Infortrend ®

Safeguarding Data Storage

for Video Surveillance and Security

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Overview
Increased concerns over personal injury and property damage have led to the growth of Closed Circuit Television (CCTV), a video surveillance technology designed to monitor a variety of environments and activities. Used in warehouses, retail stores, casinos, automated teller machines, and other public and private high security/high risk areas, the goal of CCTV is to discourage crime by recording events that can be used as evidence in criminal prosecution.

Executive Summary
As digital surveillance systems increase in popularity, data storage becomes an important issue especially when monitoring large installations. There is a range of options available to store CCTV footage depending on the data capacity requirements. This white paper:
1. explains how RAID storage is used in video surveillance and security applications
2. describes a sample installation
3. provides guidelines on determining specific needs

Traditional Storage
Early analog CCTV systems recorded events onto VCR tapes. If a crime occurred, a single tape would be provided to the police as evidence. While simple, the police faced the time-consuming process of fast-forwarding and rewinding the tape in order to find specific events. Tape recorders have many moving parts, making them susceptible to wear and tear, and the tapes themselves degrade in quality over time and with repeated use.

Advanced Digital Storage Solutions
CCTV suppliers are now turning to digital CCTV systems to deliver more comprehensive security surveillance. Compared to analog systems, digital CCTV systems provide additional features and important benefits like higher resolutions and frame rates; instant, random access to a specific time and specific camera; no quality reduction when copying the image; greater storage capacity in the same space; and improved service life and reduced maintenance.

As digital surveillance increases in popularity, data storage becomes an important issue especially when monitoring large installations. There is a range of options available to store CCTV footage depending on the data capacity requirements.

Redundant Array of Independent Disks (RAID) systems are used to protect computer data against hard drive failure, while increasing system performance and enabling easy expansion for larger storage. This technology is designed for any organization that requires high capacity storage, 24x7 data protection, shared access, and simplified capacity expansion.

Digital CCTV Storage Basics
Storage capacity can range from one single hard drive up to a SAN (Storage Area Network) consisting of a number of disk array (RAID) units on a switched fabric network.
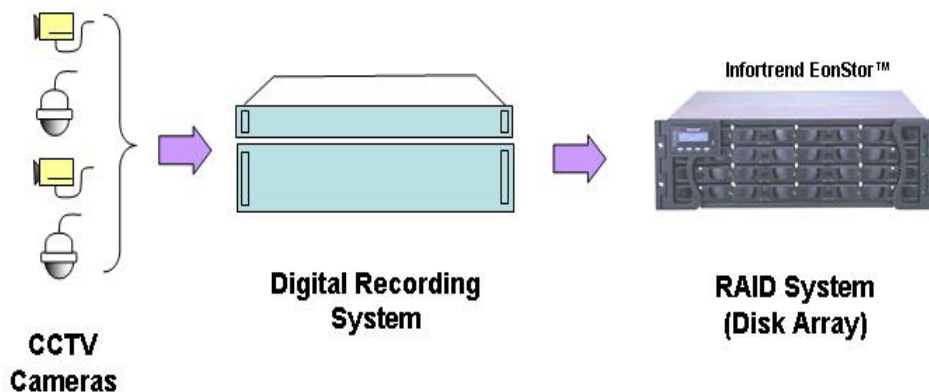

Diagram 1: Basic Elements in a Digital CCTV System

While various kinds of digital media can be used, many parameters need be considered including:

- Storage capacity
- Access timing
- Cost

To calculate the capacity required, the following information is needed (the provided sample parameters will be used in the configuration discussed below):

- Data size of each frame - 40KB
- Frame rate (number of frames recorded in one second) - 3 frames per second
- Number of cameras connected - 100 CCTV cameras
- How long the data will be kept - 31 days

If data from 100 cameras has to be kept for 31 days, the Digital Recording System (DRS) will overwrite data recorded on the first day with data recorded on the 32nd day. On the 33rd day, the DRS overwrites the data recorded on the second day and so on. In this way, the last 31 days of data will always be stored.

