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Managing NetApp Storage with VSI

Van Symons

Storage Arrays from NetApp are some of the most flexible and rich in function arrays in the indiustry. One unique feature of their original FAS and their new CLUSTER MODE arrays is the ability to provide both Block (host/LUN Mapping) and NAS (NFS/CIFS) support on a single array. Most other vendors require separate storage arrays for these two distinctly different workload and storage requirements. These features can make reporting and analytics on NetApp arrays challenging - and providing integrated reporting for what and how storage is being used, as well as tracking performance results, can be more difficult than it is for most storage environments.

Visual Storage Intelligence (VSI) provides a number of unique reporting features designed specifically to help customers manage and get the most out of their NetApp arrays. Some of the features that make VSI a unique tool for managing a NetApp storage environment are:

- Structured and Unstructured Data Analysis
    o NAS vs. Block Storage usage
    o CIFS/NFS Share Reporting
    o File Share Analysis
- Specialized Free Space Analysis
    o Volume Locked Freespace
    o Fragmentation Analysis
- Controller Specific Analysis
    o Storage mapping/usage
    o Performance by controller (IOPS & Controller utilization)
- Unique Configuration Error Reporting
    o Unsupported configuration warnings
    o Multi-path HA cabling analysis
    o Single point of failure warnings (Cards, wiring,..)

Unstructured and Structured Data Analysis (Storage by Data Type)

VSI tracks storage by "Data Type" with the types of storage being:

- Block   (Host/LUN Mapping)
- NAS   (NFS/CIFS Shares)
- BAS Backup   (File Shares specifically designed for backup storage pools)
- Mixed   (A combination of both)

VSI not only gives you an overall picture of your environment, but breaks it down automatically by type of data stored (block or file) while tracking usage over time. This breakdown is important because typical Block devices are configured for high performance - with features like Flash drives or all Flash arrays to maximize performance - while NAS storage is typically configured for high capacity, with performance secondary.
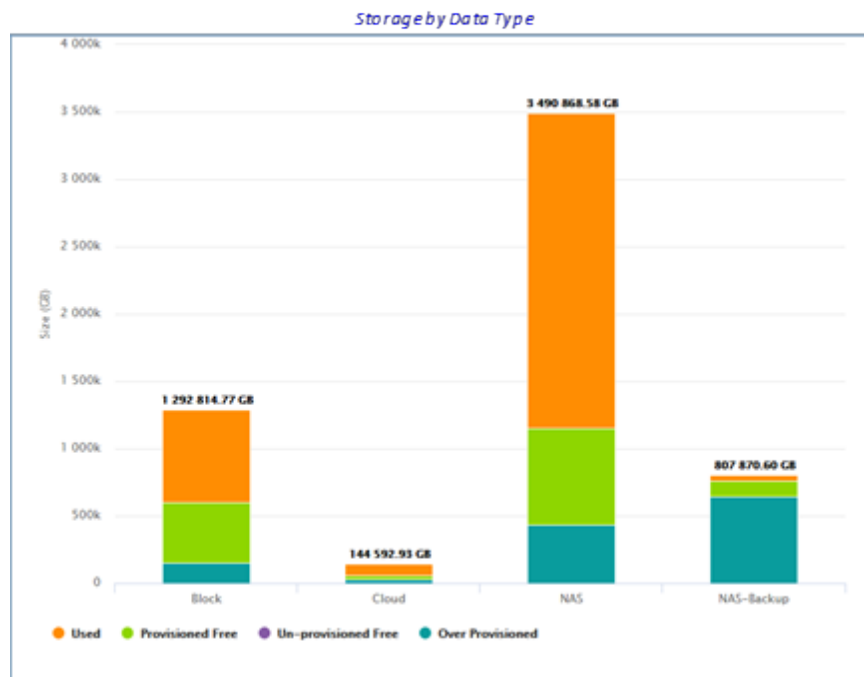
This is a point in time picture showing your storage by data type- both how much is available, how much is allocated and how much is free.
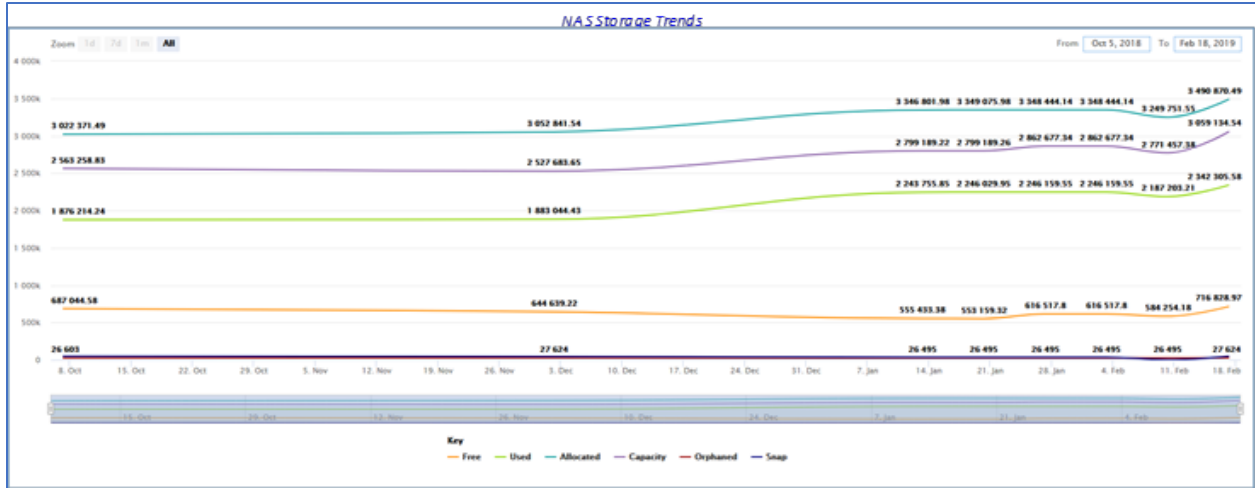
Trends over time by Data type: this shows the trends for storage considered "file storage" so you can plan accordingly.

