INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (ISR) SOLUTIONS WITH PIXIA HIPER STARE AND EMC ISILON SCALE-OUT NAS

Abstract
This white paper provides an overview of Intelligence, Surveillance and Reconnaissance (ISR) solutions that combine the PIXIA HiPER STARE Wide Area Surveillance (WAS) system and EMC Isilon scale-out network attached storage (NAS). Performance testing results are summarized and key benefits of the solution are described.

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# Table of Contents

- Introduction ................................................................................................... 4
- PIXIA HiPER STARE for WAS data sets ........................................................... 4
- EMC Isilon Scale-out NAS for WAS data storage ............................................. 6
- Evaluating performance ................................................................................. 7
- Test results .................................................................................................... 9
- Conclusion .................................................................................................... 10
- About EMC Isilon .......................................................................................... 11
- Contact Isilon ............................................................................................... 11
Introduction

This white paper provides an overview of Intelligence, Surveillance and Reconnaissance (ISR) solutions that combine the PIXIA HiPER STARE Wide Area Surveillance (WAS) system and EMC® Isilon® scale-out network attached storage (NAS). PIXIA and EMC Isilon solutions allow wide-area surveillance (WAS) data to be instantly accessed and managed anywhere, anytime, within a cloud-based environment.

PIXIA HiPER Stare provides best of breed WAS data processing and dissemination with Open Geospatial Consortium (OGC) compliant web services interfaces. HiPER STARE is used to catalog, organize and share large volumes of WAS data within a cloud-based architecture. Users may access this data through SaaS applications and RESTful Web services incorporated into HiPER STARE.

EMC® Isilon® scale-out NAS systems are designed for organizations that want to manage their data, not their storage. Isilon storage systems are powerful yet simple to install, manage and scale, at virtually any size and deliver increased performance—from the highest performance I/O-intensive applications, to primary and secondary storage, to nearline archives—all from an easy-to-manage single filesystem architecture. With multi-protocol support (e.g. NFS, CIFS and HTTP), Isilon storage systems are highly flexible and can support a wide range of file-based data applications and workflows. Isilon scale-out NAS systems are highly resilient and, with over 80% storage utilization, highly efficient.

PIXIA HiPER STARE for WAS data sets

WAS data comes from many different platforms and produces enormous amounts of data. Table 1 illustrates some specific throughputs that typical WAS sensors can produce. As indicated, the throughputs are significant and as a mission time increases to capture the appropriate are of interest, the needed capacity increases linearly.

<table>
<thead>
<tr>
<th>Sensor/Platform</th>
<th>Resolution</th>
<th>Capture Rate</th>
<th>Average Throughputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gorgon Stare</td>
<td>460 Mpixel</td>
<td>2 Hz</td>
<td>~15.3 Gbps @ 16bit mono</td>
</tr>
<tr>
<td>Constant Hawk</td>
<td>96 Mpixel</td>
<td>2 Hz</td>
<td>~1Gbps @ 8bit mono</td>
</tr>
<tr>
<td>ARGUS</td>
<td>1.8 Gpixel</td>
<td>12 Hz</td>
<td>~345.6 Gbps @ 16bit color</td>
</tr>
</tbody>
</table>

Table 1: Standard Resolutions for Various ISR Sensor Platforms

PIXIA HiPER STARE allows rapid access of WAS data with software-as-a-service (SaaS) applications that use this data to deliver mission analysis. With PIXIA technology, large homogenous data sets are organized into logic containers on a proven high-performance file system. If the data is on an object storage system, these data sets are managed within the containers.

By using this approach, the overhead on the file system is greatly reduced from managing billions of files to managing hundreds or thousands of files/objects. As a result, system performance for content-specific usages improves considerably. This is
proven out for WAS data sets with EMC Isilon storage using standard network storage protocols (such as CIFS, NFS, and HTTP) between servers processing WAS data and the EMC Isilon storage systems.

HIPER STARE provides many benefits to the ISR mission, including use of the existing infrastructure and increased flexibility to incrementally add resources (both compute and storage) as mission needs grow and change. This flexibility allows sharing and provisioning of compute resources to more effectively balance workloads and meet service levels across the enterprise. Additionally, HIPER STARE provides smart Web service interfaces for exploitation, integration, and dissemination of WAS data that allow it to be viewed in a raw format or to be placed in a geographic coordinate system. These capabilities are reflected in Figure 1.

