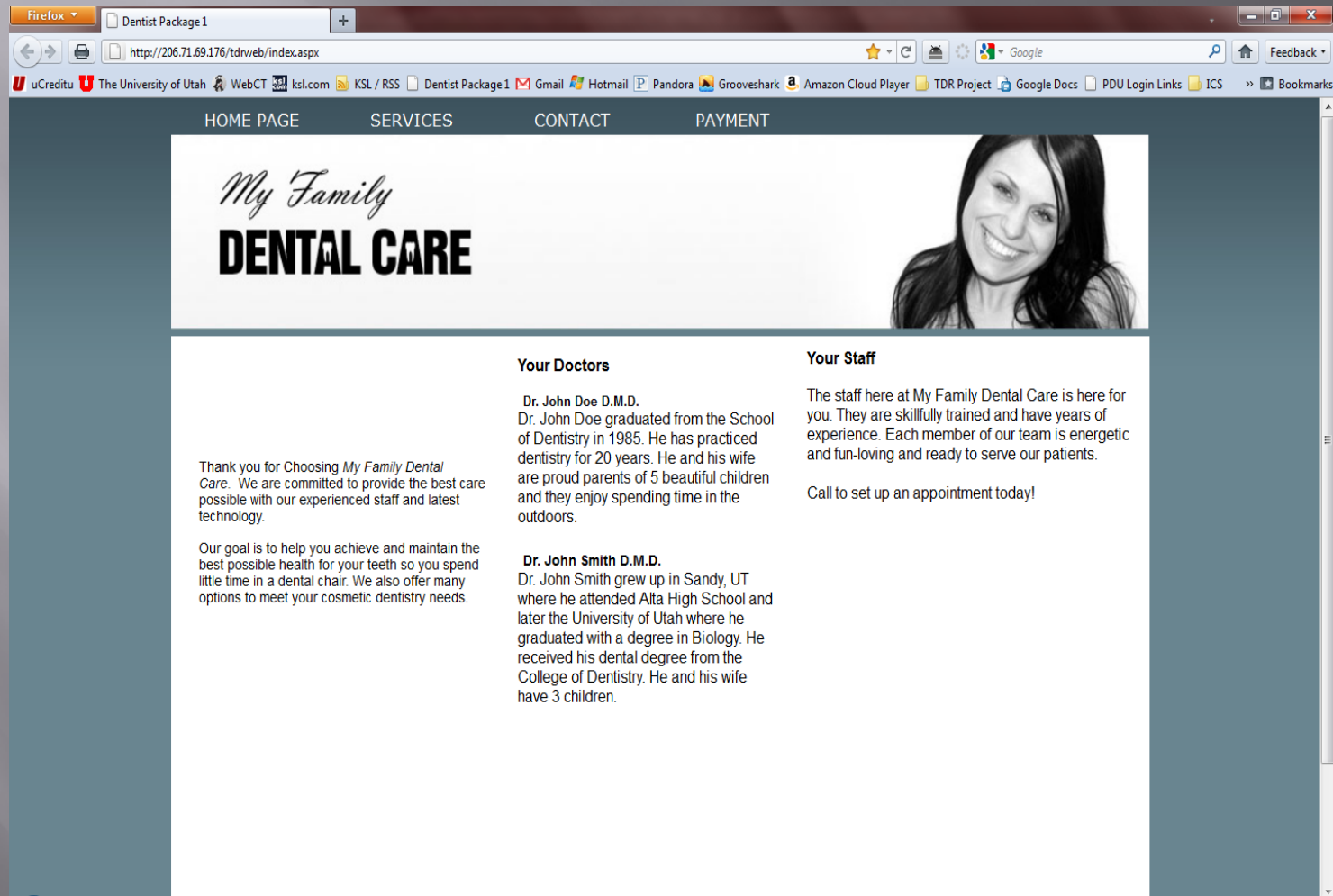
Attemps to fix the IIS-7 Cluster

1. In IIS-1, tried to repair the server farm. FAIL

2. Attempted to 'Repair' IIS-Primary and IIS-Secondary.   FAIL

3. Rebooted IIS-Primary and IIS-Secondary.   FAIL

4. Reverted IIS-1, the NLB for the cluster, back to an earlier state. WORKED
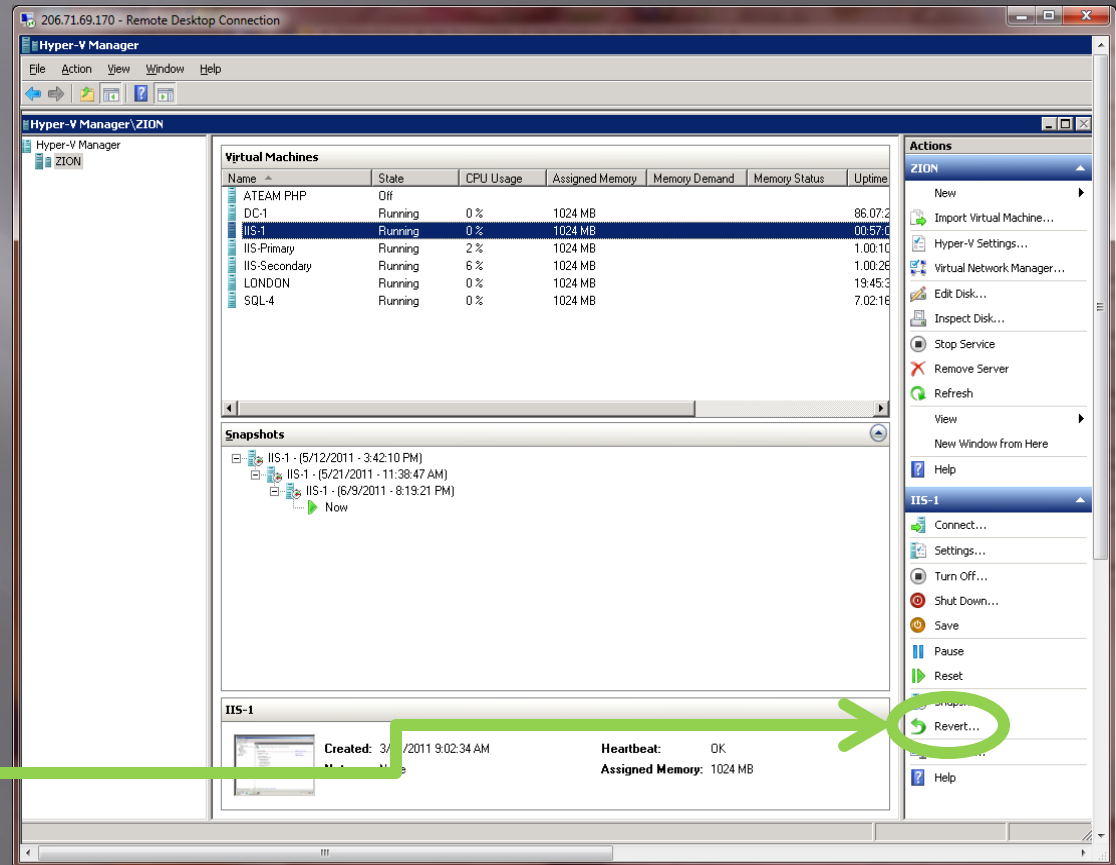
Lesson Learned!

- DO NOT add a non-configured server node to the IIS-7 Cluster in hope that the cluster will configure, replicate, and attach the new node.

- Each node needs the role of IIS Server added to it before it can be accepted into the IIS Cluster and made ready for load sharing.

- For some reason, adding a server without IIS Server previously installed breaks the cluster