Share File Analysis

The final phase of analysis for unstructured file is access patterns. This feature allows you to analyze both the types of data stored in your file space (text, video, data base,…) as well as when each file was last accessed. Understanding access patterns allows customers to make informed decisions about what data can be moved to different types of storage based on the regularity of information access required.

File Share Analysis by Data Type and Last Access Date

NAS File Overview | Storage by Access / Update | Space by Type | Potential Savings | Potential Savings Over Time

File Systems At a Glance

Total Files:	Shares Analyzed:	Total GB:	# Old Files (> 1yr):	Old Files (> 1yr) GB:
27,105,545	1	1,656,604.65	24,457,545	1,461,927.00

NAS File Summary

Bucket	Text Size	Text Count	AV Size	AV Count	DB Size	DB Count	Compress S	Compress C	Other Size	Other Coun	Custom Size	Custom Cou
30 day	1,184.87	3,500	0.00	0	0.00	0	29,637.64	1,000	23,645.99	1,952,500	0.00	0
90 day	783.29	3,500	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
180 day	111.10	33,500	0.33	3,000	0.00	0	103,260.89	363,000	12,692.01	288,000	0.00	0
365 day	9,945.24	213,500	0.00	0	0.62	100	97,827.04	2,000	42,987.27	11,448,000	0.00	0
730 day	47,030.63	1,181,000	919.81	16,000	5.71	2,000	158,249.69	116	9.81	14,430	0.00	0
older	689,028.32	11,448,000	4,320.39	1,559	2,113.99	650	70,089.06	26,700	282,066.04	103,490	0.00	0

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The chart included here is a graphical represention of the tablular data presented previously. This particular file share is over 1.6 PB in size and 64% of the space has not been touched in over 3 years.

File Space by Date of Last Access

VSI provides not only the ability to see and track file storage growth overall, but also provides the data necessary to manage individual file shares efficiently .

