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DEFINING THE ROI FOR MEDICAL IMAGE ARCHIVING

Advances in medical imaging have increased the critical role archiving plays in the treatment of patients, and IT decision makers are under more pressure than ever to make sound investment decisions. In lieu of the variety of options available on the market, many purchase decisions continue to be heavily influenced by acquisition cost. IT professionals, who selected tape as a medical image archive, commonly cited initial cost as a primary driver in the decision. Tape is simply, "cheaper" than disk. These purchase decisions are coming down to a trade-off between the performance and protection attributes of disk-based archives and the "perceived" cost advantages of tape.

This paper provides a comprehensive benefit and cost comparison to help medical organizations define the ROI of their archiving investments.

WHITE PAPER

Through the adoption of PACS, imaging departments have digitized almost every aspect of patient care from image acquisition, processing and retrieval, to reporting and archiving. The pace of treatment and volume of data generated by these systems is increasing exponentially. This growth has created an impasse for administrators who need to control the costs of storing this data along with:

- Protecting against data loss
- Ensuring continuous access to studies
- Meeting staff performance demands

The inadequacies of tape make it no longer suitable for many medical imaging environments as it fails on all of these fronts. The priorities listed above, including cost, have served as the catalyst in driving demand for next-generation disk-based archives.

Although the choice is clear when comparing the qualitative benefits, IT professionals who choose tape will usually cite that tape is simply, "cheaper" than disk.

The concern with this practice is that it overemphasizes the importance of short-term acquisition costs at the expense of incurring both higher operating expenses and ongoing capital expenses.

The pain points of tape archiving are well documented: tape is slow, unreliable and complex. Given these limitations, why is tape still used? This is due to the perception that tape is "good enough" to meet a medical center's data protection requirements, despite the well publicized findings highlighting tape's propensity for data loss as one of the largest areas of risks in the data center.

Because a cost comparison between tape and disk is obviously far more complex than simply calculating the cost of media, this brief will provide a more thorough comparison of the true costs between tape and disk.

PACS Infrastructure Requirements

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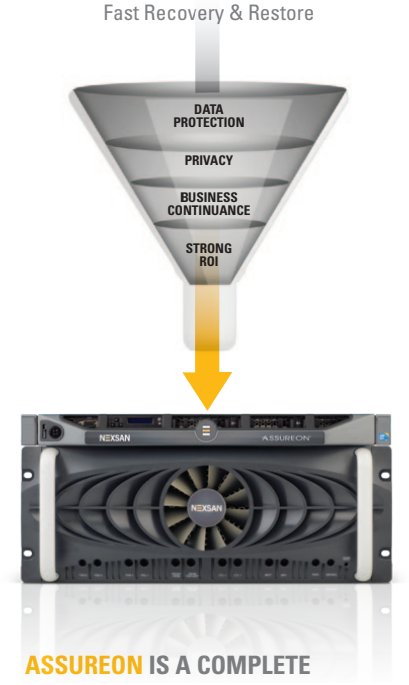
Digital File Fingerprinting
File Integrity Auditing
Data Availability Auditing
Self-Healing & Self-Managing
Fast Online Access
Access Authentication
File Access Audit Log
Remote Replication & Failover
Business Continuance
Fast Recovery & Restore



ASSUREON IS A COMPLETE PACS ARCHIVE SOLUTION

ASSUREON® PACS ARCHIVING

Assureon is a secure disk archive which eliminates the limitations of tape archives by providing fast, secure and cost efficient data archiving.

Assureon provides:

- **Data Protection:** Data loss and corruption are eliminated through automated file audits and self-healing features.
- **Disaster Recovery and Business Continuance:** Remote replication with failover ensures continuing operations during disaster or outage. Restore is simplified through self-healing and fast shortcut restore, which accelerates restore of data when systems are back online.
- **Cost Efficient:** As a self-managing archive, Assureon eliminates significant information management overhead.

