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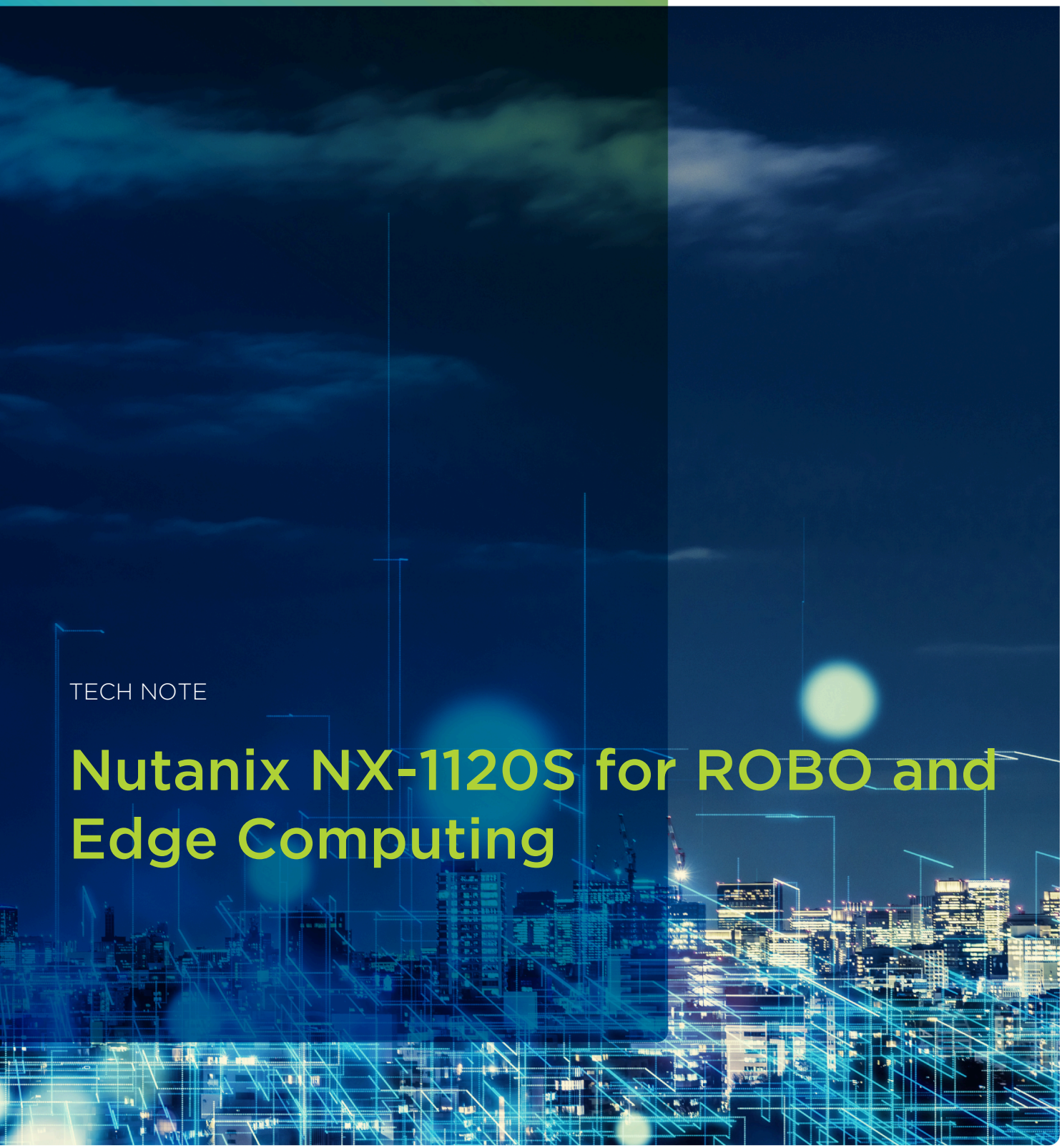

TECH NOTE

Nutanix NX-1120S for ROBO and Edge Computing

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Contents

1. Executive Summary

To support the growing needs of remote office and branch office (ROBO) and edge computing applications, Nutanix has added the NX-1120S to the product portfolio.

The NX-1120S, or Mini-NX, is a result of extensive engineering efforts to create a portable appliance suited for environments with specific, high-priority requirements for low density, power, and cooling. Engineered for reliability, resilience, and scalability, the NX-1120S inherits the same Nutanix enterprise cloud OS that over 14,000 of the world's most advanced datacenters run.