Specialized Free space analysis

VSI provided storage usage and freespace analysis for all storage arrays. NetApp arrays in particular have a number of features to allocate and reserve space. One of those features is the ability to "volume guarantee" the space you have allocated. This is a useful feature to insure specific volumes have the space they may need in the future. The downside of using this feature is the unused space within a volume is "hidden and not available for use" but the other volumes or LUNS within the aggregate (storage pool) where the volume exists. While this may seem harmless to most NetApp customers, the free space "trapped" by all your volume guarantees can become quite large depending on the number of volumes where this feature is used and the number of NetApp Arrays within the environment.
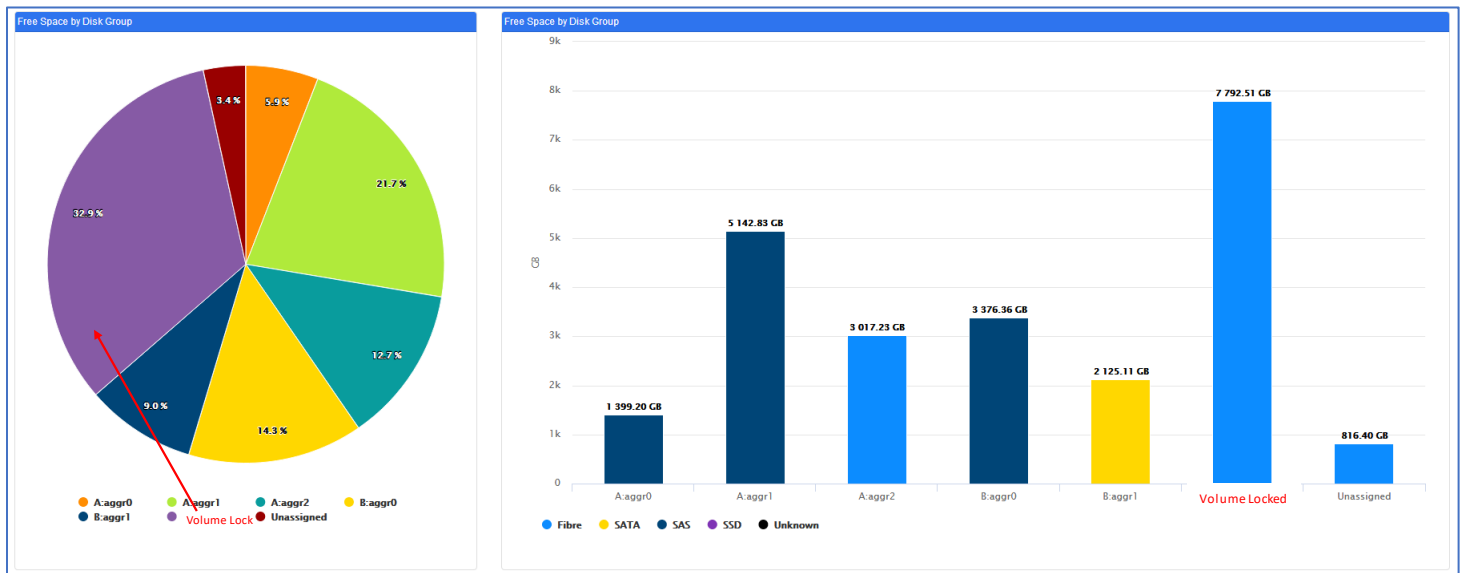
This space is reported in the free space by disk group chart. This space is labeled "volume locked" free space. This example is a small NetApp configuration, but you can see the largest amount of free space across the array (7 TB) won't be reported by this storage array because it is hidden from the aggregate.

One large NetApp customer reviewed the total "volume locked free space" and discovered this space was over 2 PB. The customer's comment was *"I can avoid buying 4 large arrays by just changing my space guarantee policy, and thereby save our company over $1.5M in additional storage purchases. This feature alone made VSI worth every penny and we verified that even the NetApp tools were not making us aware of this potential space savings."*

This free space analysis shows all the pockets of free space and allows you to see both the total available as well as how it is fragmented within a storage array. Sometimes the array will appear to have free space, but this chart may reveal "no usable free space" due to the fragmentation.

Fragmentation analysis

VSI provides free space fragmentation analysis at the array level, but also includes the same analysis at the data center and enterprise level. In many instances the customer has enough free space to provision more storage, but the problem is:

- The storage is not all in one pool/volume
- Storage is not in the right location
- Storage is not the right type of storage (high speed vs. high density)

