

iSCSI SAN Benefits

White paper

Author: Ray Quattromini

iSCSI Appliance Ltd

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Registered Office: Brickells Business Court, Oakley Lane, Oakley, Basingstoke, Hants, RG23 7JU.
Reg. No. 05191363.

Telephone: 01256 782030

Web: www.iscsiappliance.com E-mail: sales@iscsiappliance.com

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What is an iSCSI SAN?

A SAN (storage area network) is a network dedicated to run block level storage. An iSCSI SAN can utilise an existing Gigabit network, which is then segmented into VLAN's. These VLAN's can be used to create a SAN for block level storage and a LAN for file sharing.

Many companies today have major investments in network switches which offer high performance, reliability and redundancy. iSCSI runs over Gigabit networks and utilises the existing company network to serve up storage.

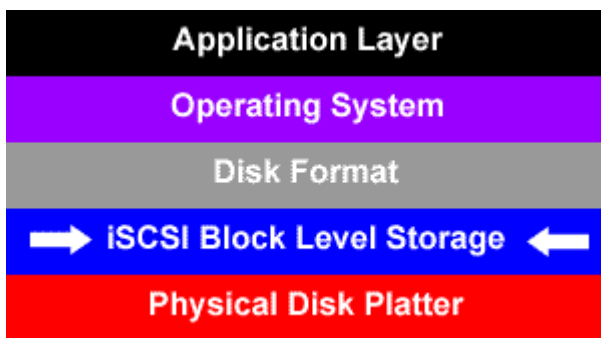
In the case of Fibre Channel this is not the case. A whole new separate network needs to be installed, along with switches and cards.

How does iSCSI work?

iSCSI is a combination of SCSI and IP. The SCSI commands are encapsulated in an IP packet which is then transmitted over IP to the destination server where it is then unwrapped. Both SCSI and IP have been around for more than 20 years and are fully understood. IT departments have the networking tools to manage the infrastructure and therefore should easily be able to understand iSCSI.

The physical disk storage resides on the iSCSI storage management server which serves up disk volumes to servers on the network at block level.

iSCSI storage structure diagram.



As you can see from the diagram the operating systems and applications can easily run on an iSCSI served disk.

What can iSCSI Storage provide?

A primary usage of iSCSI is instant disk space. With no server downtime or re-boot required, you install the initiator driver on the Windows machine, map the storage to the disk then allocate the desired disk capacity and format it under disk manager.

iSCSI allows system managers to easily scale disk storage to meet the application demand. The traditional method of guessing how much disk an application is going to need is banished to the history books. You can now allocate additional disk space to the server as another volume or using Microsoft Dynamic Disk program, grow the original disk to fit the new volume.

The iSCSI served disk can be mirrored at the OS level for resilience.

How fast is iSCSI?

Today many organisations are installing Gigabit networks these networks use CAT 6 cabling. Whilst the server and storage technologies tend to last for 3-5 years, the networking infrastructure normally lasts for 5-10 years. Organisations today should be planning to install 10Gbit cabling now to facilitate the move to VOIP (Voice Over IP), VOD (Video On Demand). As 10Gbit switches are now shipping, albeit at a high price per port cost. These costs will naturally start to tumble over the next 5 years.

Choice of media and optics –

IEEE 802.3ae - 10GBASE-SR (26 m over 62.5-micron FDDI grade multimode fiber, 300 m over 50-micron 2000 MHz*km multimode fiber)

10GBASE-LR (10 km over single-mode fiber), 10GBASE-ER (40 km over single-mode fiber)

10GBASE-LX4 (300 m over multimode fiber)

IEEE 802.3ak - 10GBASE-CX4 (15 m over copper providing 10Gbit/s over dual twin axial cables) Information provide by Cisco.

Fibre channel companies are already shipping 2Gbit products, 4Gbit switches are starting to emerge. But as companies move from 2Gbit or 4Gbit to 10Gbit the whole infrastructure will need to be replaced.

iSCSI performance over 1 Gigabit is roughly equivalent to that of 1Gbit FC. Whilst 2Gbit Fibre channel provides double the performance of 1 Gigabit iSCSI. The moves towards 10Gbit will clearly show that in the long term an iSCSI based fabric using 10Gbit switches will provide a lower total cost of ownership than that of Fibre Channel.

As a simple solution to increase iSCSI performance why not install two Gigabit cards.

What are the business benefits of iSCSI?

