RAIDIX Data Storage Solution

Data Storage System for Mid-Level CCTV Infrastructures (up to 1,000 cameras)
Synopsis

This document covers the ins and outs of IT infrastructure and storage subsystem organization for Video Surveillance, pros and cons of employing data storage systems instead of local DAS storage. Read on for key CCTV requirements, RAIDIX-based system architecture, and technical characteristics of the comprehensive RAIDIX storage solution.
Introduction

Compared to a traditional DAS solution, configuration of a full-fledged data storage system entails extra expenses and adds up to project complexity. However, this approach offers a number of benefits aside from high performance, reliability and fault-tolerance:

- No need for servicing DAS arrays on the servers. Almost all video data is stored in a centralized data storage location, the capacity of local server drives is only utilized for creating boot partitions with an OS and pre-installed VMS (Video Management Software). For this purpose, the system can incorporate two mid-priced mid-capacity devices combined into RAID 1 based on a built-in controller on the motherboard.

- A compact high-performance 1U server is the optimal platform for video server infrastructure. In this case, there is no need to employ bulky 2–4U server platforms and DAS enclosures or implement costly RAID controllers for each server.

- Creation and maintenance of RAID groups and volumes, monitoring and access management — all storage operations are performed from a central data storage console. Data storage management tools outperform any disk controller in terms of flexibility, functionality and ease-of-use.

Data storage systems function regardless of the quantity of VMS servers, even if the cluster only involves two video servers (main and reserve). Data storage ensures 24/7 data availability for all nodes of a CCTV cluster. Should one of the main nodes fail, the reserve node will take over all video streams and maintain uninterrupted writing to the same archive on the same storage system. In fact, the VMS server entity will migrate from the main device to the reserve node with prior settings intact. At that, the user will still be able to access the video archive in its full depth from this server (in case this function is supported by the VMS software).

The traditional DAS approach implying local arrays precludes a centralized storage environment. On a server failure, its local array turns unavailable: the reserve server will have to write archive data to the local storage, previously written data will become inaccessible, and the main server archive will be unavailable for viewing. Once the main server gets restored, the user may experience archive synchronization issues.

Unlike a standalone server, a reliable data storage system has no single point of failure (SPOF). Data storage is a dedicated hardware and software solution ensuring reliable
storage and IO performance, fault tolerance being incorporated into a model storage architecture by default.

This document encompasses key tasks and recommended storage configurations for supporting CCTV infrastructures of up to 1,000 cameras.
Challenge

The modern video surveillance market grows exponentially and demands brand-new solutions that keep up with the pace. Apparently, CCTV system functionality should go beyond camera capacity and software capabilities and factor in the IT infrastructure required for servicing cutting-edge professional equipment.

Should it come to hundreds and thousands of video cameras, a single server or boxed solution will fail to deliver the coveted reliability — even more so when a system involves video analytics (detection, tracking and recognition), integration with POS solutions, access control, etc. These scenarios call for specialized surveillance software — VMS — that delivers high scalability, smooth support for a multitude of IP cameras as well essential video functions.

Deploying VMS requires a dedicated IT infrastructure — a server farm processing multiple video streams. Processing a large quantity of high-definition threads demands maximum computation power available.

For writing and storage of major video archives in this infrastructure, we recommend using dedicated data storage systems with file or block access. Let's consider a system supporting 1,000 IP-cameras. As a basis for further calculations, we'll take a stream generated by a single IP-camera via ONVIF (an open standard that ensures interoperability of IP-cameras with VMS), with Full-HD definition (1920×1080), basic H.264 codec, a frequency of 25 fps and high frame activity. Average traffic volume in this configuration constitutes 6.86 Mbit/s.

The computing power required for servicing 1,000 video streams can be easily provided with two Intel Xeon E3-2637 v4 (4 cores 2.5GHz each) or two Intel Xeon E3-2667 v4 processors (8 cores 2.5GHz each). Storage capacity for a video archive with 30 days depth, 1,000 streams, and 24/7 writing will amount to 2.1PB (2119.67TB). This storage volume can be generated with the use of numerous 12TB drives.
Suggested Architecture

Organization of capacity

The data volume of 2.1PB can be covered with 180 drives, 12TB each. This number of drives will not fit into a standard server platform (standard 4U server houses the maximum of 24–36 HDD 3.5”), so the system will require drive enclosures (JBODs).