2. Introduction

Audience

This tech note is part of the Nutanix Solutions Library. We wrote it for IT decision makers and architects responsible for deploying edge computing and ROBO applications. Readers of this document should already be familiar with Nutanix.

Purpose

In this document, we present an overview of ROBO and edge computing on NX-1120S and cover the following aspects of the hardware:

- Availability
- Recoverability
- Security
- Performance and scalability
- Manageability

Unless otherwise stated, the solution described in this document is valid on AOS versions 5.17 and later.

Document Version History

Version Number	Published	Notes
1.0	March 2021	Original publication.
1.1	November 2021	Updated the maximum system memory specifications.

Version Number	Published	Notes
1.2	August 2022	Updated links and product naming.

3. NX-1120S Solution Overview

We custom-engineered the NX-1120S appliance exclusively for the Nutanix enterprise cloud OS and Nutanix Xi Internet-of-things (IoT) platforms in production, development, and test environments.

Users can deploy the NX-1120S in either a single-node or clustered (at least three nodes) configuration.

System Overview

The NX-1120S is a 1RU appliance that users can rack mount or install on a flat surface.

On the front, the system features two 2.5-inch hot-swappable SSD device bays with a simplified panel that uses illumination to articulate the health of key hardware components.

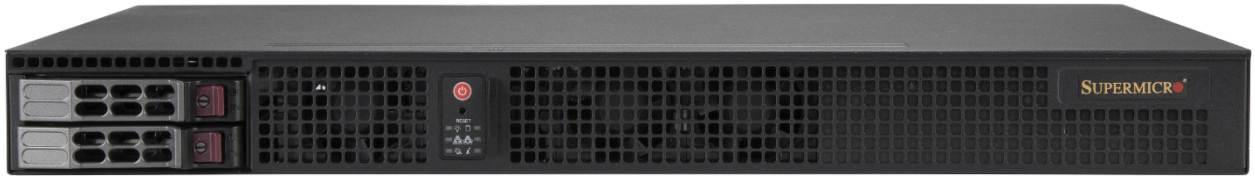

Figure 1: NX-1120S Front View

On the rear, the system has two hot-swappable power supply units with 300 watts, integrated out-of-band management, and a variety of Ethernet mediums including UTP and SFP+ adapters. A single PCIe (peripheral component interconnect express) expansion bay incorporates a SAS 3008 I/O Controller, enabling users to specify optional self-encrypting drives (SEDs) in applications that need increased security.

Figure 2: NX-1120S Rear View

The following image shows the system interior, including the embedded Xeon processor and associated cooling flow. This processor ensures that the unit and components receive sufficient maximum air flow throughout.

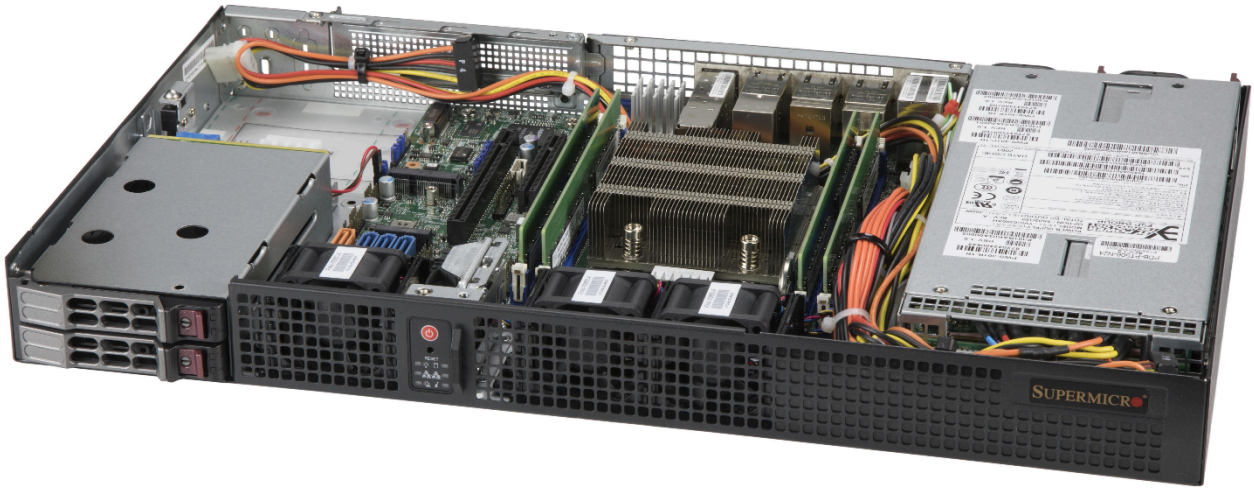

Figure 3: NX-1120S Internal View

System Specifications and Configuration Items

The following table contains the high-level system specifications for the NX-1120S appliance. Full system specifications are available in the Appendix.