Conclusions of Testing

IIS Cluster Farm Principles

Microsoft IIS7 Web Farm

IIS-1
(10.10.10.52)
(206.71.69.177)
Web Farm Controller

IIS-Primary
(10.10.10.59)
(206.71.69.178)
Windows Server 2008 Enterprise
IIS-7 Cluster Node 1

IIS-Secondary
(10.10.10.54)
(206.71.69.179)
Windows Server 2008 Enterprise
IIS-7 Cluster Node 2
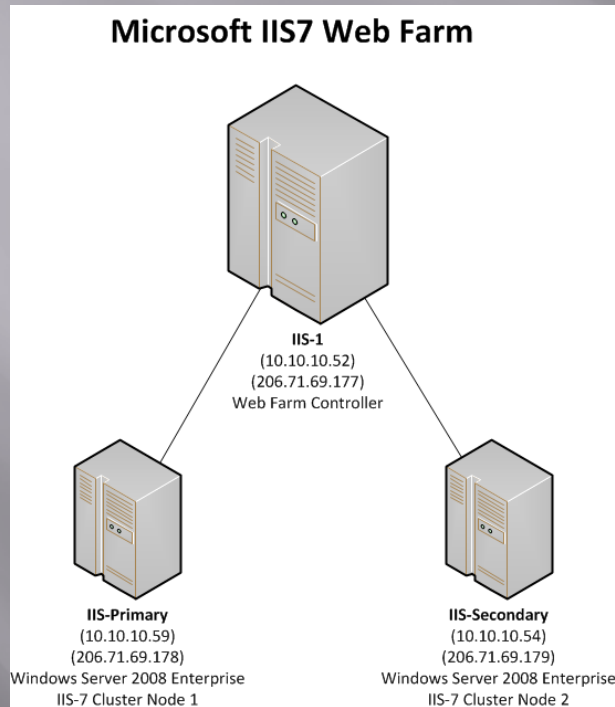
- Make all changes to IIS-Primary (or designated 'Primary' node)

- Any changes made to IIS-Secondary will be erased and overwritten and the node will inherit the properties of IIS-Primary

- While a node is brought offline for updating, all other nodes support the network traffic

- A single node can be brought offline with no delays in web services.