In this scenario, the top recommendation is a two-socket 1U server and three 4U 60 HDD JBODs with cascade connection. Given the use of RAID 7.3 with three parity disks, the capacity structure is suggested as follows:

3 RAID 7.3 groups comprised of 60 drives each:
- 54 drives of usable volume
- 3 drives for checksums
- 3 drives as hot spares

Organization of a storage network

Connecting video servers to the data storage system is performed via NAS (NFS, SMB) or SAN (iSCSI, FC, etc.) protocols and requires a dedicated data storage network. For this purpose, every video server should be equipped with corresponding physical adapters, preferably dedicated and duplicated. The core of this storage network is comprised of two allocated switches that connect a multitude of video servers to the data storage system. Physical decoupling of a data storage network from other data transfer networks and organization of allocated equipment with duplication (switches and adapters)
will guarantee ease-of-use, transparency, security, required throughput and fault-tolerance.

In a simple scenario, a storage network can build on two high-performance 10GbE (Ethernet, 10Gbit/s) switches and two allocated 1–10GbE ports for each video server. The NFS and iSCSI protocols may be used for connectivity. Some scenarios demanding greater performance may involve convergent Ethernet or InfiniBand adapters with RDMA (SRP, iSER, RoCE) support, as well as corresponding switches. At that, 10Gbit/s ports will suffice on the server level whereas the switch level will require no less than 40Gbit/s.
Solution

The suggested solution is RAIDIX, a high-performance and high-density software-defined storage technology tailored to the needs of CCTV and video analytics. At the core of RAIDIX for mid-level and high end CCTV infrastructures sits the classic dual controller storage architecture. The system can be scaled up with new drives and JBODs, or scaled out into a clustered storage pool comprised of 2 to 64 blocks.

RAIDIX reveals record performance when processing hundreds of parallel video streams, ensures full data integrity and uninterrupted operation of CCTV systems. RAIDIX Data Storage supports an Active-Active cluster configuration out-of-the-box without employing any third-party components.

The RAIDIX technology resolves the following video surveillance issues:

Exponential growth of data streams for write/read in case of black operations or terrorist threats

Leveraging multi-gigabyte volumes of cache memory, RAIDIX allows for simultaneous processing of hundreds of heavy data streams with millisecond latencies. For cache data consistency, RAIDIX employs high-performance interfaces that may be combined into a trunk avoiding bottlenecks on cache synchronization. Cache protection against power failure is ensured with extra SPS modules.

Scalability on expanding CCTV coverage

RAIDIX enables flexible scalability of the video surveillance infrastructure. The system scales linearly up to 1800TB (raw volume), and up to 16EB when using the high-performance scale-out technology (HyperFS). At that, infrastructure extension does not entail any IO downtime and performs with full transparency to applications communicating with the storage system.

The system scalability increments are: a batch of 12 disks, a 60-disk JBOD enclosure, a separate node.
Processing and storage of video streams generated by Full HD/2K/4K/8K cameras from versatile vendors

The RAIDIX performance is optimized for storing large volumes of video data. Peak performance may reach 40GB/s for a standard rack in 42U. RAIDIX also delivers maximum efficiency when using commodity-off-the-shelf hardware by paralleling input/output operations.

High availability of the RAIDIX storage builds on using HA configurations of RAID 7.3 and RAID N+M on read/write. The technology sustains high performance even if hardware fails or the system undergoes array reconstruction. The system also supports multi-gigabyte volumes of cache memory and allows for simultaneous processing of multi-hundred data streams with millisecond latencies.

Ensuring data integrity

Even partial data loss on saving video information may lead to losing an entire video stream. The use of patented RAID calculation algorithms, such as RAID 7.3, allows the system to accomplish record-high speeds and data integrity. The array remains fully functional and reveals no performance degradation even if three disks fail in a RAID group.