Connecting Cameras to Storage
Most DRSs are able to connect multiple cameras. In the example show in *Diagram 2*, five DRSs are connected 100 cameras (20 cameras connected to one DRS). Each DRS is then linked to the data storage (RAID system) using Fibre Channel cables.
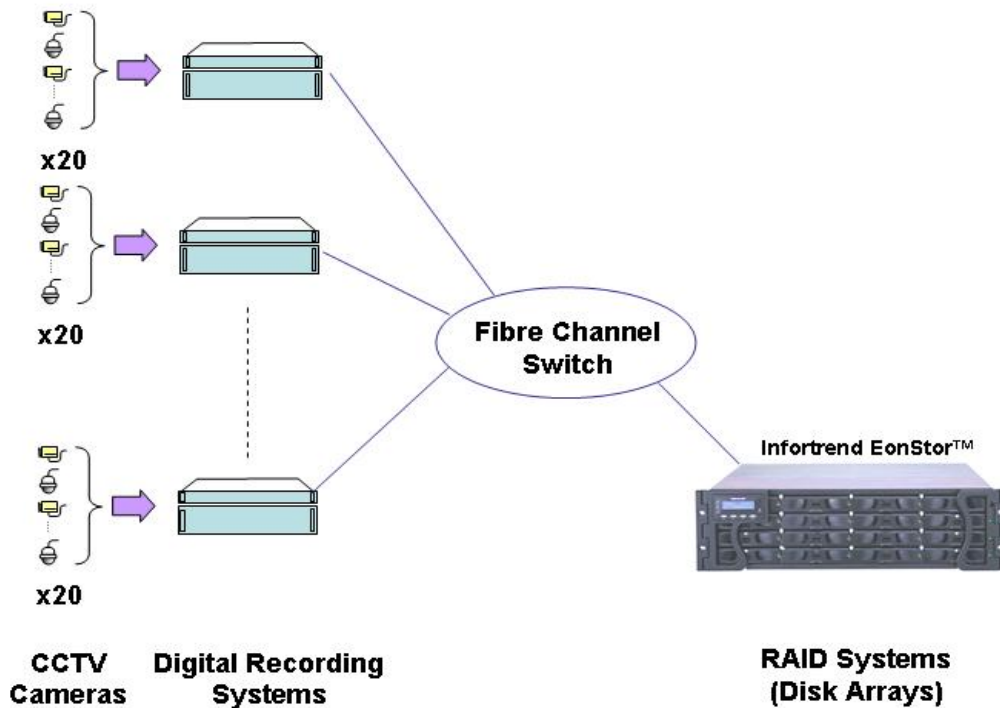

Diagram 2: Example Digital CCTV System with RAID

When multiple DRSs are connected to one or more RAID systems, Fibre Channel optical cables are the preferred choice as they make the connections more flexible, easier, and enable connectivity over a longer distance. However, if each DRS has its own dedicated RAID system, SCSI cables can be used as well.

The security aspect of sharing the stored data must also be considered.

Sharing One RAID between Multiple Digital Recorders
The DRS usually uses an embedded operating system, Windows, or Linux. Most operating systems will not assume that the same data volume is being shared with any other DRS. When one RAID system is shared by multiple DRSs, it is vital to ensure they do not "see" one another (unless specifically designed to do so).

The user can create multiple RAID 5 data volumes from the RAID system. When one data volume is created for each DRS, each volume will require the capacity of one drive for RAID 5 operation. Therefore the more RAID 5 volumes created, the more drives are taken up by the RAID5 operation. To minimize the number of drives used by the RAID5 operation, it is recommended to divide one RAID5 volume into multiple partitions, and then allow each DRS to access its own partition. In the configuration shown in *Diagram 3*, the 3.18TB (3262GB) RAID5 volume was sliced into five equal partitions (652.4 GB each).
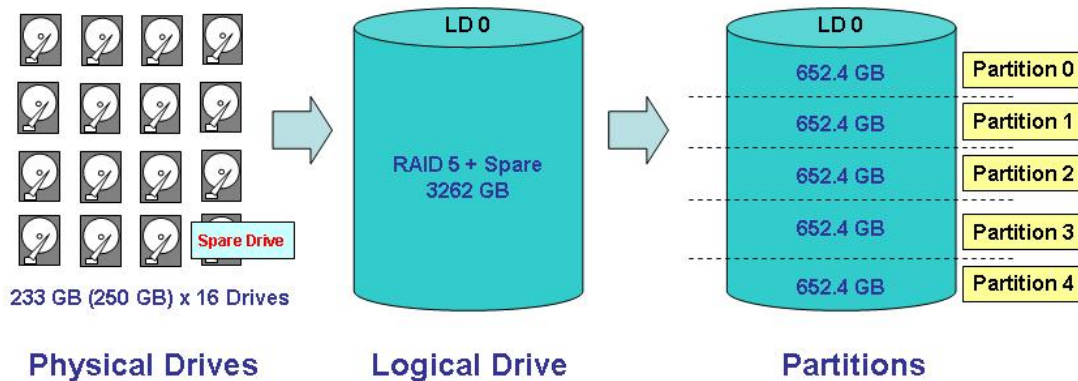

Diagram 3: Creating a RAID5 Data Volume and Dividing it into 5 Partitions

As the physical view in *Diagram 2* shows, one RAID system is storing data for five (5) DRSs without the need for any additional software or drivers. As shown in *Diagram 4*, each DRS can see only its own data partition.