1. **Integrates with existing networks** – Organisations have already made significant investments in their networking infrastructure, iSCSI leverages this investment to provide a simple and convenient way of managing, installing and configuring storage across this network.
2. **Reduced Server Costs** – By separating the physical disk storage from the processors/memory, companies can reduce server costs by purchasing smaller servers, such as blade, shoebox or pizza servers. These servers typically run the disk OS and have a high performance processor and memory. By using iSCSI we can then provide large amounts of RAID disk space to the servers to run applications.
3. **Less Server Downtime** – In a traditional DAS (Direct Attached Storage) SCSI attached environment, any company wishing to add disk space or upgrade a server will need to firstly backup all the applications running, and then schedule server downtime. Once this has been done they insert the new disks and rebuild the RAID storage. Replacing the server requires a far more involved process of copying the application data back to the new server and hoping things will work as before when they are switched on. With iSCSI the disks are remote from the server, therefore adding a new disk just requires the use of disk manager or if replacing the whole server re-mapping the data to the server using iSCSI.
4. **iSCSI Management** – Having an iSCSI SAN can provide significant benefits for providing failover for high availability configurations, performance monitoring, and topology mapping for asset management. SAN Management improves these benefits. SAN Management allows multiple operating systems to share a centralised storage pool of disk which can be broken down in to SCSI, SATA or Fibre Channel based storage. This can potentially save an organisation a significant amount of money by purchasing a pool of disk for sharing to Windows, Linux, UNIX, Novell or MAC.
5. **Cost Savings** – iSCSI has the potential to save money in two ways: personnel and hardware costs. iSCSI can save personnel costs by allowing multiple servers to gain access to the centralised storage and managing that storage as a single logical entity. With today's direct attached SCSI storage each server and storage element must be managed separately. With iSCSI the storage arrays in the storage pool can now be managed through one logical interface. This allows more dynamic allocation of new storage and simplified backups since the storage pool can now be backed up, instead of each individual storage array. These greater efficiencies in management allow more personnel productivity. This is especially important in environments where additional headcount for IT operations is not available. Since the storage is growing 100% a year in many cases, no additional headcount means new tools must be found to cover the personnel gap. iSCSI allows more efficient storage management.

iSCSI also saves on hardware by more efficiently allocating storage to the application servers. Storage no longer needs to be allocated based on physical size. Part of a physical device can go to one server, and a different portion could go to a different server. Due to the dynamic nature of the centralised storage, it is also easier to provide temporary disk to a user for migration, testing, financial closing, or other purposes.

iSCSI is a cost effective way to build SAN's at much lower cost point, giving users greater consolidation in their environment

6. **High Availability / DR site** – As iSCSI is IP based replicating/mirroring data from site A to site B only requires a suitable size network pipe. As iSCSI is an underlying technology to the OS and application, anything that an organisation currently has can be used.

7. **Storage/Server consolidation** - A server consists of four key components these being the storage, processor, memory and operating system. When you buy a server you would pay for disk drives, CD/DVD drives, SCSI controllers, RAID controllers, processors, memory, case, tape device and operating system license. These servers normally act as file & print servers or run applications. When the server becomes fully populated with disks another server is bought and so the cycle continues. That is until cracks start to appear in this approach, having 100's of servers that need constant attention requires people dedicated to monitoring servers 24x7 and the on-going investment/maintenance of these servers is huge. Even so some of the servers probably only have 5GB of used disk others have far more than they need. Consolidating your storage and servers will clearly make cost savings and improvements to the whole storage/server infrastructure:
- a. Disk utilisation will be optimised
 - b. CPU processors will now perform more efficiently
 - c. Management and monitoring will be simpler
 - d. Upgrades/Rollouts easier
 - e. Reduced maintenance, floor space, power requirements
 - f. Greater flexibility for storage design and architecture
 - g. Reduced upgrade and on-going costs
 - h. Reduced operating system and backup license costs

iSCSI is an enabling technology that allows companies to adopt the technology and deploy a consolidated storage/server approach, when the legacy systems new replacing. It can also breathe new life in to older servers that need more disk space to operate.