Since NetApp arrays generally have a large number of pools (called aggregates) and volumes, this issue can be particularly difficult and important to manage in NetApp environments.
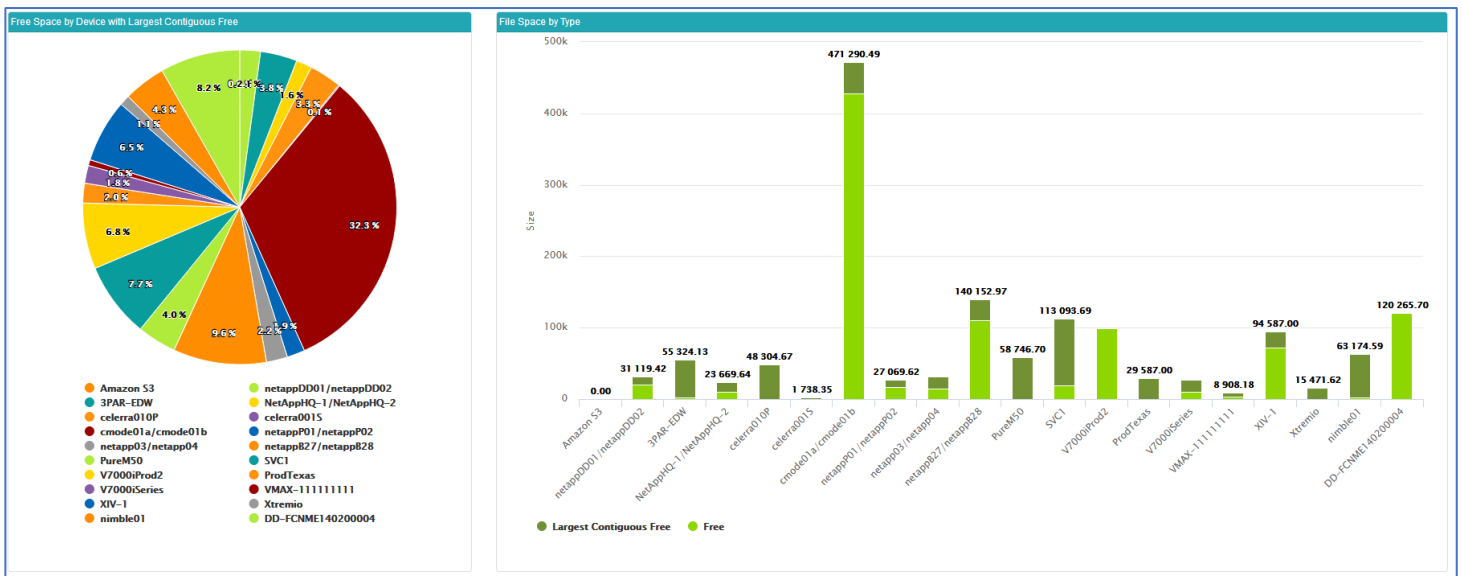
This is an example of the enterprise freespace fragmentation chart. It looks much like the chart for an individual storage arrays, but it includes the overall freespace for each array as well as the largest single pocket of free space within the array. In this example, the array with the most overall freespace has many pockets of fragmentation and it largest contiguous freespace is not the overall available. In fact, several arrays have single locations with more available free space. This is an excellent example of the freespace analysis provided for all levels of the organization, designed specifically to enable improved storage efficiency.

Controller Specific Analysis

Visual Storage intelligence provides detailed performance and capacity analysis at the overall cluster level for all NetApp arrays, but it also provides detailed analysis at the individual controller level as well. This analysis allows the customer to see imbalances between nodes in a cluster whether the imbalance is from storage capacity or storage performance. Appropriate action can be taken to resolve these issues and improve overall storage performance.

Business Unit Provisioning

Search and Filter Data

Drag here to set row groups

System Name	Category	Application	Usable	% Capacity	% Perf	Constraint	Largest	% Usage
cmode01a	NAS	Shared Block	186,058.00	62.96	2.88	Capacity	62.96	62%
cmode01b	NAS	Shared Block	186,058.00	60.55	47.23	Capacity	60.55	60%
cmode01c	NAS	Shared Block	186,058.00	59.70	85.64	Performance	85.64	85%
cmode01d	NAS	Shared Block	186,058.00	63.82	47.41	Capacity	63.82	63%
cmode01e	NAS	Shared Block	754,804.00	89.61	146.12	Performance	146.12	146%
cmode01f	NAS	Shared Block	699,244.00	87.36	90.06	Performance	90.06	90%
cmode01g	NAS	Shared Block	19,603.00	58.82	93.21	Performance	93.21	93%
cmode01h	NAS	Shared Block	19,603.00	58.47	85.12	Performance	85.12	85%
netapp03	NAS	Shared File	29,530.20	50.19	0.00	Capacity	50.19	50%
netapp04	NAS	Shared File	29,530.20	42.59	0.00	Capacity	42.59	42%
netappB27	NAS	Backups/NetApp	220,881.50	73.03	0.00	Capacity	73.03	73%
netappB28	NAS	Backups/NetApp	218,650.40	67.68	0.00	Capacity	67.68	67%
netappDD01	NAS	Cloud	48,047.90	74.34	0.00	Capacity	74.34	74%
netappDD02	NAS	Cloud	45,179.40	58.41	0.00	Capacity	58.41	58%
NetAppHQ-1	NAS	Corporate	21,227.50	37.37	0.00	Capacity	37.37	37%
NetAppHQ-2	NAS	Corporate	13,268.40	27.96	0.00	Capacity	27.96	27%
netappP01	NAS	Oracle	35,436.20	68.32	0.00	Capacity	68.32	68%
netappP02	NAS	Oracle	35,928.40	55.90	0.00	Capacity	55.90	55%

