

Storage Area Networks (SANs) and iSCSI Protocol

An Introduction to New Storage Technologies



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Introduction

This paper explains the concepts of “Storage Area Network” or SAN, iSCSI technology and how they are improving the storage options for network video surveillance systems.

As video management systems continue to trend toward IP and away from more traditional DVR solutions, RAID arrays have become increasingly popular for their ability to provide massive quantities of storage in a highly secure manner. This has typically involved connecting a RAID directly to an NVR or DVR using a SCSI connection.

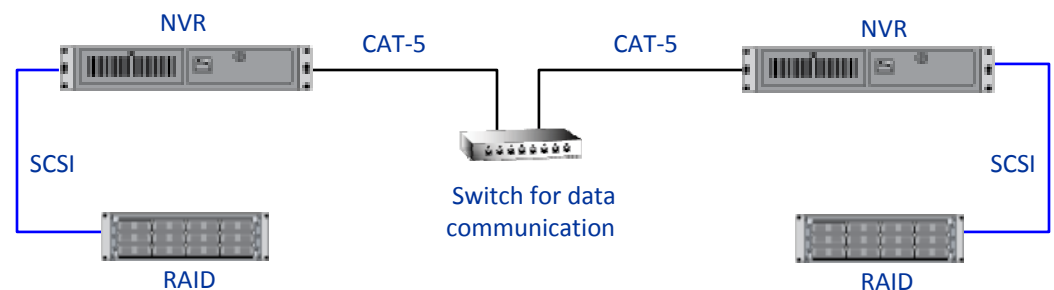
While this type of storage solution is still a very good option, a new type of RAID that uses an iSCSI protocol is opening up new levels of flexibility for system design and operation. These units utilize the concept of a “Storage Area Network,” or SAN.

As Vicon is updating its line of external storage arrays to make use of iSCSI SAN technology, this paper will discuss the advantages of these products and present some “best practices” for designing system topologies that make use of them. This will include examples that make use of the new RAIDs both as a local storage unit as well as within a larger Storage Area Network.

What is a Storage Area Network?

A Storage Area Network eliminates the need for RAID units to be directly attached to an NVR or DVR..

The traditional external RAID, like those Vicon has offered for the past several years, is a Direct Attached Storage (DAS) unit that connects directly to the server (NVR or DVR) through a SCSI cable. Every NVR/DVR has its own RAID unit(s). (See below illustration.)



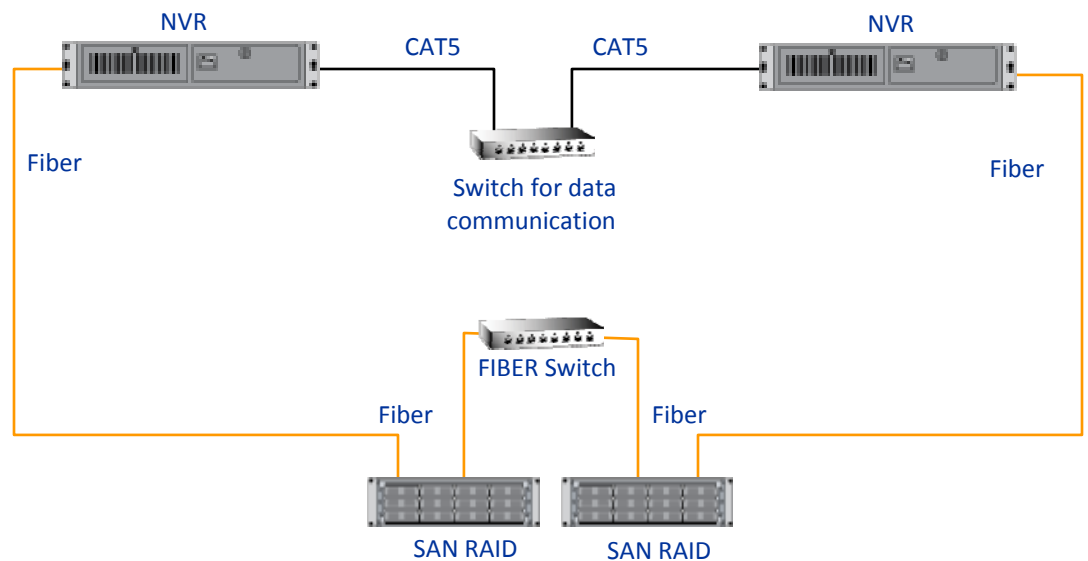
NVRs with Traditional External RAIDs

In a Storage Area Network, one or multiple SAN RAID units form a Storage Area Network. The NVRs and DVRs can record to the network without being physically connected to any of the SAN RAID units.