DATA PROTECTION CONCERNS IN A TAPE ENVIRONMENT

Reliability of media risks data loss: Tape is a relatively delicate contact media that degrades with use. Gartner estimates 10 – 50% of all tape restores fail, and restores that are older than five years experience 40% to 50% failure rates. Unfortunately, many facilities do not realize this until it is too late as Gartner also reported, 34% of organizations never test a restore from tape.1

Secondary data vulnerability: The protection elements of NAS & SAN are often limited to RAID and replication, which may provide redundant copies but do not offer image preservation. Files are still vulnerable, and even if a file is replicated a hundred times over, a copy is only as good as the source. Due to the vulnerabilities of NAS, primary storage often requires confirmation that a copy of the study is archived before data can be flushed. Facilities need a layer of protection that preserves original image integrity and complements other storage layers.

Data privacy at risk: Concerns over SAN security is also rising and privacy is difficult to measure as a data breech can leave a file seemingly intact. Without file access authentication and auditing, data privacy is difficult to validate. While HIPAA guidelines are somewhat subjective, any platform used to store patient data should provide a layer of privacy protection.

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PROTECTION ARCHITECTURE CONTRAST

Tape Archive Environment

Secondary Vulnerabilities Exposed

- Risk of data corruption & loss
- RAID & replication ignore data integrity
- A copy is only as good as the source
- Privacy risk of online storage increasing

Tape Media Risks Data Loss

- Tape is a delicate contact media
- Reliability degrades with use
- Increased risk of restore failure over time

Assureon Archive Environment

Assureon Mitigates Risks to Tier-2 Data

- Immediate preservation of original study
- Limiting tier-2 footprint lowers privacy risks
- Archive data requres access authenticaiton

Assureon Immediately Protects All Ingested Data

- Automated audits eliminate corruption, viruses and tampering
- All access attempts tracked and logged
- Availability audits validate file retention
- All discrepancies are self-healed

[1] Source: The Gartner Group (www.gartner.com)

ASSUREON DATA PROTECTION

Immediate data preservation: Assureon immediately preserves data by creating a digital fingerprint for both the original image and the associated metadata when a study is first reported. This fingerprint is then leveraged during self-auditing to guarantee that the data stored is the data retrieved, regardless of time.

Automated data audits: Assureon audits verify both the integrity and availability of all archive data. If any discrepancies are discovered or files are missing, Assureon will automatically restore the study to the original state and log the action.

Privacy protection: Assureon includes authenticated access which blocks unauthorized users from viewing studies. Additionally, all attempts to access data, whether successful or unsuccessful, are recorded in an access audit log, providing absolute certainty that privacy is not compromised.

TAPE PERFORMANCE LIMITED

Performance limitations: Tape performance is limited by slow transfer rates and mechanical construct, which delay data recall. With today's pace of treatment and high-resolution modalities, retrieval from tape is far too slow to meet the demands of internal staff for even a small portion of files.

Inadequate contingency plan: If secondary storage were to go offline for even a limited time, the anticipated workload, due to mechanics and re-cataloguing, could completely immobilize a tape library. This would have devastating effects on the workflow of PACS and possibly limit the ability to create new studies. (This scenario is outlined in the "Extended downtime" section on this page.)

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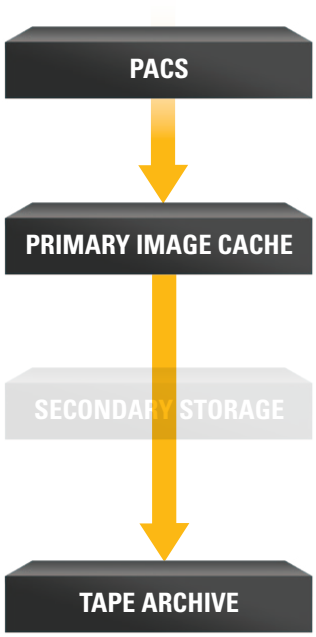

TAPE PERFORMANCE RESULTS IN POOR CONTINGENCY SCENARIO INVOLVING DOWNTIME OF SECONDARY STORAGE

Performance Limitations of Tape Library
Risks Data Loss and Downtime
Archive bottlenecks limit ability to store second copy, increasing risk of data loss. PACS unable to report new studies if primary reaches capacity.

Primary Cache Unable Flush Data
Lack of second copy prevents data flush which may result in primary reaching full capacity in high-volume environments

Persistent Job Queues
Mechanical delays and incessant re-cataloguing when instering & removing tapes creats unrelenting job queues during high-volume periods.