Complicated systems require access control in order to access the stored data anytime, anywhere. This is available through the WWN (World Wide Name) access control function from the Fibre Channel switch.
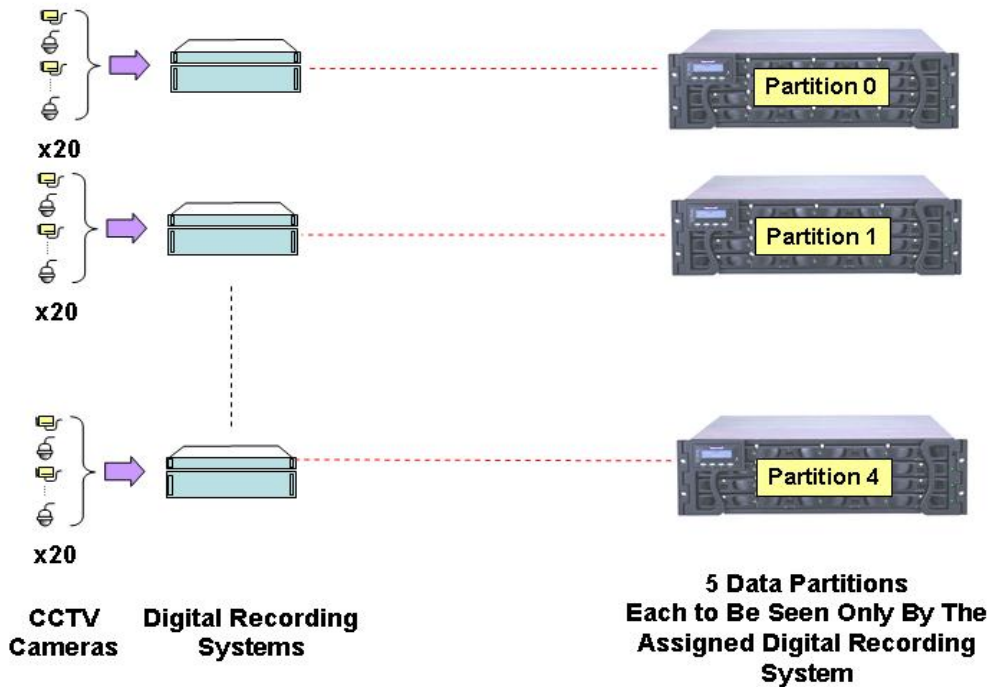
Diagram 4 – "Logical" View of the Sample Configuration

Drive Options – IDE, SATA, SCSI or Fibre
There are various types of hard disk drives in the market today—IDE (PATA, parallel ATA), SATA (serial ATA), SCSI, and Fibre—and there RAID systems available based on each type of drive. Many RAID storage vendors only offer products using one drive type. This can be a major disadvantage as it reduces the overall number of available options and solutions that a CCTV company can offer their customers.

Because RAID features are provided by the RAID controller, RAID operations are similar between IDE, SATA, SCSI and Fibre drive RAID systems. The differences between the systems are based on the different characteristics of the drive types themselves, especially in terms of maintenance, expandability, and cost.

Some manufacturers provide a complete range of products which enables them to offer diverse solutions that utilize all of the available drive types. But regardless of the drive type selected, the systems are designed to appear identical to the operating system and user. This gives customers maximum flexibility to choose products that exactly meet their budget and technical requirements without sacrificing RAID functionality.

User Scenario: Providing Evidence to the Police
When an event (e.g., a crime) has occurred, it is vital to be able to quickly provide the evidence to the police for investigation. The evidence taken by the police must be unique (i.e., must be the only copy), which means the site is not allowed to keep a duplicate. CCTV systems require the implementation of "removable media" in order to provide an easy method for delivering the evidence. Specific requirements will vary from country to country or between sites.

When an analog CCTV system is used, the evidence is simply the VCR tapes. There is usually only one copy (the master copy) of the tape. The police take this master copy and the CCTV operator puts in a replacement tape.