By contrast, a Storage Area Network allows storage devices (in our case, RAID's) to be connected to servers (in our case NVRs and DVRs) in a way that the storage "appears" local to the server, regardless of its physical location. In fact, the RAID and NVR or DVR may be located miles apart.

In simple terms, a SAN involves a storage unit or units connected within their own "network." Data from NVRs or DVRs is sent onto this network to be recorded and stored on the connected storage devices; the video is retrieved back over the network when playback is desired. The NVR/DVR connectivity to the storage network is done in a way that makes the physical location of the storage devices irrelevant.

In the early SAN days, the storage network was based on fiber optic cabling. The NVR/DVR would have a network interface card for regular (TCP/IP) networking and an additional fiber optic interface card to connect it to the SAN. (See illustration below.)



Older Storage Area Network that Transmits Over Fiber

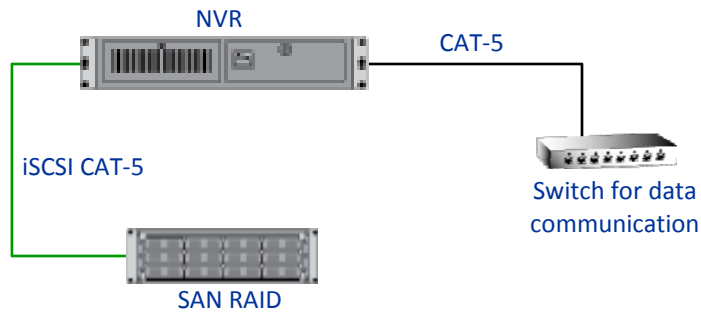
With introduction of iSCSI protocol, the connectivity has become even easier.

What is iSCSI?

The use of fiber optic cabling to create the network part of a SAN can be limiting when a special fiber optic network needs to be put in place or when the distance or infrastructure does not allow for fiber cabling.

iSCSI is an IP-based storage networking standard that transmits over CAT-5 using standard SCSI protocol. It allows for NVRs and DVRs to transmit to SAN RAID units up to 25 times farther than if they were using a traditional SCSI interface.

iSCSI (Internet Small Computer System Interface) is an IP-based storage networking standard for linking data storage facilities. By carrying SCSI commands (yes – the same good old SCSI protocol) over IP networks, iSCSI is used to facilitate data transfers over the regular data network and to manage storage over long distances. iSCSI can be used to transmit data over local area networks (LANs), wide area networks (WANs) or the Internet and can enable location-independent data storage and retrieval. Although the cabling is typically CAT-5, any Ethernet link (Ethernet fiber, radio, etc.) may be used.



SAN RAID Connected to NVR via iSCSI CAT-5 Cable
The RAID may be located anywhere within CAT-5 or Ethernet fiber reach.

iSCSI SAN Advantages

Advantages of using iSCSI architecture include:

- Regular Ethernet cabling (CAT-5E, CAT-6) and switching link NVR/DVR to SAN
- May stream multiple NVR/DVR to a single/multiple SAN, depending on specific model capabilities
- Extreme scalability
- Location flexibility, including the ability to transmit over CAT-5 up to 25 times farther than a traditional SCSI interface

Best Practices

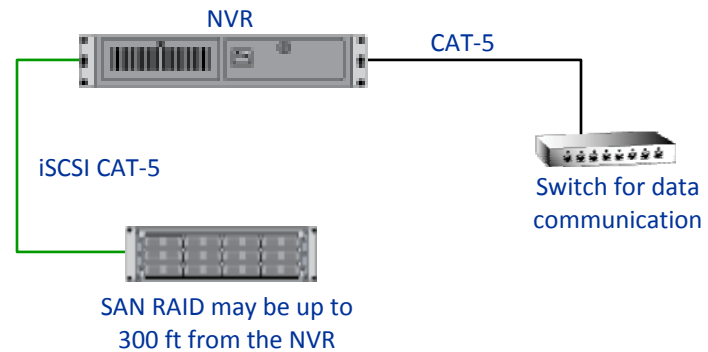
Although technically, iSCSI can run over the same TCP/IP network infrastructure that is supporting the system's data, Vicon recommends some best practices when designing a system with the SAN line of products.