8. **No expensive re-training** – As most IT professionals understand the operating system and the network IP infrastructure, adding iSCSI should be simple. Whereas adding Fibre channel storage to a network involves extensive training on mapping and managing storage.
9. **Uses less power** – By purchasing smaller servers and centralising your storage the overall power requirements will come down.
10. **Takes up less floor space** – By buying smaller servers you can fit considerably more in a 19" rack.
11. **Less business disruption** – Many companies today have in place Gigabit networks, these networks are tested installed and working. All the cabling and network points are in place and multiple power sockets put in for the servers. Any company installing an iSCSI SAN today can take an immediate advantage of this infrastructure and by buying blade servers actually reduce the number of power sockets and power consumption as the blade servers typically have redundant power supplies that power 10-20 blades. Conversely putting in a Fibre Channel network might involve the moving of servers to a temporary location, contamination from dust, planning consent or consent from the landlord to route cables, fault finding of faulty connections, additional floor or rack space for FC switches, increased power consumption, the financial cost to the business during this disruption.
12. **Easier administration** – Rather than have distributed storage attached to each server. iSCSI centralised the disk storage in a single place(s). Management of this can be done through a simple GUI and disk space allocated to the servers on the network via the GUI.
13. **More available storage capacity** - In the distributed storage network each server has a RAID controller, a set of RAID disks and typically a hot-spare in case of failure. Now if we have 20 servers each with 6x 72GB disks, the total disk capacity available is 8.6TB. The actual free useable disk per server using RAID 5 and a hot spare is 288GB x 20 servers = 5.76TB's. We have 20x 72GB available for standby in case of disk failure equalling 1.44TB of spinning, power using disks. 20x 72GB (1.44TB) of disk being used for the parity across each 5 RAID set. We therefore loose 2.88TB's of disk across 20 servers. Now if we create 6 RAID 5 disk sets on iSCSI we would loose only 864GB's a disk space saving of 2TB's!
14. **Reduced maintenance costs** – As the servers are far smaller, have less components and are less complex they should in theory be cheaper to maintain.

15. **Higher reliability** – As the servers no longer have SCSI, RAID controllers or multiple disks rotating the reliability should increase.
16. **Reduced backup software costs** – Today each server requires a client or server license for the data to be backed up. With iSCSI the disk is centralised and therefore this disk only needs to be moved to the backup server for backup.
17. **Scales to facilitate future growth** - As we have explained any company deploying an iSCSI SAN today can grow their infrastructure by leveraging IP as the primary storage technology. iSCSI today supports IPv4 and IPv6 and with the advent of faster point – point network connections through Terabit, the global centralisation of the storage data centre can be achieved.
18. **Open Systems** – Many of today's storage solutions are vendor-centric, in other words, if you need advanced functionality of a fibre channel array, you are usually limited to products from one vendor. The real power of the iSCSI centralised storage architecture is released when different vendors' storage is supported under a single management framework. This provides several benefits. In terms of migration, having a storage management platform that can manage the old and the new storage in a common manner is tremendously useful. Also, in today's world, even if a datacenter is all based on one vendor, mergers and acquisitions mean that it will probably be a mix of vendors at some point, and open system storage must now be managed by the iSCSI Appliance. But above all, the iSCSI protocol means freedom of choice. Now different vendors can be managed under one platform. This provides a practical way to integrate best-of-breed storage without having to get rid of the legacy equipment. You get investment protection and innovation in one package by using an iSCSI Appliance for the common storage management.
19. **Future proof** – A simply analogy of iSCSI compared to Fibre channel is the Hare and the Tortoise. Today Fibre channel (Hare) is faster than iSCSI (Tortoise). Fibre channel currently runs at 200MB/sec whereas iSCSI runs at 90MB/sec. Today iSCSI has Gigabit networks and within the next few years 10Gbit shipping products will become affordable, iSCSI runs on both Gigabit and 10Gbit networks. Gigabit has a roadmap to 100Gbits where Fibre channel has a roadmap to 10Gbits (not shipping) and the problems it brings with legacy 1, 2 and 4 FC Gbit networks. Companies with large budgets intent of jumping on the Fibre channel bandwagon, probably have the resources to understand and deploy Fibre channel. Companies that take a more strategic long term view of TCO (Total Cost of Ownership), ROI (Return On Investment), major advantages and plan for expansion, would be better off investing in iSCSI. In the end iSCSI is the smart choice and Fibre channel the hasty one.

Uses for iSCSI

Other than the obvious one for providing disk space to servers, below are ideas using the technology.