ASSUREON AND PERFORMANCE

High performance recall: While actual performance will be influenced by the utilities of the PACS application, data recalls with Assureon are immediate and not limited by the mechanics known to tape. This enables a facility to continue operations with stable image access in the event that secondary storage or an entire site was to go offline.

TAPE AND DISASTER RECOVERY

Extended downtime: Assuming the media stored in the library is available, restoring operations from tape could require an extended time-frame depending on the amount of data. For a medical imaging environment which operates 24 hours a day, 365 days a year, slow restore performance is less than optimal.

Tedious restore process: The transfer rates of tape lengthen data migration. As data is restored from tape (or NAS), administrators are required to validate the file properties and permissions of each file. This tedious process is outlined in the following table.

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Tape = 96 Hours

Disk = 2.5 Hours

Assureon = 0 Hours

ASSUREON AND DISASTER RECOVERY

Business Continuity: Assureon dual-site configurations eliminate the risk of data loss and downtime, whether caused by a regional disaster or site failure.

Real time replication: Whenever a study is written, Assureon immediately replicates both the file and associated metadata to a remote site. All replication is managed within Assureon, and continuous file audits protect against corruption during replication.

Failover to remote site: In the event of a failure at the primary site, Assureon will fail-over to a remote location enabling the facility to continue operations without interruption.

Simplified Recovery: Through a replicated Assureon configuration, facilities are able to maintain operations and eliminate the arduous restore processes known to tape. Assureon's uninterrupted data access makes recovering from downtime not really a recovery at all. When the primary site is restored, reads and writes will resume at site one. During a restore, Assureon automatically audits all data and settings to ensure consistency of all data and file properties between replicated sites.

Streamlined disaster recovery and data migration: Following a major disaster where rebuild is required, Assureon's automated audits simplify migration by validating integrity of all restored data and associated properties. Assureon further accelerates recovery by restoring shortcuts at a rate of 800/sec.

ASSUREON VS. TAPE COST COMPARISON

In the following cost comparisons, the capital expense and operating costs for an environment using tape are compared to an Assureon-supported infrastructure.

All examples will be based on 16TB usable capacity and will compare both a single-site configuration and dual-site (replicated) configuration.

It should be noted that the assessed value for mitigating data loss, downtime and privacy risks must be determined by each facility and that this value will vary greatly depending on each facility's propensity for risk. As outlined above, the differences in the level of protection between Assureon and a tape archive are significant.

The purpose of the following calculations is to provide decision makers with a quantitative "hard cost" comparison which can be combined with the assessed value of risk mitigation to define the ROI for both solutions.

Single Site

	Assureon	Tape
Equipment	$ 61,000	$ 34,000
Tape media total	N/A	$ 10,512
Total 5-year cost	$ 61,000	$ 44,512
Cost difference	($16,488)	+37%

Dual Site

	Assureon	Tape
Equipment	$ 130,000	$ 68,000
Tape media total	N/A	$ 21,025
Total 5-year cost	$ 130,000	$ 89,025
Cost difference	($40,975)	+46%

*Total media costs based on 5-Year NPV

COST OF CAPITAL (TAPE VS. ASSUREON)

In this example, the capital expense of Assureon is compared to that of a tape archive. Assureon inputs are limited to the initial acquisition cost, whereas tape will begin with a fully loaded jukebox and expand through additional purchase of media alone.

Assumptions

- No tape media is damaged or lost
- 80% utilization rate for tape
- Re-mastering (for new transports) not required
- No backup schema factored (e.g. Grandfather-Father-Son)
- NPV discount rate = 4%

Inputs

Starting with the most basic comparison, a 5-year capital expense for Assureon will be compared to the cost of a tape archive.

Results

- **Tape appears "cheaper" at first glance:** As expected, when looking solely at the cost of media and equipment, tape appears to carry a lower cost. This typically enforces the common assumption that tape is cheaper. However, there are several other factors which need to be factored to accurately compare the costs of the two systems.

Note - Backup methodologies add considerable cost, which is not factored. For example, the most common backup process, grandfather, father, son (GFS), is estimated to require 25X capacity of tape for every 1TB of data. With GFS factored, total equipment cost of tape would exceed those of Assureon within 1 year.