Table: System Specifications

Component	Specification	Configurable
Server compute	Intel Xeon Processor D-2146 (2.30 GHz)	No
Maximum memory	256 GB	Yes (64, 128, or 256)
Maximum processor core	8 cores	No

Component	Specification	Configurable
Maximum storage capacity	2 x 3.84 TB	Yes (1.92, 3.84, or 7.68 TB)
Storage type	All-flash SSD	No
Network connectivity	2 x 10 GbE SFP+ from D-2146NT SoC; 4 x 1 GbE with Intel I350-AM4; 2 x 1 GbE with Intel X557	No

Software Options

The following table details the Nutanix software supported on the NX-1120S. Further specifications are available on the Nutanix Software Options page.

Table: Software Specifications

Software	Configuration
Nutanix Cloud Infrastructure (NCI) software editions	Standard, Pro, Ultimate
AOS software version	5.17 and later
Hypervisor supported	AHV
Licensing models	Capacity-based, appliance-based, VDI per user, and remote and branch office per VM

System Availability

The deployment model of the Mini-NX influences overall system availability. For example, single-node Nutanix deployments achieve different degrees of system availability than clustered deployments because they have fewer compute nodes and the platform's intelligent features implement different actions.

Nutanix also built additional availability into the following NX-1120S hardware components to mitigate potential failures:

- Power supply unit (PSU): The Mini-NX has two hot-swappable power supplies with sufficient wattage to keep the appliance running if a single PSU becomes unavailable.

- Data storage: The Mini-NX has two hot-swappable SSDs to mitigate drive failure. Nutanix implements replication factor 2 across both SSDs to automatically protect the Nutanix CVM and customer VMs when used in a single-node configuration.
  - › In a clustered configuration, NX-1120S nodes form a distributed system (the Nutanix cluster) responsible for providing NCI. All services and components are distributed across all CVMs in a cluster to provide high availability and linear performance at scale. In clustered configurations, all nodes in a cluster are designed with replication factor 2.
- Multiple NIC ports: The Mini-NX has eight NIC ports that use a variety of connection mediums (SFP+ or UTP) and speeds of up to 10 GbE to provide redundancy and load balancing at the networking layer. Users can achieve additional availability by configuring logical switches with AHV.

System Recoverability

Nutanix has several recoverability options for customers who want to protect and back up their data against defined SLAs. The following figure and table illustrate common recoverability strategies.