Increased Desktop disk space

An increasing amount of valuable information is stored on local hard disks and notebook computers including Outlook's PST files, spreadsheets, multi-media presentations, financial information etc. This information costs more than the hardware but the data is never or rarely backed up. By creating an iSCSI volume, the user now stores his local information on a RAID system rather than a single spindle disk drive in the desktop computer. Whenever the user switches on the computer it automatically re-connects to the remote volume and is backed up nightly.

Remote Offices

Depending on the network connection, the main office could serve up virtual disk volumes to the remote sites. For example an estate agent has lots of information stored at its offices. The information relates to confidential client information. In a normal environment if the PC's were stolen then all the client information also disappears. Now if we serve up iSCSI disk, the physical disk resides at HQ and therefore if these PC's get stolen, no data is taken and lost.

Virtual Disk Library

With ever decreasing backup windows the cost of managing and maintaining a backup of information is becoming problematic. The normal way to increase backup performance and decrease the backup window is to buy faster higher capacity tape drives and automate the backup solution. The problem is cost, unless you have purchased a tape library that can be expanded new tape hardware will need to be bought making your old tape technology obsolete, including all the tapes with the valuable information. A simple cost effective solution would be to serve up iSCSI disk space to the backup server, create a Virtual Disk Library that mimics a real library with slots and cartridge capacities but is based on hard disks. Data can now be backed up at disk-to-disk speeds. When these virtual tapes are full the data can then be transferred to your real tape library and then the tapes stored for safekeeping. Should you need to increase the number of media slots or require additional tape drives all that is needed is to reconfigure the Virtual Tape Library.

7x24 Backup / DR Backup

Most companies perform a backup once a day and typically at night. Should the backup fail for some reason, that night backups are never completed? This is especially critical at weekends when weekly full backups are run. Now herein lies the problem as full backups are run once a week and either incremental or differential are run daily should a server suffer failure, the backup tapes for that server would probably run into many tapes and take considerable time to restore. At best with backups being performed nightly you would lose a day's work should server or disk failure occur, if you're an animation house this could run into many thousands of pounds.

Why not using iSCSI every hour replicate user selected files or entire volumes from one or more source servers to your backup server. By doing this the data loss suffered is minimised to the last snapshot backup.

Many companies today have a Business Continuity or Disaster Recovery plan. Normally this consists of:

- Off-site location
- Room full of servers
- Backup tapes for restore
- Communication links
- Networking connections

These organisations then run periodic tests to check that they can recover information and be operating within the minimum timeframe.

In an ideal world "less is best" by this I mean less data = faster restores and availability. In reality many companies today have more than a terabyte of data. Now let's assume the following:

- Servers are all functioning correctly
- Backup tapes are free from defects
- Tapes are fully labelled and correctly marked
- Tape library hardware fully functional
- Backup software is working
- Operating systems are fully patched
- Communication & Networking links functioning

As a Disaster Recovery site is normally a scaled down version of the real site. Only critical data is restored first using a smaller robotic library or device.

Company "X" has 1 terabyte of critical information to restore within a 12-hour period. They have four SDLT-600 tape drives 36MB/sec native transfer rate x 4.

$4 \times 36\text{MB/sec} = 144\text{MB/sec} \times 60 \text{ secs} \times 60 \text{ minutes} = 518\text{GB/hour}$

Now company "X" can restore the 1 terabyte of information in 2 hours right?

Well yes and no. Its true restoring the data can take 2 hours but we live in the real world:

- How many companies are using SDLT-600 tape drives in their Disaster Recovery site? They are probably still using LTO-2, LTO-1, Super DLT, DLT or DAT for recovery.
- How many companies' backup critical individual server data to a single tape for restore?
- How many Disaster Recovery sites run Gigabit networking connections to the critical servers?
- How many companies interleave multiple server backups on a single tape?

In reality just to recover the critical data would take 2 or more days. This in the banking/trading house world runs in to Millions of Dollars/Pounds etc.

As explained above many companies with Disaster Recovery plans have:

- Two tape libraries one for the main site and one for the DR site
- Backup tapes are transported from the main site to the DR site for storage
- Tapes are duplicated at the main site to aid restores
- Two copies of backup/restore software are required

By utilising the disk snapshot utility, information can be restored in minutes with the minimum of fuss and inconvenience.

If you install an iSCSI Appliance at your main site that either replicates the data to another iSCSI Appliance or server in your remote site the whole system of recovery can be accomplished in a few hours not days.