Adhering to these best practices will ensure high-reliability and the best performance for a basic or an enterprise-level system.

Adhering to best practices when designing a system with SAN RAID units will ensure the best performance. This is true regardless of system size.

Example 1: Single NVR System

Scenario: After designing a system, you determine that a single NVR is needed to handle your camera recording, and storage calculations show that you require 12 TB of storage. By using an iSCSI connection between the NVR and SAN RAID unit, you have the flexibility to place the array in the rack right next to the NVR/DVR or up to 300 feet away. This would be desirable in situations where rack space is not available but there is space in a room nearby. By contrast, a traditional SCSI connection would require the RAID to be placed no farther than 12 feet from the NVR/DVR.



Even in small systems, it is recommended to use two separate network interface cards within the NVR to interface with the data network and the storage network.

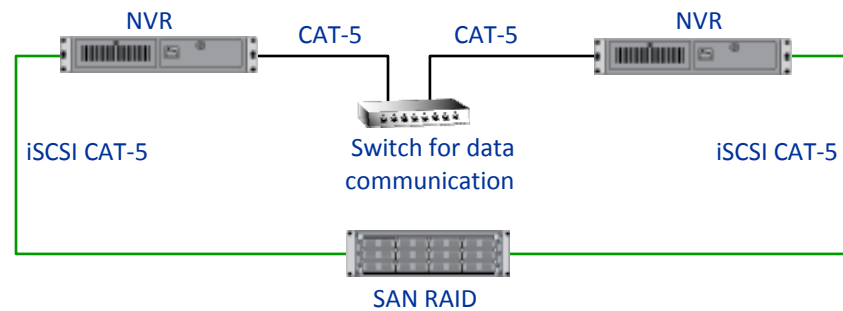
In the above example, best practice dictates that the connection to the SAN RAID be separated from the connection to the data network that supports transmission of video and data between the cameras and the NVR. By using a second NIC (Network Interface Card) in the NVR/DVR it is easy to create one network for data communication and a second one for the storage. The cost of the additional NIC and switches is very low, and this architecture offers higher reliability and bandwidth, plus it makes the system easier to maintain and to trouble-shoot.

Note that in systems where a single NIC will be used for both data and storage, there may be, under certain loads, performance degradation due to bandwidth usage and processing overload.

Example 2: Two NVRs with One RAID

Scenario: Your system requires two NVRs to handle your camera recording and storage calculations show that each NVR requires 6 TB of storage. Rather than connecting a separate 6 TB RAID to each NVR, you can now use a single 12 TB SAN RAID and connect it to both NVRs.

If you have more than two NVRs, you can use a switch to create a separate network for storage (refer to the next example).

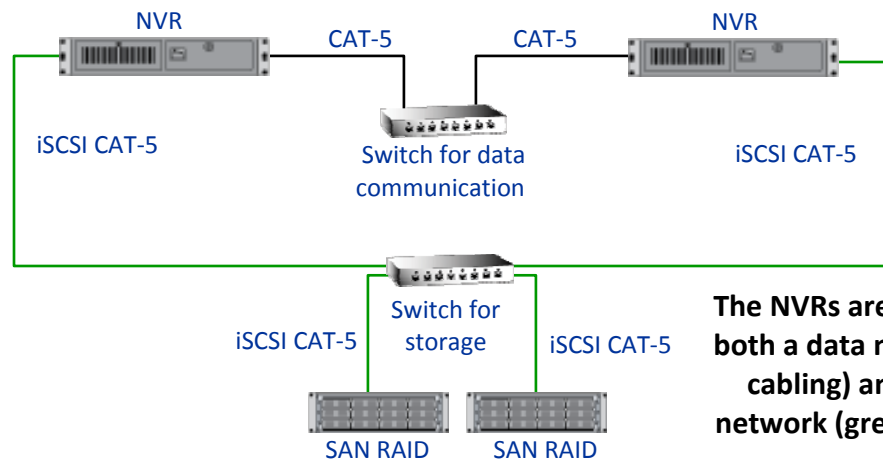


As shown in the above example, some SAN RAID models allow you to connect to more than one NVR/DVR by providing multiple network interfaces from which iSCSI cable may be run. Of course, the number of network connections may vary by SAN RAID model.

The SAN RAID units are connected to the NVRs using the NVR's second NIC.