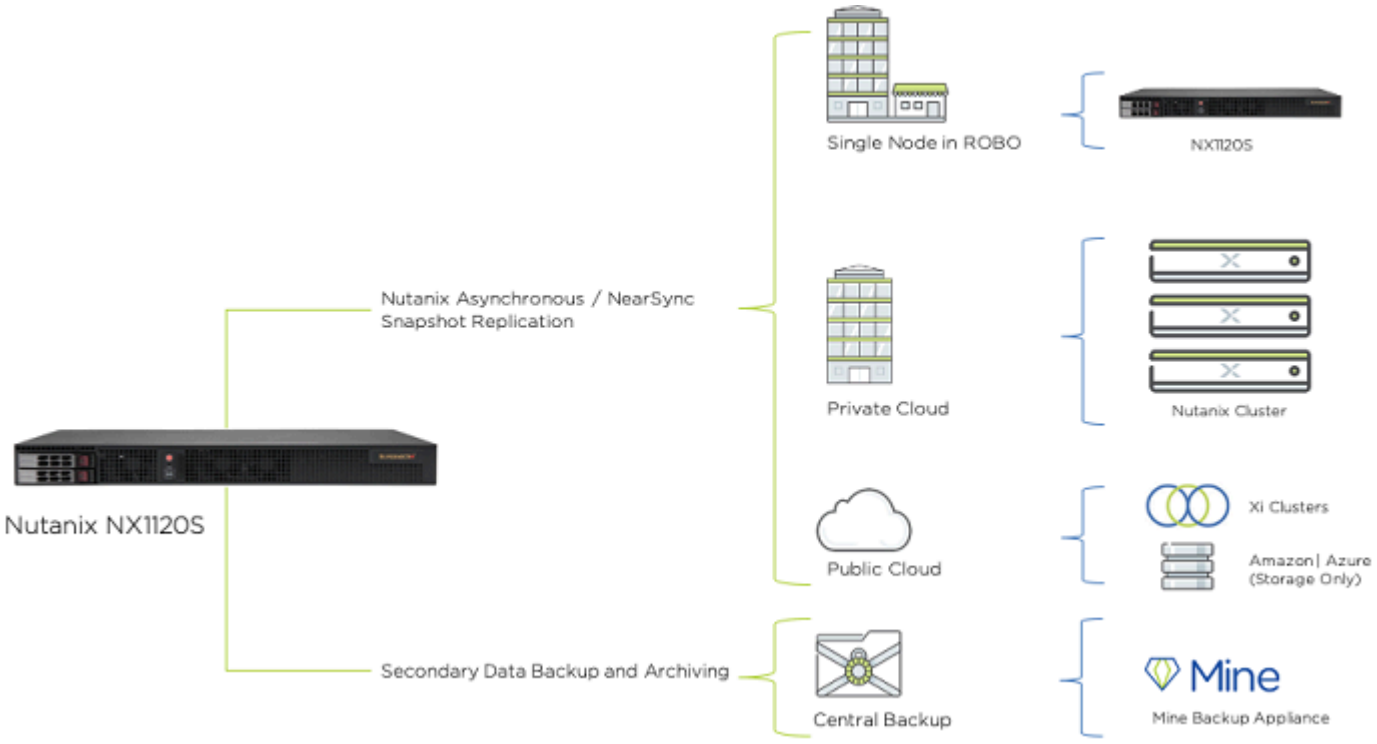

Figure 4: Recoverability Options

Table: Comparison of Replication Options

Destination	Strategy	Description	RPO	Recovery Method
Single-node ROBO	Asynchronous replication	Used when the source and the destination are single-node clusters.	6 hours	VM
Private cloud	Near-synchronous (NearSync) replication	Used when there are at least three nodes in a cluster on both the primary and the remote site.	1–15 minutes	VM

Destination	Strategy	Description	RPO	Recovery Method
Public cloud	Nutanix Cloud Clusters (asynchronous)	Used when customers need to host Nutanix on AWS, GCP, or the Nutanix public cloud; allows customers to use the same replication strategies as the private cloud.	60 minutes	VM
Public cloud	Amazon S3 or EBS; Azure Blob	Uses the Nutanix Cloud Connect feature to replicate VMs to AWS S3 (EBS for metadata) or Azure Blob Storage. With this option, customers can't start VMs because they are just using a storage target or service in the public cloud.	60 minutes	VM

Destination	Strategy	Description	RPO	Recovery Method
Central backup	Nutanix Mine (secondary data backup and archiving)	Used when customers need a dedicated, turnkey solution that supports backup and archiving using integrated solutions from Veeam and HYCU.	60 minutes	VM or file-level backup

Organizations may wish to design their own advanced replication and recoverability strategies, such as many-to-many or hub-spoke topologies.

For NearSync requirements and limitations, consult the Data Protection and Recovery with Prism Element Guide. For more information on single-node clusters, consult the section on single-node clusters. To understand more about the Cloud Connect feature and protection domains, see the section on asynchronous replication with Cloud Connect.

System Security

Nutanix provides a comprehensively secure landscape for customers operating in private and public cloud environments.

AI applications often involve terabytes of sensitive data and proprietary information from various industry verticals including government organizations. For this reason, the data needs to be encrypted on the disk to mitigate the risk of unauthorized physical access or theft. Encryption also can't affect performance or management simplicity.

To protect their data, organizations can elect to configure their appliance with hardware- or software-based data-at-rest encryption. The NX-1120S comes preconfigured with a LSI3008 storage I/O controller that allows customers to use optional hardware-based self-encrypting drives (available in 1.92 TB, 3.84 TB, or 7.68 TB capacities).

Alternatively, organizations can configure software-based data-at-rest encryption in the Nutanix Prism management console. Software-based encryption uses the Intel Advanced Encryption Standard (AES) New Instructions (NI), an encryption instruction set that improves on the AES algorithm and accelerates data encryption. Supporting AES NI in software gives customers flexibility across hardware models while reducing CPU overhead. The default encryption setting is AES-256.

Organizations should review the following guides when using hardware- or software-based encryption, including setting up a key management server (KMS):

- Nutanix Security Guide: Configuring Dual Encryption (software-based)
- Nutanix Security Guide: Configuring Data-at-Rest Encryption (hardware-based)

Beyond the encryption of data at rest, Nutanix also provides a wealth of security-based features, detailed in the following list.