E-mail Recovery

With an iSCSI served disk to our Exchange server. We move the Exchange mailboxes, public folders, log files etc to the iSCSI served disk. On the Exchange server we run a high availability software failover application and this information is replicated across the LAN or WAN to our secondary Exchange server.

First Scenario - If we need to perform maintenance or an upgrade of the Exchange server, we can carry out a controlled shutdown of the Primary Exchange server and we failover to the Secondary Exchange server. The time this takes is approx 2-3 minutes. If the users are running Outlook 2003 they will not see any problem, for users running Outlook 2000, they might have to close and re-open Outlook. As we hold the databases on a remote disk, all that the failover software needs to pass to the secondary Exchange server is the service information.

Second Scenario – Now should the primary Exchange server fail, the secondary would issue pings to determine if the primary Exchange server has failed, if after a pre-determined time frame approx 1 min. The Failover software issues a start services command to the secondary Exchange server and starts the Exchange services. This takes about the same time as above, the users again would not notice if anything failed. As above the Exchange information is held on the iSCSI Appliance served disk, no database rebuild is required to bring the Exchange server back up.

E-mail Archiving

In light of the recent scandals, involving WorldCom, Enron and Tyco regarding the deletion of e-mails. There is currently 63% growth in storage usage attributed to e-mail. Governments now have legislation in place regarding the storing and retrieval of e-mail and attachments for 7 years or more. Many companies have more than 200 employees and backing up either Exchange or Notes is a major headache for IT departments. The problems are the size of peoples mail boxes grow to utilise all the available disk space available, backups and restores of the whole mail system or individual mailboxes take longer due to the files types and information stored .avi, .jpg, .mov, .doc, .xls, .mp3 .pst etc.

Why not serve up an iSCSI disk to the server and automatically migrate aged files from the main mail server to the iSCSI disk. The user is unaware this has happened as he still sees the files as he would normally with the attachments. By doing this the backups on the mail server will be considerably quicker and in the event of failure the server can be restored much faster.

Archival Storage

With the Data Storage explosion the management of files is becoming a major problem for many IT departments. When files are last accessed, they clog up the file systems, they cause daily backups to increase and consume ever increasing amounts of storage space.

We all know disk is cheap but management costs 5-10 times that of the storage. Over 80% of this information has not been accessed for over 90 days and 60% of that data will never be accessed again.

File Archiving Considerations

File Archiving moves the files from expensive disk storage to less expensive media, but allows information to be always available. In effect, the system makes all secondary storage devices available as an extension of the primary storage infrastructure. Even though the files are removed from primary storage, navigation and recovery of the archived data is transparent to the user, who uses the same tools to access the archived data as they would for their normal online files.

For business, legal, and regulatory requirements, the data must be available for many years or even decades. Thus, longevity of the media, drive technology, and data file systems must be weighed when designing the archiving system.

Compliance and Regulations

Data can be both an asset and a liability. Depending on external or internal compliance regulations, files such as .doc, .xls, .ppt, .jpg etc, might need to be archived for a specified period, other data might need to be deleted. Clearly a File Archiving system needs to be flexible to allow for both compliance regulations and individual requirements of the organisation. The data retention rules for the files must be flexible enough to allow for the files to be migrated to key storage media and deleted, when they are no longer required.

Compliance is not just a function of data retention. It is also a function of data privacy and data audit ability. A compliant archive protects files from unauthorised access and at the same time, monitors and records in an audit trail all authorised access and movement of files in the archive.

Time Management

File Archiving rules and retention periods must be clearly defined. Otherwise the administrators of the system will forever be defining file policies, data retention periods and file migration rules to secondary storage. The system needs to be fully automated in design, once the departmental heads have defined which servers, drives, and directories the policies will be applied to, these schedules are set, the policies should run unattended... literally "set and forget".

Should there be a need for intervention, the administrator is automatically notified.

Secondary Storage Support

A file archiving system; potentially make use of any device and media type across the network for data storage. These include disks, tape libraries, optical jukeboxes, or any combinations thereof. The archiving system maintains a full catalogue of available devices and media, while also keeping track of media already in use.

Given this “map” of the infrastructure and the availability of media, file archiving system uses its built in intelligence to determine which media/device to use. If ever a device is not available, file archiving system will use an alternative. The file archiving system also provides complete robot management facilities for automated use of most standard storage devices.

Data Access and Security

The file archiving system must provide a comprehensive database that stores metadata related to all archived files. The database must provide an audit trail of activity for security and management purposes, as well as an index of files for easy data navigation, access, and recovery.