- In the middle of the Node Updating Process, some users will receive non-updated web pages stored on non-updated IIS nodes, while other users will receive the updated web page served from the updated IIS nodes.

- IIS cluster nodes need to be repaired once they are brought back online after being powered off.

- Each node needs the role of IIS Server added to it before it can be accepted into the IIS Cluster. If this is not done, the cluster breaks and is not repairable except through a revert of the Network Load Balancer (NLB).

SQL Cluster
Farm Principles

SQL-1
(10.10.10.58)
(206.71.69.181)
SQL Server 2008

SQL-2
(10.10.10.56)
(206.71.69.182)
SQL Server 2008

Microsoft

Microsoft®
SQL Server2008
Management Studio
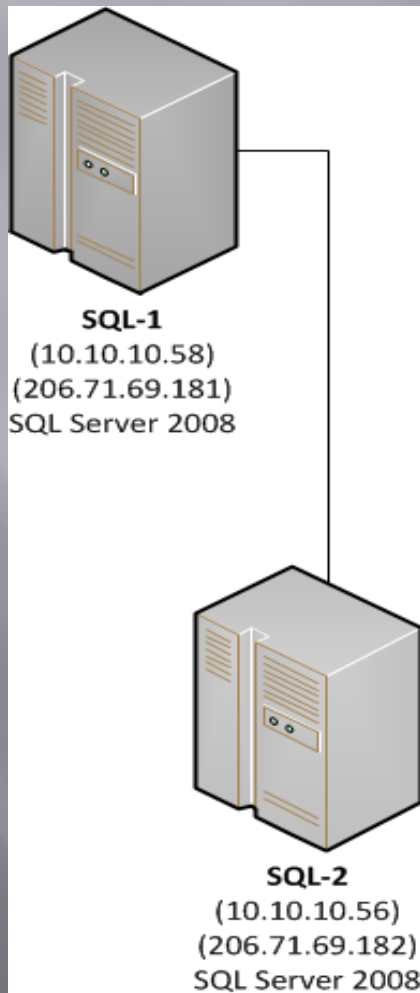
- Changes can be made to either SQL-1 or SQL-2, or any other cluster node and the change will cascade to all remaining nodes.

- There is not SQL-Primary, all nodes can replicate to other nodes.

- The SQL Cluster automatically brings servers online after a power outage or the like

IIS 7 Recommendations

- Configure server with IIS Server before adding to cluster

- Use Physical servers where feasible. These servers should be hardened.

- Take snapshots of all machines to roll back crashes

- Servers need to be manually repaired after falling out of IIS 7 cluster

SQL-2 S-Drive failure

- Whilst SQL-1 has ownership of the iSCSI drives, the website works great.