- Authentication and authorization
  - › Configuring authentication
  - › Assigning role permissions
  - › Password complexity support with standard pluggable authentication module (PAM) library
- Network segmentation
  - › VLAN-based, data-driven segmentation
- Security policy management
  - › Implement security policies using (https://portal.nutanix.com/page/documents/details?targetId=Nutanix-Flow-Guide%3Amul-security-policy-management-pc-c.html

- Data security and integrity
  - Controlling cluster access
  - SSL certificate management
  - Data-at-rest encryption
- Hardening instructions
  - Hardening AHV
  - Hardening Controller VM
  - TCP wrapper integration
- Log monitoring and analysis
  - Cluster-wide log shipping
  - Documenting the log fingerprint
  - Nutanix Pulse diagnostics

Performance and Scalability

Nutanix distributed storage drives high performance for guest VMs by providing storage resources to VMs locally on the same host. This method enables the local storage controller (one per Nutanix node) to devote its resources to handling I/O requests made by VMs running on the same physical node. Other controllers running in the cluster are then free to serve I/O requests made by their own local guest VMs. This architecture contrasts with traditional storage arrays that have remote storage controllers and resources located across a network (SAN or NAS).

The Nutanix architecture has several important performance benefits. Because storage resources are local, requests don't have to traverse the network; by removing the physical network from the I/O path, the architecture drastically decreases latency. Additionally, each host (or Nutanix node) has its own virtual storage controller (CVM), which eliminates the storage bottlenecks common in shared storage architectures. As users add new Nutanix nodes to the cluster, CVMs are added at the same rate, providing predictable, scalable,

and linear performance. The scale-out architecture allows for predictable high-performance storage

You can find more information about Nutanix storage in the Nutanix Bible.

Data Locality

A common characteristic of a VM cluster is that VMs migrate from host to host within a cluster throughout the day and over time to optimize CPU and memory resources. Because distributed storage serves data locally to guest VMs, the VM's data must follow when it moves between hosts.

In a traditional shared storage environment, users access data over the network, so a VM's data stays in the same place (in other words, on the central array) even if the VM migrates throughout the cluster. Because of the distributed and scalable nature of the Nutanix architecture, however, the data remains as close to the VM as possible to provide the fastest performance and minimize both cross-talk and network utilization.

After a VM completes its migration to another host, the CVM on the destination host takes ownership of the migrated VM's files (vDisks) and begins to serve all I/O requests for these vDisks. Accordingly, the writes also go to the local CVM on local storage to ensure that write performance remains as fast as it was before the VM migration event.

The Nutanix platform serves all read requests for newly written data locally and forwards previously written data to the source host's CVM. In the background, Curator dynamically moves the VM's remote data to the local Nutanix node so that all read I/O occurs locally and does not traverse the network.

You can find more information about data locality in the Nutanix Bible.

Performance Testing

We used Nutanix X-Ray to test and evaluate the performance and scalability parameters for the NX-1120S. X-Ray is the simplest way to test, analyze, and report on the architectural, performance, and scalability differences between hyperconverged infrastructure (HCI) vendor platforms.

Four Corners Microbenchmark

This test uses the open-source Nutanix microbenchmark framework to measure peak burst performance. It runs the four data workload types (random reads, sequential reads, random writes, and sequential writes) and shows the peak burst performance for each. Each workload runs in sequence for 1 minute with 1-minute intervals between. For random reads and writes, higher IOPS indicates better performance; for sequential reads and writes, more bytes per second indicate better performance.