Example 3: Multiple NVRs with Multiple SAN RAIDs

Scenario: Your system requires several NVRs to handle camera recording and each NVR requires substantial storage. By calculating the total required storage of all the NVRs combined, you can now use multiple SAN RAID units to build up to the total required amount of TBs required by the system. All NVRs are connected to the SAN RAID network and storage may then be allocated to optimize your system.



The NVRs are connected to both a data network (black cabling) and a storage network (green cabling).

Some SAN RAID units, including those offered by Vicon, allow connection to more than one NVR. This can save both on system cost and required rack space.

Using a storage switch, the storage capacity of multiple SAN RAID units can be used to accommodate multiple NVRs without required a one-to-one relationship.

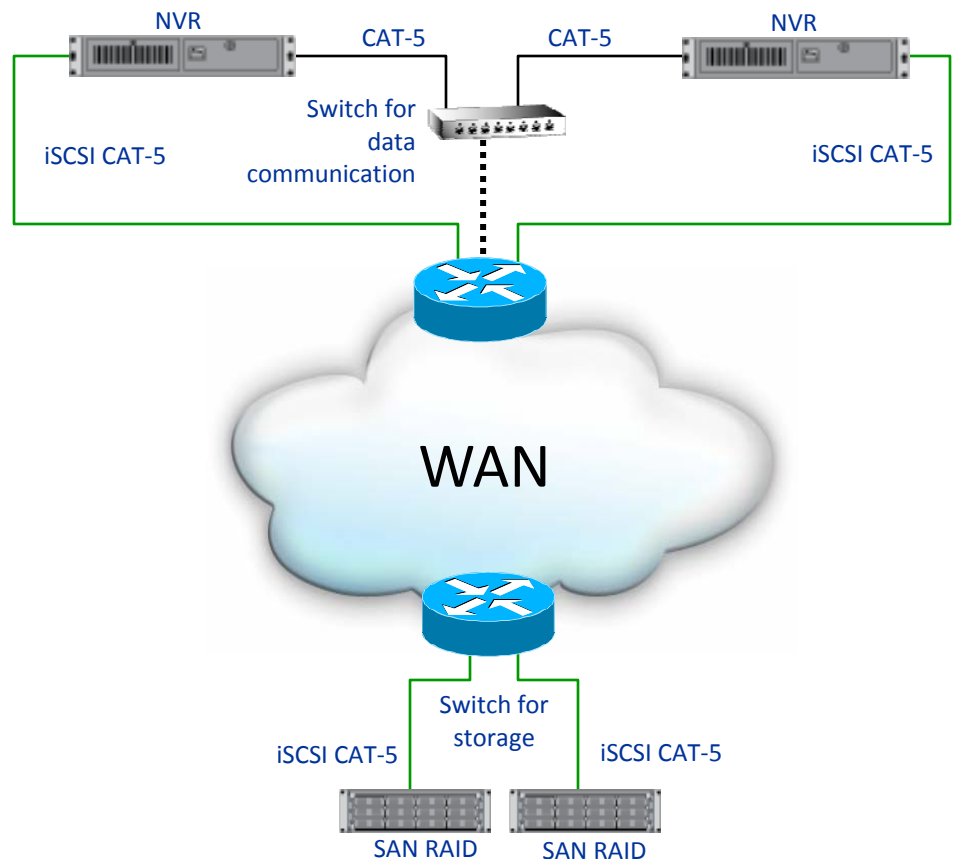
In this example, a network switch (1000 Mbps) creates a storage network that allows multiple NVR/DVR units to be “connected” to a single SAN RAID unit. (Vicon approves a maximum of 4 NVRs/DVRs to be assigned to a single SAN RAID.)

Also, best practices state that separate switches should be used for the data and storage networks. As explained in the first example, keeping the networks separate will deliver higher system reliability and bandwidth and aid in maintenance and trouble-shooting.

Example 4: Accessing a Storage Area Network over a WAN

Scenario: A high-speed WAN network ties together the many buildings of a campus. You wish to locate all of your storage arrays in one server room and stream data from all over the network to that single location for storage. The traffic from each building to the storage location is over iSCSI and through the WAN. If someone at the storage site wishes to view live ViconNet video, this will travel over a separate CAT-5 traffic path and through the WAN.

This type of installation requires a highly reliable bandwidth and network infrastructure.



Both data and storage can be transmitted over a WAN. However, this architecture requires a highly reliable bandwidth and network infrastructure.