- When SQL-2 has ownership of the drives, the website throws an error and cannot connect to the databases
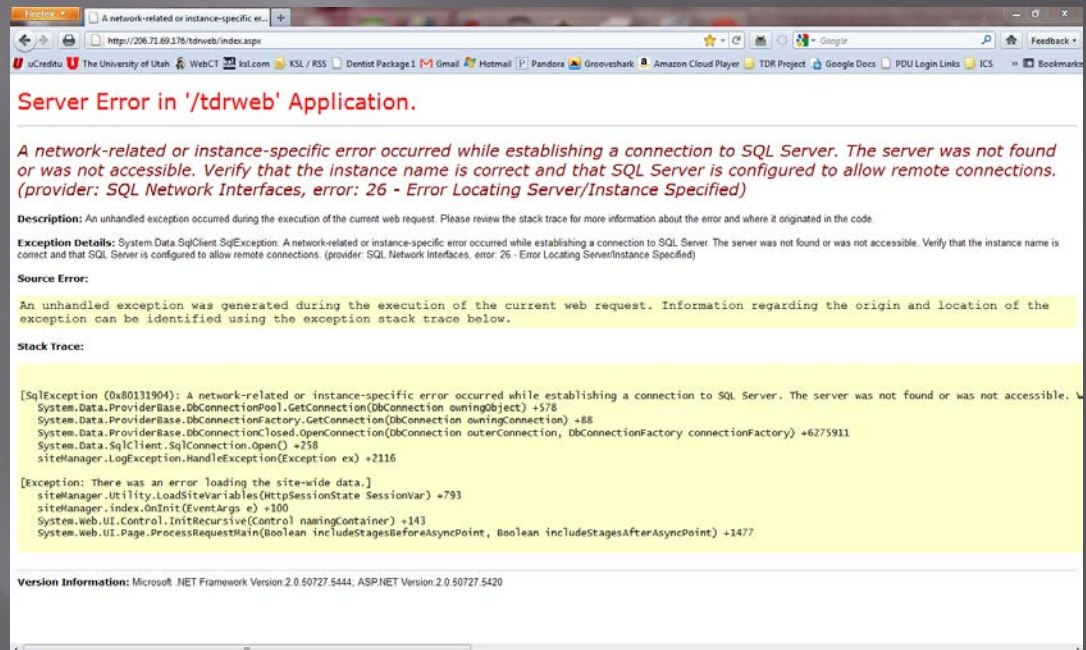
SQL-2 S-Drive failure

- Possible causes for this error are:
  - **Connection String Configuration:** Tried to directly target the SQL cluster logical name, SQL cluster static IP address. SQL-1, SQL-2. changed passwords, created new SQL Server users with Admin permissions.
  - **IP Address:** Pinged SQL cluster and SQL instance – received 'reply from 10.10.10.203/201' while SQL-2 had all drives.
  - **Move iSCSI disks to Cluster Shared Volume (CSV):** MS prohibits database storage in the CSV
  - **Firewall Configuration:** No Access to internal Firewall
  - **DNS Configuration:** No Access to DNS files

SQL Failover Recommendations

- SQL 2008 standard will only work if there are two nodes. In order to have more than two nodes you must use SQL 2008 enterprise

- Carefully consider the limitations of 'Mirroring' and 'Clustering'

- Use physical servers where feasible. These servers should be hardened

Basic Recommendations

- Use ping to check resolution, check server firewalls, dns config, connection string etc etc.
- if on failure of one node you get automatic failover to the second node then it sounds to me like the cluster is working! You issue is simply one of configuration somewhere.

Mark Broadbent

- SQL 2008 Cluster expert from the United Kingdom
- 14 years experience working on HA solutions
- Currently holds Microsoft Certifications:
  - MCSE+I
  - MCAD.NET
  - MCDBA
  - MCITP in Database Admin for SQL 2005 & 2008
  - MCITP in Database Development in SQL 200

Mirroring vs. Clustering

- "When your cluster group containing your Instance fails over to the other node, please be aware that the SQL instance is effectively shutting down and restarting on this 2nd node. This means that whilst it is doing so your SQL instance will be unavailable for around 30 seconds plus recovery time of your databases (in total usually around 40 seconds max). " – Mark Broadbent -

Mirroring vs. Clustering

- "The cluster wont be available 100% of the time since there is the possibility of failover, but then no solution can be guaranteed to be 100% available - ever. Windows and SQL Clustering is known as "shared nothing" which means just that, nothing is shared. There will only ever be 1 owner of a cluster group at any one time. The sort of thing I think you are thinking about is Oracle's implementation call RAC (real application clusters) which is a shared everything and is just a different approach and has its own drawbacks too. SQL Server can do read only shared db" - Mark Broadbent DBA-

Mirroring vs. Clustering

- "You can tier HA solutions too, and SQL Server does provide lots of different possibilities. The one which is probably most likely for you is Database Mirroring with Automatic fail-over http://technet.microsoft.com/en-us/library/ms175191.aspx In your connection string you can specify a fail-over partner which once the db has failed over will autoredirect the application connection see http://msdn.microsoft.com/en-us/library/5h52hef8%28v=vs.80%29.aspx" -Mark Broadbent-

Mirroring vs. Clustering

- "Mirroring failover can be very very quick in comparison to clustering however each technology has its benefits and drawbacks. In brief you should use Mirroring for providing HA to your db and Clustering to provide HA to your instance. If you just went for mirroring then you would have to ensure that you manually synchronise your instance level components (if they change) such as the logins or agent jobs etc. Mirroring is also an SQL Enterprise Edition feature sadly.

  Other technologies you can also look at for HA is Peer to Peer replication (might be a good one for your load balancing suggestion) http://msdn.microsoft.com/en-us/library/ms151196.aspx or Service Broker." - Mark Broadbent-

Q & A