When a digital CCTV system is implemented, various key points concerning the presentation of evidence need to be considered:
1. Master copy
2. Cost of the removable media
3. Time to retrieve the captured images

Most RAID systems are designed so that all of the drives are easily removable. Some RAID systems have "Configuration-on-Disk," which means that when all of the disks from one RAID system are removed and placed in another RAID system, the RAID's logical drive and data can still be recognized and accessed.

If the police have an identical RAID system, the disks from the CCTV system can be removed and installed into the police system. The evidence can then be retrieved immediately, with no reduction in quality. Care must be taken when transporting the disks between sites. If the drives are removed by the police, CCTV operators can just install replacement drives to continue running the CCTV operation.

Another option is to take the complete RAID system to the police site. In the example described above, a 100-camera CCTV system requires only one RAID system, which can easily be transported by car.

The site in *Diagram 5* has two RAID systems with identical configurations. At any given time, only one of the RAID systems is switched on. The data is normally stored in the RAID system labelled "Master Copy." When the police take the Master Copy, the operator simply switches on the "Replacement System" and the CCTV operation can then continue immediately.
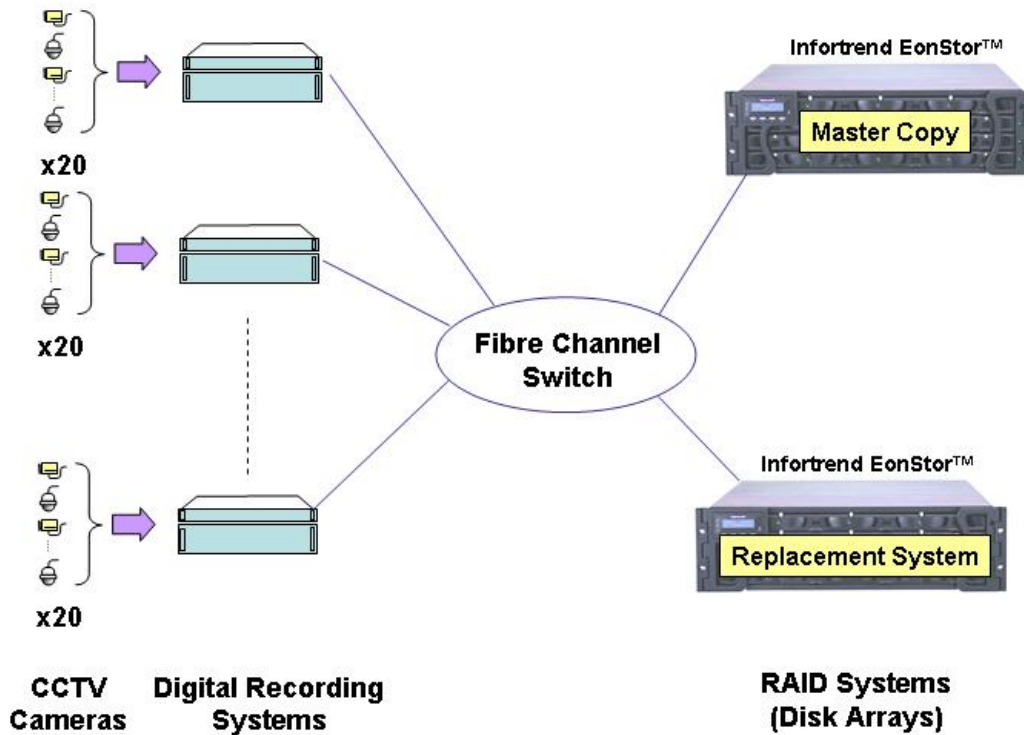

Diagram 5: User Scenario—The Master Copy is Removed as Evidence and the Replacement System is Turned On

As DRSs usually have a built-in hard drive, the software should be able to record and store the images captured from the time the Master Copy was taken off-line to when the Replacement System was brought on-line. As soon as the Replacement System is on-line, this data is immediately moved from the DRS's built-in hard drive onto the RAID system.

Digital CCTV was designed and developed to improve upon the existing analog CCTV systems by providing pictures with a higher resolution and better image quality and by offering immediate and random access capability. Ideally digital CCTV developers will want to balance the solution based upon many different parameters including product features, timing, cost, etc. On the data storage side, RAID manufacturers can help by providing a variety of high quality, cost-effective storage products which will satisfy the requirements of all CCTV applications, regardless of size or budget.

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