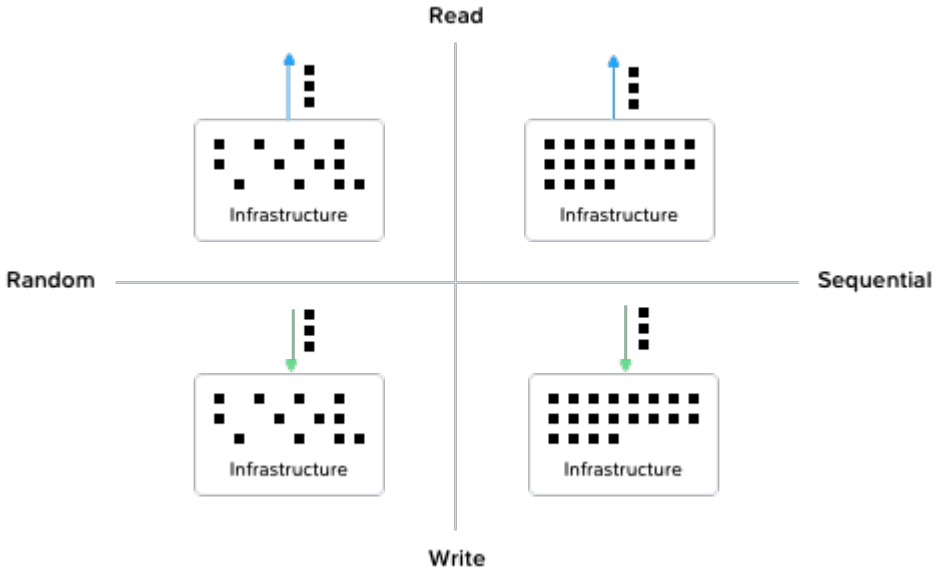

Figure 5: Four Corners Microbenchmark Quadrant

Note: This test scales with the number of nodes.

Test requirements:

- vCPU: 4 vCPU per node
- RAM: 4 GB per node
- Cluster storage: 116 GB per node
- IP addresses: one per node

Benchmark setup:

1. Deploy one workload VM per host.
2. Fill virtual disks with random data.
3. Run random read workload warmup for 5 minutes.

Hardware setup:

- Single Nutanix cluster of four NX-1120S nodes.
- Each node has two 1.92 TB SSDs and two dual-homed 10 GbE NICs per node.
- Each node has two 10 GbE connections to the top-of-rack switch.

After we set everything up, we ran the benchmark:

1. Run random read workload for 1 minute on all VMs.
2. Wait 1 minute.
3. Run sequential read workload for 1 minute on all VMs.
4. Wait 1 minute.
5. Run random write workload for 1 minute on all VMs.
6. Wait 1 minute.
7. Run sequential write workload for 1 minute on all VMs.

The following images show the results of running the Four Corners Microbenchmark on a single Nutanix cluster with four NX-1120S nodes.

After X-Ray created a single Ubuntu (version 16.04) VM on all four nodes in the cluster, it assigned six 16 GB vDisks to each VM and began to fill these vDisks with 2 GB of random data. For the random read test X-Ray used a block size of 8 KB and 128 outstanding I/O operations and read blocks of data from random locations on each VM's vDisk. The random read IOPS across the nodes were high, highlighting the performance benefits of a distributed system and data locality.

Random Read IOPS

Min	Max	Median	Mean	Standard Deviation
6	285,442	277,991	239,503	93,113

Figure 6: Random Read IOPS

X-Ray waited 1 minute before starting the sequential read throughput test, which measures disk performance when reading large contiguous blocks of data from adjacent locations on a storage medium. X-Ray used a block size of 1 MB and 128 outstanding I/O operations and achieved an excellent peak sequential read throughput of 8.1 GBps across all four nodes.

Min	Max	Median	Mean	Standard Deviation
182.29 KBps	8.1 GBps	7.97 GBps	6.88 GBps	2.51 GBps

Figure 7: Sequential Read I/O Throughput

After waiting 1 minute, X-Ray evaluated the write performance of our cluster. For the random write test X-Ray used a block size of 8 KB and 128 outstanding I/O operations and wrote 2 GB of data to random locations on each VM's vDisk. The peak random write IOPS reached 187,273.

Min	Max	Median	Mean	Standard Deviation
4	187,274	178,950	154,843	61,073

Figure 8: Random Write IOPS

X-Ray waited 1 minute before starting the sequential write throughput test, which measure disk performance when writing large contiguous blocks of data from adjacent locations on a storage medium. X-Ray used a block size of 1 MB and 128 outstanding I/O operations and achieved an excellent peak sequential write throughput of 3.01 GBps across all four nodes.

Min	Max	Median	Mean	Standard Deviation
81.55 KBps	3.01 GBps	2.9 GBps	2.49 GBps	974.64 MBps

Figure 9: Sequential Write I/O Throughput

During these tests, X-Ray also recorded cluster CPU usage. Because the cluster didn't have any competing workloads configured, it could use all the available CPU resources. During the microbenchmark, the system CPU peaked at 66.15 GHz out of 73.41 GHz and maximized all available resources to the CVMs and Ubuntu test VMs