This chart from the business unit provisioning section shows the percent of capacity for both storage usage and storage performance. Whichever is the most constrained is shown as the limiting factor and is done for each controller throughout the enterprise. Sorting the data in this example reveals a 12-node cluster when some notes are performance constrained, some are capacity constrained, and some are not constrained at all. There are many opportunities to improve the efficiency and performance for this particular storage cluster and once completed the efficiency improves 20% and performance almost 35%! All from a single picture.

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NetApp arrays are some of the most flexible in the industry and this flexibility can be both a feature and a flaw depending on who is managing the storage and how well they know how to configure the technology.

VSI is designed to collect and analyze the network configuration of the storage array to insure:

- No single points of failure
- Multi-Path HA Configuration is wired properly
- Unsupported Configurations are flagged
- Auto-support is configured properly for notification in case errors occur
- Detailed drive configurations are optimized for High Availability as well as performance (I.e. hot spares exist to cover failures w/o an outage on all controllers)

Device Health Check Summary

Configuration & Setup	Balance	Server Volume Mapping	Errors & Other Alerts	Storage Layout	Volumes/Snapshots
⚠️	⚠️	✅	✅	❗	N/A

Device Health Check Details

Columns ▾

Category	Alert Level	Description	Alert
Storage Pool Configura	❗	Multiple Size Drives in Enclosure	Multiple size drives in: B1a1
Storage Pool Configura	❗	Multiple Size Drives in Enclosure	Multiple size drives in: B1a3
Storage Pool Configura	❗	Multiple Size Drives in Enclosure	Multiple size drives in: B1a4
Config	⚠️	Single Point of Failure	Enclosure =A0a1, Card=0
Config	⚠️	Single Point of Failure	Enclosure =A0a2, Card=0
Config	⚠️	Single Point of Failure	Enclosure =A0a3, Card=0
Config	⚠️	Single Point of Failure	Enclosure =A0a4, Card=0
Config	⚠️	Single Point of Failure	Enclosure =A0a5, Card=0

In the example included here the array is being flagged for an unsupported configuration because there are different size drives with a single drawer of storage. This configuration is allowed on newer arrays, but was unsupported in older array configurations. This might not seem important until an incident occurs and support is called only to discover this issue.

All single points of failure are analyzed. An adapter (card within the storage array) has been flagged because multiple resources may be using the same card. For example, the storage may have 2 loops of storage drawers, but if both loops have a path through a single card that card

will be tagged as a single point of failure (SPOF) and a warning in the health analysis will be created so further investigation can be performed.

Auto-support is also analyzed to insure email, alert notification user ids and contact information is included so the moment anything unexpected occurs the proper people are notified so the issues can be resolved quickly without an unplanned storage event.

These are few of the higher profile warnings provided for NetApp configurations and all of these are designed to help customers:
- Avoid unplanned outages
- Maximize their storage efficiency
- Reduce overall storage costs
- Identify unused resources to these resources can be reused

So, what do I need to do to manage this type of storage?
Most customers monitor with vendor specific tools which tend to provide the information vendors want to know, or generic tools which don't have customized features for each array that make sure you get the most out of each and every one of your storage arrays. VSI is different because it is built for customers by customers and contains the information customers need to maximize their storage efficiency, minimize outages and reduce storage costs. VSI provides the visibility to maximize the efficiency of individual storage arrays and manage your entire storage infrastructure from a single pane of glass.