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Single Site

	Assureon	Tape
Capital	$ 61,000	$ 44,512
Support	$ 24,565	$ 21,191
IT Overhead	$ 3,846	$ 22,406
Environmental	$ 25,705	$ 9,576
Total 5-year cost	$115,117	$ 97,685
Cost difference	($17,432)	+18%

Dual Site

	Assureon	Tape
Capital	$130,000	$ 89,025
Support	$ 52,977	$ 42,381
IT Overhead	$ 3,846	$ 44,812
Environmental	$ 30,876	$ 19,152
Total 5-year cost	$217,699	$195,370
Cost difference	($22,329)	+11%

*5-Year Cumulative Costs Based on NPV

CAPITAL COST + OPERATING EXPENSE COMPARISON (TAPE VS. ASSUREON)

To determine hard costs of the solutions, operating expense should also be factored. The overhead associated with tape maintenance during required jobs such as performing backups, drive-cleaning and verifying data can be significant. Conversely, Assureon simplifies management of both the systems and the data contained as facilities can go extended periods of time without the need to interact with the system.

Based on results from current Assureon customers and industry estimates for the variable costs of tape[2], the total operating expense for tape and Assureon is calculated. These costs are combined with the system costs previously calculated to provide a more comprehensive cost comparison.

Assumptions

- Power and cooling: $0.10 KWH
- Monthly footprint: $20/sqft
- Hourly cost of labor: $36[3]
- 5-year TCO: NPV factors discount rate of 4%
- Yearly Support & warranty: 10%

Inputs

- Power and cooling: $0.10 KWH
- Tape - Footprint (per site): 4.24sqft
- Tape - Overhead (labor): 2.9hrs/week
- Assureon – Energy: (single) = 6.227KWH, (replicated) = 3.645KWH/site
- Assureon – Footprint: (single) = 1.33sqft, (replicated) = 1.14sqft/site
- Assureon – Overhead: 30 min/wk

Results

- **Cost differences are minimized when operating expenses are factored:** When the operating costs and system costs are combined, the difference is reduced to 13%.
- **Operating costs remain constant as Assureon grows:** The management overhead for Assureon does not increase as data is ingested and capacity is added. As a self-managing, self-healing system, Assureon automates the operational management of both the system and data contained.

[2] Tape vs. disk: how to calculate the cheapest option Apr 28, 2008 Russ Fellows

[3] Labor cost based on data from United States Department of labor www.bls.gov

Single Site NAS

	Assureon	Tape
Capital (NAS)	$ 7,897	$ 39,487
Software (NAS)	$ 607	$ 3,037
Maintenance (NAS)	$ 4,657	$ 23,287
Admin (NAS)	$ 4,252	$ 21,262
Environmental (NAS)	$ 2,835	$ 14,175
Total cost (NAS)	$20,000	$101,248
Cost difference	($81,000)	-80%

Dual Site NAS

	Assureon	Tape
Capital (NAS)	$15,795	$ 78,975
Software (NAS)	$ 1,215	$ 6,075
Maintenance (NAS)	$ 9,315	$46,575
Admin (NAS)	$ 8,505	$42,525
Environmental (NAS)	$ 5,670	$28,350
Total cost (NAS)	$40,500	$202,500
Cost difference	($162,000)	-80%

*Itemized NAS Costs Based on 5-Year NPV

SECONDARY STORAGE COST COMPARISON BETWEEN TAPE ENVIRONMENT AND ASSUREON ENVIRONMENT

Traditionally, PACS implementations include secondary storage, which provides fast access to a pre-defined set of prior studies (up to 2-years). However, for various reasons, many facilities are maintaining data on tier 2 for indefinite periods. This trend is apparent in tape environments, where secondary storage is used to compensate for the limited performance and reliability of the tape archive. Alternatively, in an Assureon environment, facilities are able to reduce dependency on tier-2 storage due to the improved reliability and access performance.