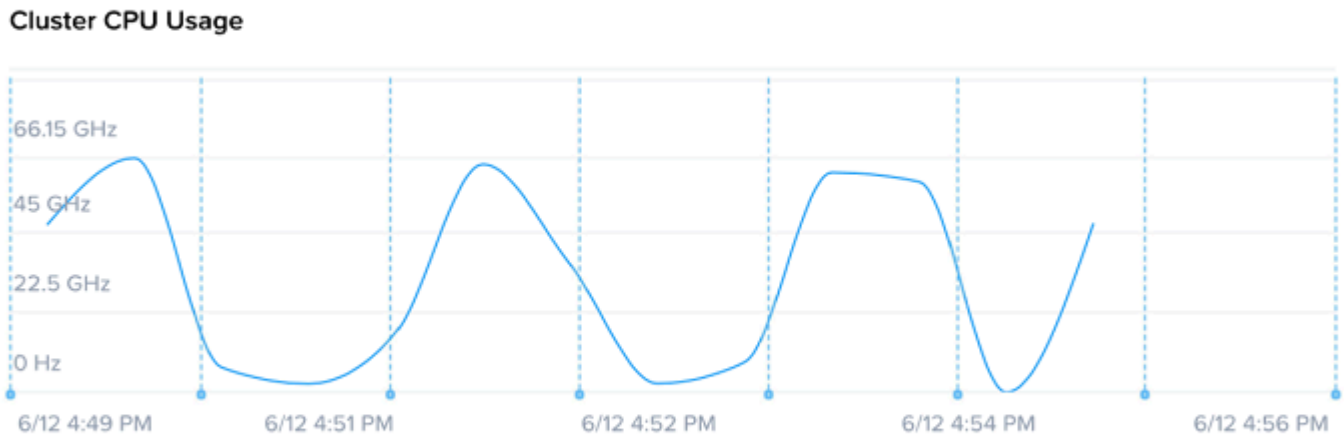

Figure 10: Cluster CPU Usage

The peaks in CPU usage coincide with the testing timeline shown in the following figure.

Events	Four Corners Microbenchmark - default
Random Read: Started workload	4:49:17 PM
Random Read: Finished workload	4:50:23 PM
Sequential Read: Started workload	4:51:28 PM
Sequential Read: Finished workload	4:52:33 PM
Random Write: Started workload	4:53:38 PM
Random Write: Finished workload	4:54:43 PM
Sequential Write: Started workload	4:55:47 PM
Sequential Write: Finished workload	4:56:53 PM

Figure 11: Timeline of X-Ray Tests

Manageability

Nutanix Prism provides central access for administrators to configure, monitor, and manage virtual environments in a simple and elegant way. Powered by advanced data analytics and heuristics and rich automation, Prism offers unprecedented simplicity by combining several aspects of datacenter management into a single, easy-to-use solution. Using innovative machine-learning technology, Prism can mine large volumes of system data easily and quickly and generate actionable insights for optimizing all aspects of virtual infrastructure management. Prism is a part of every Nutanix deployment and has two core components: Prism Element and Prism Central.

Prism Element

Prism Element is built into every Nutanix cluster and enables users to fully configure, manage, and monitor Nutanix clusters running any hypervisor. When customers deploy the NX-1120S appliance, Prism becomes highly available, fault tolerant, and distributed across all members in the cluster, which ensures that

management operations continue in the event of failure. This setup also means that Prism scales when customers add new nodes.

Prism Central

Because Prism Element only manages the cluster it is part of, each Nutanix cluster in a deployment has a unique Prism Element instance for management. Prism Central allows users to manage different clusters from separate physical locations on one screen and offers an organizational view into a distributed Nutanix environment.

For more information about Prism, see the Nutanix Prism tech note.

Nutanix Self-Service

Users can also orchestrate application, deployment, standardization, and life cycle management across single- or multinode clusters and geographically dispersed clusters using Nutanix Self-Service.

Nutanix Self-Service (built into Prism Central and licensed separately) allows administrators to design and deploy application blueprints or choose from a variety of preconfigured application blueprints using the Marketplace feature.