Fault-tolerance on data writing

The data storage system ensures full fault-tolerance in case of multiple disk or enclosure failures, hidden errors in disk sectors or human error. The RAIDIX solutions have no single point of failure (SPOF) and ensure high data availability at 99,999 and higher.

Increased requirements for media servers running analytics software

The Advanced Reconstruction feature allows the system to sustain required data rate even in degraded mode and during RAID reconstruction. The reconstruction process does not impact other disks or overall system performance. RAIDIX can permanently track 1/2048th part of the disk and restore damaged data only — on the fly. Also, reconstruction priorities may be tweaked in real time.
The use of standard x64 hardware and high-density chassis allows for minimal TCO, $/GB and $/IOPS. Compliance with COTS hardware enables the user to pick the optimal configuration for building high-performance fault-tolerant data storage systems in Video Surveillance.

RAIDIX offers flexible solutions tailored to specific camera configurations and workloads and obviates costly industrial systems whose capacity and functionality may exceed the customer's real needs.
## Technical Characteristics

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Supported RAID levels</td>
<td>RAID 0/5/6/7.3/10/N+M</td>
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<tr>
<td>Max. number of drives in a RAID</td>
<td>64</td>
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<tr>
<td>Max. number of drives in the system</td>
<td>600</td>
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<td>Scalability unit</td>
<td>12 drives</td>
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<td>Hot spare</td>
<td>Dedicated reserve disks and shared access disks</td>
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<td>Max. LUN size</td>
<td>Unlimited</td>
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<tr>
<td>Max. number of LUNs</td>
<td>487</td>
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<tr>
<td>iSCSI</td>
<td>MPIO, ACLs, CHAP-authorization, LUN masking, CRC Digest</td>
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<td>Supported number of sessions</td>
<td>1024</td>
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<tr>
<td>Max. number of hosts in case of direct connection</td>
<td>32</td>
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<tr>
<td>Supported operating systems</td>
<td>Mac OS X 10.6.8 and higher, Microsoft® Windows® Server 2008/ 2008 R2/ 2012, Microsoft ® Windows® XP/Vista/7/8; Red Hat Linux, SuSE, ALT Linux, Cent OS Linux, Ubuntu Linux; Solaris 10</td>
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<td>Supported virtualization platforms</td>
<td>VMware ESX 3.5/4.0/4.1/5.0/5.1/5.5/6.0; KVM (Kernel-based Virtual Machine); RHEV (Red Hat Enterprise Virtualization), Microsoft Hyper-V Server, XenServer</td>
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<td>Supported high-performance interface</td>
<td>Fibre Channel 8Gb, 16Gb; InfiniBand (FDR, QDR, DDR, EDR); iSCSI; 12G SAS</td>
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<td>Supported NAS protocols</td>
<td>SMB, NFS, FTP, AFP</td>
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<td>Integration with MS Active Directory</td>
<td>Yes</td>
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<td>WORM (Write Once – Read Many)</td>
<td>Yes</td>
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<tr>
<td>Number of nodes</td>
<td>2 in the Active/Active mode</td>
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<tr>
<td>Data caching</td>
<td>Two-tier: RAM and Flash, WriteBack and ReadAhead for multiple streams</td>
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<td>QoS support</td>
<td>On the host/application level</td>
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Business Impact

Building on RAIDIX Data Storage and modern commodity hardware, system integrators offer efficient storage solutions to CCTV infrastructures ranging from entry-level to large-scale.

RAIDIX stands for the following business benefits:

- Data availability — 73% higher compared to the competition, storage costs — 31% lower compared to average market showings
- Full support for required data volumes along with low TCO
- Record performance with multiple parallel video threads
- Flexible scalability on increasing data volumes. The systems scales up by adding new enclosures and controllers with no prejudice to IO processes or applications interacting with the system.
- Decreased hardware overheads due to universal compatibility.

About RAIDIX

RAIDIX (www.raidix.com) is a leading solution provider and developer of high-performance data storage systems. The company’s strategic value builds on patented erasure coding methods and innovative technology designed by the in-house research laboratory. The RAIDIX Global Partner Network encompasses system integrators, storage vendors and IT solution providers offering RAIDIX-powered products for professional and enterprise use.