The database must manage file access privileges, ensuring that data is protected according to the security and access rights of the original file, so that only authorised users can access and recover copies of the archived file. These security facilities ensure that users can only access data that they were originally authorised to view within the online file system. Administrators with appropriate privileges can manage and navigate files across the entire archive, recovering data as required.

Transparent Access to the Archive

With an effective file archiving system, administrators and users can view and/or retrieve archived files using the standard Windows Explorer interface. This means that they can navigate the archive as easily as their normal online files. The archive file structure is an exact mirror of the original file system directories.

Applications for iSCSI

1. Offer power users disk space on demand
2. Run databases on iSCSI disk
3. Video Imaging
4. Graphical image store
5. Centralised heterogeneous file sharing
6. File system mirroring
7. Snap shot critical data
8. Replacement of traditional backup methods
9. Medical imaging
10. CAD/CAM

iSCSI Questions

1. **Is iSCSI an International Standard?** – iSCSI is an international standard ratified by the IETF.
2. **How many companies are supporting iSCSI?** – iSCSI is supported by 99% of the world's computer and storage companies. Primary advocates of iSCSI are Microsoft and Cisco and these companies are investing huge amounts of money in promoting and endorsing iSCSI.

3. **Is iSCSI expensive?** - Compared to Fibre channel an iSCSI network will cost roughly 50% of a Fibre channel network to implement and over the life of the technology probably 70% of a Fibre channel network. Even today a company can purchase a 24 port Gigabit switch and 10 Gigabit cards for less than a thousand Dollars. In contrast a single Fibre Channel cards cost more than thousand Dollars. Economies of scale dictate price, many corporations have indeed deployed Fibre channel networks at their HQ, main offices etc albeit on a far smaller scale than their previous way of connecting servers over 100Mbit networks.

Fibre channel is a tied architecture that gets more expensive over time, whereas iSCSI is an Open Architecture based on known protocols that allows network managers to easily deploy, manage and scale disk based storage over proven networks

4. **The iSCSI protocol is not secure** – IP is not by definition a secure networking topology. iSCSI fully supports IPsec for those companies wishing to move data globally. IPsec has two functions to ensure data security and data integrity. Security is achieved through data encryption techniques, and integrity through a combination of techniques that authenticate the data sender.

Furthermore, IPSec can be used to form ‘tunnels’ through IP networks. In other words, it can make a connection between two computers or networks on the Internet appear as though they’re connected via a private link. This is known as a VPN, a virtual private network.

5. **Can iSCSI offer disk space to my non Windows servers?** - Our iSCSI Appliance allows us to pool all of our physical disk storage. This disk can be SATA, SCSI or Fibre Channel based. We control how this disk space is allocated to each of the servers. These servers or clients can be Windows XP, Windows 2000 Workstation or Server, Windows 2003 server, Novell, Linux, UNIX, MAC etc. The only proviso is that they have iSCSI initiator support natively or the iSCSI TOE card has initiator support.

How reliable are your iSCSI Appliance Servers?

All the components in our iSCSI Appliance machines are designed to serve optimised high performance disk space to servers and/or desktops.

From the outset our aim was to build a solution that would last longer than a normal file server. We have spent the last 12 months testing and evaluating RAID controllers, Gigabit networking cards, motherboards, processors, operating systems, disk drives, power supplies etc., deciding which components we should use. Each component in our iSCSI Appliance is optimised to offer the maximum performance and low CPU utilisation. Today we have a solution that we feel can compete with the “world’s best” in performance, reliability and offer a great ROI.

Each iSCSI Appliance has options for disk expansion to SCSI, SATA or Fibre channel. The iSCSI Appliance has redundant drives, PSU, FANS, Processors, Memory and is supplied as standard with 7x24x8 1 year on site engineering response. Remote management of the iSCSI Appliance can also be performed by using the built-in remote management card.

Summary

As mentioned above iSCSI is an enabling technology that provides instant disk space to many different operating systems. iSCSI Appliance fully understands how iSCSI works and the requirements organisations need to fully utilise the benefits. iSCSI allows flexible easily managed storage to be controlled and deployed and used in a wide and diverse range of applications and environments.

About iSCSI Appliance Ltd

Founded in 2004 iSCSI Appliance Ltd are a UK based ISO 9001:2000 registered company. Who manufacture iSCSI Storage solutions.