In the following comparison, the total cost of secondary storage, based on an NAS configuration in a tape archive environment is compared to that of an environment using an Assureon archive. [7]

Assumptions

- Initial cost of NAS: $3/GB Monthly footprint: $20/sqft
- Disk prices declining 10% yearly 5-year TCO: NPV factors discount rate of 4%
- Discount rate (NPV): 4%

NAS cost breakdown:

- Hardware (39%), Software (3%), Maintenance (23%), Administrative & Operations (21%), and Environmental (14%)

Inputs

- Initial capacity: 8TB / Ending capacity: 16TB
- Percentage of studies retained on NA Tape: 100%
- Assureon: 28% (2 years of data)

Results

- **Assureon reduces the cost of secondary by up to 80%:** Assureon performance provides the flexibility for imaging departments to minimize data retained on secondary storage. By limiting data stored in secondary to only the first two years of a study, facilities could reduce the total cost of secondary by as much as 80%.
- **Assureon reduces capital expense of secondary by up to 80%:** Decreasing the footprint of tier-2 alleviates ongoing capital expenses by a factor of 4. For example, in the replicated configuration, the capital expense for NAS approaches $80,000 in a tape environment, vs. a little more than $15,000 in an Assureon supported environment.
- **Assureon elimanates up to 80% of the operating costs for tier-2 storage:** As with capital expense, Assureon also significantly reduces the operating expense of secondary storage. Estimates for operating expense of tier-2 are in the range of $124,000 for a tape archive environment and only $25,000 in an Assureon environment.

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CHALLENGES

Minimize Complexity

- As a fully self-managing and self-healing system, Assureon eliminates the bulk of operational overhead
- Simplified "future" data migration enabled through Assureon's transparent application integration
- Reduce the footprint of tier-2 storage by leveraging Assureon's disk-based performance and reliability

Preserve Data Integrity

- Assureon preserves image integrity by immediately creating a digital fingerprint of the original study when first reported
- Reoccurring file integrity audits enforce data authenticity and protect against corruption, viruses and tampering

Protect Against Data Loss

- Assureon availability audits continuously validate the presence of all data and automatically restore all missing files
- Hardware layer protection prevents the intentional or unintentional deletion of RAID sets or volumes

Provide Remote Copy

- Assureon's built-in replication immediately replicates reported studies to a remote site
- Reoccurring audits ensure consistency of remote site data, and protect against corruption during replication

CONCLUSION

When combining all measurable cost inputs, including CAPEX and OPEX for both secondary storage and tape, a strong case can be made for the ROI realized through the adoption of Assureon. Keep in mind that the calculations supporting this cost comparison do not factor the clear advantages offered by Assureon, which include:

- Unparalleled data protection
- High availability
- Privacy protection and monitoring
- Fast recovery and restore

In summary, imaging departments have dramatically improved their ability to treat patients through software automation. These improvements must be supported by an infrastructure that meets this accelerated pace of treatment.

Tape archives are no longer meeting the needs of many medical imaging departments, as the limitations of tape create additional risks to effective patient care, while also increasing the overall costs across the infrastructure.

Assureon® is a self-managing and self-healing archive which provides unmatched data protection, system availability and privacy. Assureon performance levels are able to sustain image access to the archive, providing more flexibility to minimize architectural complexity and cost.

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CHALLENGES (cont)

Assureon Solutions:

Protect Against Downtime

- Remote site failover enables the facility to continue operations without interruption
- All Assureon systems are equipped with redundant hardware components and disk drive parity (RAID 6)

Disaster Recovery

- Assureon eliminates the need for an overt restore with instantaneous availability to all data
- Restoration simplified through automated verification of all data and settings during recovery
- Assureon quickly restores data access, by restoring shortcuts at a rate of 800-per-second

Eliminate Privacy Threats

- Assureon protects the privacy of patient data through user access authentication
- All attempts to access data, whether successful or unsuccessful, are recorded and logged, providing a complete file history

ABOUT NEXSAN

Nexsan® is a leading provider of innovative data storage systems with over 10,000 customers worldwide. Nexsan's pioneering hybrid storage systems combine solid-state technologies, spinning disk storage and advanced software to deliver radical new levels of performance and capacity at lower cost. The company's advanced technologies enable organizations to optimize traditional, virtual and cloud computing environments for increased productivity and business agility. With more than 28,000 systems deployed since 1999, the company delivers its data storage systems through a worldwide network of solution providers, VARs and system integrators. Nexsan is based in Thousand Oaks, Calif. For more information, visit **www.nexsan.com.**

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