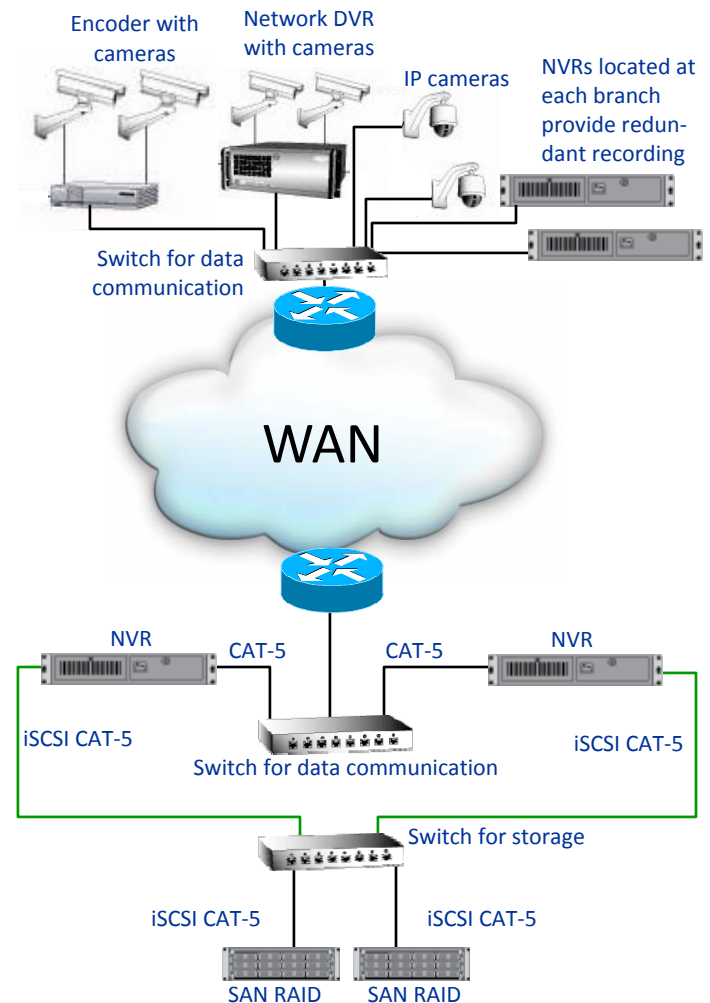
As this example shows, iSCSI SAN can be used over WAN or wireless. However, it is important to understand and remember that, much like the video transmission from ViconNet devices, the storage protocol is sensitive to bandwidth and network stability (sometimes even more sensitive). In situations where the network's performance is questionable, it is recommended to bring the storage closer (network-wise) to the video source (refer to Example 5).

Example 5: Using a WAN for ViconNet and a LAN for the Storage Network

Scenario: A corporate headquarters and its many branch offices share a network that communicates over leased WAN lines. The network's speed and availability are good but inconsistent. Video is captured in every branch using IP cameras, encoders or DVRs. The video is then transmitted over the WAN to headquarters, where it can be viewed and controlled and using several NVRs and recorded to a Storage Area Network comprised of several SAN RAID units.

Only ViconNet video is transmitted from the branches to HQ over the WAN, which is optimized by the ViconNet system to allow highest quality and best frame rate. Recording occurs once the video reaches headquarters.

Recording redundancy is offered by adding a local NVR in every branch. These may be set to record for a shorter time period or at a higher frame rate than what is being stored at headquarters. This will ensure availability of video even if the WAN becomes disconnected.



A good alternative to transmitting both data and storage over the WAN is to locate the Storage Area Network closer to the NVRs and make use of the LAN for transmission.

The many advantages of using SAN RAID and iSCSI technology should be considered before planning your next installation.

As this example demonstrates, there are alternatives available in situations in which data and storage would otherwise need to share a single WAN connection. Rather than transmit storage over the WAN, the topology diagram illustrates a solution in which SAN RAID units are located next to the NVRs and only ViconNet video is streamed over the WAN. This method minimizes bandwidth and overhead over the WAN link and allows ViconNet's streaming algorithm to optimize performance. Storage need only travel over a LAN from NVRs to SAN RAID units, and optional storage redundancy may occur at the satellite locations.

Summary

New SAN RAID and iSCSI technology allow system designers significant flexibility in determining placement of storage within a network as well as how the storage is allocated across multiple NVRs. While traditional RAID technology with SCSI connectivity remains a solid option for users seeking extensive and secure storage, the advantages of the newer SAN RAID units make them worth serious consideration for future installations.