**Figure 1: PIXIA HiPER STARE System Overview**

When choosing a data access solution for WAS, it is important to consider whether the solution will be extensible to allow for peak and streaming I/O throughput needs, and easily scalable in order to meet both current and future mission needs. PIXIA HIPER STARE is optimized for the pipeline associated with multiple storage technologies, and is exceptionally well suited when paired with EMC Isilon to meet the I/O needs of a WAS solution.
HiPER STARE enables a cloud-based architecture to:

- Scale to enormous volumes (beyond petabytes) of WAS data
- Maintain consistent storage I/O speed regardless of the number of requests
- Send only the relevant data from disk to an application
- Catalog and organize millions of raw data files into consolidated layers
- Access data in near-real-time during capture and analysis
- Transform WAS data to either frame-based or stream-based feeds
- Rapidly transfer data from aircraft to ground station
- Access data on airborne platforms

**EMC Isilon Scale-out NAS for WAS data storage**

EMC Isilon scale-out NAS provides a number of key advantages that complement PIXIA WAS technology to provide a comprehensive ISR solution.

**Scalability:**

EMC Isilon storage systems provide massive scalability. With a single volume, single file system cluster storage architecture, Isilon systems scale easily from a minimum three-node cluster configuration that provides 18TB of storage capacity up to a 144 node cluster that provides 20 PB of storage capacity. Nodes can added to an existing Isilon cluster very quickly, typically in less than a minute. As a result, organizations can easily scale capacity on a grow-as-you-go basis and thereby avoid over-provisioning of storage resources.

**Performance:**

As the world’s fastest NAS, EMC Isilon strongly complements PIXIA HiPER STARE technology to provide a high performing solution that meets the WAS performance challenge shown in Table 1. In June of 2011, Isilon set the SPECsfs2008 world record for fastest CIFS performance with 1.6 million file operations per second. Isilon storage systems provide over 100 GB/s of throughput. The SPECsfs2008 CIFS performance testing also showed another important advantage of Isilon scale-out NAS: as nodes are added to an Isilon cluster, performance scales increases linearly and predictably. This phenomenon was demonstrated for both CIFS and NFS environments. This means that with Isilon storage, organizations can readily scale both performance and capacity to meet the specific requirements of their ISR solution.

**Ease-of-use:**

Isilon scale-out NAS is based on an easy-to-manage, single file system, single volume architecture approach. As a result, Isilon storage systems are simple to install and easy to use. The EMC Isilon OneFS® operating system also incorporates a number of automated features that further simplify storage management. For example, Isilon AutoBalance™ automatically distributes data uniformly across all of the nodes in an Isilon cluster. When new storage nodes are added to the cluster, data is automatically moved to the new storage nodes while the system is online and in production. This eliminates “hot spots” and reduces costs, complexity, and risks for scaling storage.
Data protection:
Isilon storage systems are highly resilient and provide unmatched data protection and availability. Isilon uses the proven Reed-Solomon erasure encoding algorithm rather than RAID to provide a level of data protection that goes far beyond traditional storage systems.

With Isilon, organizations have the flexibility to set varying levels of data protection ranging from N+1 protection up to N+4 protection. For N+1 protection, data is 100 percent available even if a single drive or node fails. This is comparable to RAID 5 in conventional storage. With N+2 protection, two components or nodes within the cluster can fail and data remains 100 percent available, similar to RAID 6. With N+3 or N+4 protection, three or four components respectively, can fail, keeping the data 100 percent available.

Isilon also provides organizations with the flexibility to set data protection levels on a file, directory, or file system level so all data can be treated independently—thereby meeting SLAs based on the application or type of data.

For data backup and recovery, Isilon SnapshotIQ™ allows you to make frequent, low-impact, user-recoverable backups of files quickly and easily. For disaster reviver protection, Isilon SyncIQ™ offers powerful, flexible, and easy-to-manage asynchronous replication of data for disaster recovery, business continuity, disk-to-disk backup and remote disk archive.

Efficiency:
Isilon scale-out NAS provides unmatched efficiency with over 80 percent storage utilization. To help organizations further optimize storage resources, Isilon SmartPools™ software can be used to automate storage tiering using a policy-based approach that aligns data storage to the most appropriate Isilon node type: Isilon S-Series nodes for IOPS-intensive applications, Isilon X-Series nodes for applications and workflows that require high throughput and high concurrency, and Isilon NL-Series nodes for cost-effective, highly-scalable nearline storage.

Comprehensive ISR solution approach:
Together, PIXIA HiPER STARE and EMC scale-out NAS provide a comprehensive ISR solution that is designed to deliver the I/O throughput and scalability needed by WAS applications, while simplifying data management—providing robust data protection and lowering operating costs. With the PIXIA and EMC Isilon solution, organizations can linearly and dynamically increase the I/O throughput capabilities for the SaaS environment without overhead, downtime, or user interruption.

Evaluating performance
PIXIA and EMC Isilon conducted a test designed to measure the capabilities of combining PIXIA HiPER STARE software with the EMC Isilon scale-out NAS system. The ultimate goals were to evaluate the combined system performance and functional capabilities for the following use cases:
• Target a simple architecture for initial tests to determine the baseline performance of a joint system using Pixia HiPER STARE running on minimal servers and a small Isilon cluster using mid-range node types (Isilon X400 nodes).

• Target multiple exploitation sessions concurrently, evaluating multiple, random mission files; the goal was to identify the maximum number of sessions supported by the system.

• Target multiple resolutions and sensors for exploitation.

The tests were conducted using five (5) Isilon X400 storage nodes with 128 TB of storage, each using the 40 GbE InfiniBand backplane and N+2:1 protection (meaning 1 node of 36 drives or 2 drives from separate nodes could fail simultaneously without affecting data availability). The compute platforms used in this test were standard Intel servers with HiPER STARE 2.1.03 installed on them. Figure 2 shows the configuration used for the tests.

PIXIA provided a “GenericWebTest” tool to make random requests to the HiPER STARE server as rapidly as possible for a pre-set duration. Before running the tool, a separate tool is used to pre-generate a list of 100,000 requests, which will return valid data from the HiPER STARE server. The tool will randomly select a request from the list, make the request from the server with actual sensor data resident on it, and repeat this for the duration of the test. This simulates an environment with random requests from the analysts such as viewing a given area of interest and them scrolling to a completely different area of interest or searching for tracks of known targets.

For the configuration shown in the diagram, the test was repeated many times, iterating over four variables:

1. One to four HiPER STARE servers
2. Sensor types of Blue Devil, Constant Hawk, and Gorgon Stare
3. JPEG quality of 50%, 70%, and 90%
4. Viewports of 640x480, 800x600, 1024x768, 1280x720, 1920x1024
In review of the tests conducted, the following statistics were gathered for Blue Devil, Constant Hawk, and Gorgon Stare. As highlighted in Table 2, the EMC Isilon system with HiPER STARE® baseline tested can support up to 150 concurrent analyst workstations with HD quality for Blue Devil (BD) data, 50 for Constant Hawk (CH), and 42 for Gorgon Stare (GS1) Imp 1. This can be accommodated via local analysts running HiPER STARE or some other C2 application with HiPER STARE Web services.

Figure 2: PIXIA HiPER STARE and EMC Isilon NAS Test Configuration
Table 2. Average maximum workstations for sensor type and resolution

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Resolution</th>
<th>Max req/sec</th>
<th>Avg per W/S req/sec</th>
<th>Avg max W/S</th>
</tr>
</thead>
<tbody>
<tr>
<td>BD</td>
<td>640x480</td>
<td>2300</td>
<td>5</td>
<td>460</td>
</tr>
<tr>
<td>BD</td>
<td>800x600</td>
<td>2000</td>
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<td>400</td>
</tr>
<tr>
<td>BD</td>
<td>1024x768</td>
<td>1500</td>
<td>5</td>
<td>300</td>
</tr>
<tr>
<td>BD</td>
<td>1280x720</td>
<td>1300</td>
<td>5</td>
<td>260</td>
</tr>
<tr>
<td>BD</td>
<td>1920x1080</td>
<td>750</td>
<td>5</td>
<td>150</td>
</tr>
<tr>
<td>CH</td>
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<td>200</td>
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<td>GS1</td>
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<td>210</td>
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<td>42</td>
</tr>
</tbody>
</table>

Conclusion

Improvements in virtual compute, network, storage technology, and performance, together with the cost and ease of deploying these systems, make network Web-based systems a very attractive option for distributed WAS compute environments, which require large file sizes and very high I/O performance.

Based upon the research, we concluded that a small set of hardware consisting of four (4) PIXIA HiPER STARE servers with a 5-node EMC Isilon X400 cluster is able provide resources to handle exploitation from up to 460 disparate workstations for Blue Devil, and 190 workstations for Gorgon Stare. The storage on the test setup could support many more users if the server nodes were increased, and this is to be tested and proven in a Part 2 study. One can project linearly that to support 100 Gorgon Stare analysts at high resolution, an additional (6) servers (approximately 10 analysts per server) would need to be procured.

Together, PIXIA HiPER STARE and EMC scale-out NAS provide a comprehensive ISR solution that delivers the I/O throughput and scalability needed by WAS applications, while simplifying data management and providing robust data protection.
About EMC Isilon

Isilon, a division of EMC, is the global leader in scale-out NAS. We deliver powerful yet simple solutions for enterprises that want to manage their data, not their storage. Isilon products are simple to install, manage and scale, at any size and, unlike traditional enterprise storage, Isilon stays simple no matter how much storage is added, how much performance is required, or how business needs change in the future. We're challenging enterprises to think differently about their storage, because when they do, they'll recognize there's a better, simpler way. Learn what we mean at www.emc.com/isilon.

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