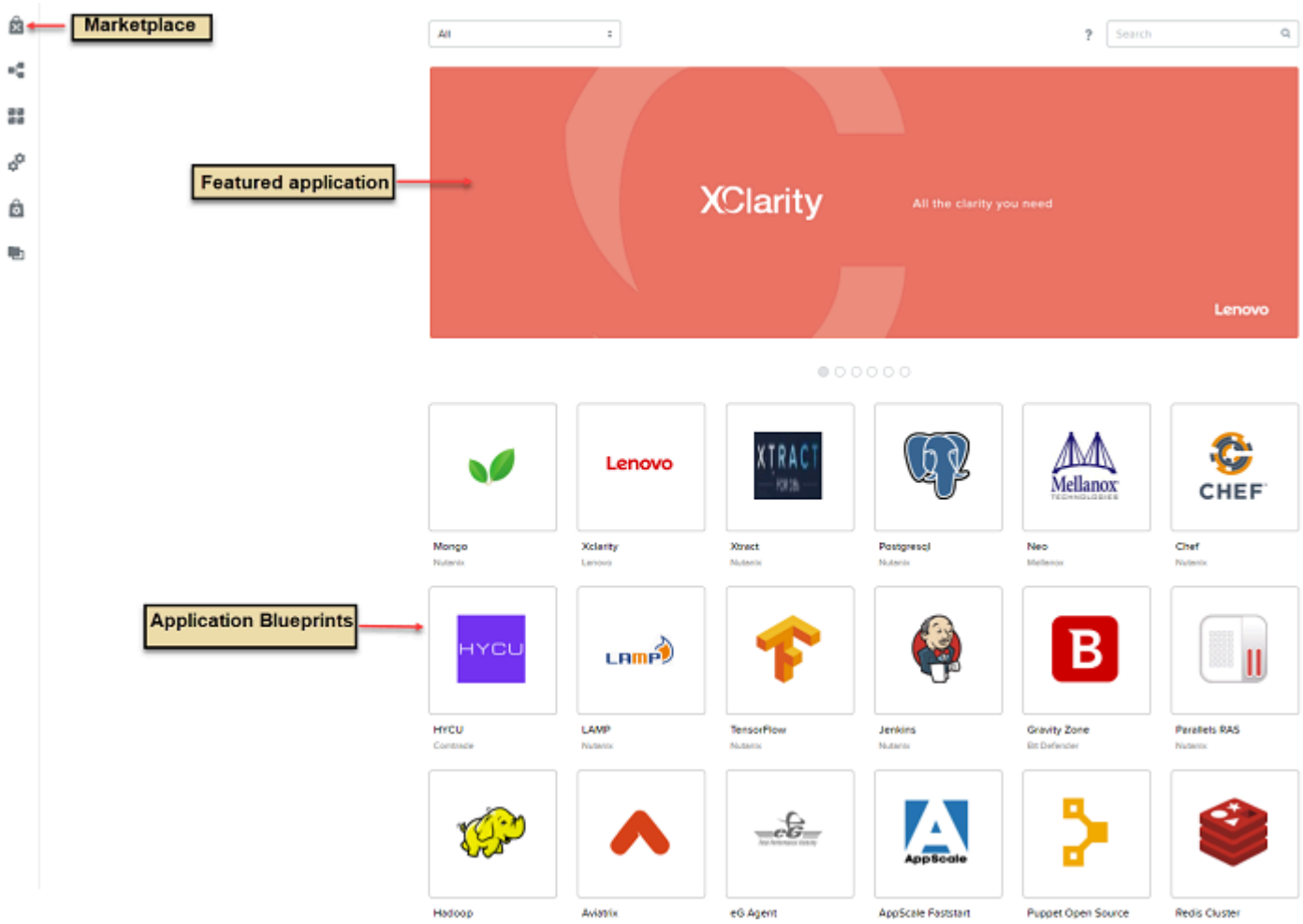

Figure 12: Nutanix Self-Service Marketplace

4. Conclusion

Edge computing and ROBO applications require lower-density form factors that reduce the requirements for power and cooling. The Nutanix NX-1120S meets the requirements for these applications while using the same Nutanix enterprise cloud OS traditionally deployed in the datacenter. Organizations that deploy the NX-1120S get the technical and business benefits of NX hardware, including resilience, data integrity, scale, and performance, while keeping an identical management framework.

For feedback or questions, contact us using the Nutanix NEXT Community forums.

5. Appendix

System Specifications

The following list details the system specifications for the NX-1120S appliance. For more information, refer to the Nutanix Hardware Platform spec sheet.

- Processor support:
  - Intel Skylake Xeon D-2146NT SoC, 2.30GHz, 8-core, 80 W BIOS version 2.0 or above is required.
- Key applications:
  - Network security appliance
  - SDN-WAN, vCPE controller box
  - NFV edge computing server
  - Virtualization server
  - IoT edge computing
- Server board:
  - Supermicro X11SDV-8C-TP8F
- Chipset:
  - System on a chip (SoC)
- System memory (maximum):
  - 4 x 256 GB DDR4 DIMM with up to 2,667 MHz LRDIMM or 256 GB RDIMM, ECC

- Expansion slots:
  - 1 M.2 slot M-key for SSD
  - 2242/80
  - 1 M.2 B-key for SSD or WAN card
  - 1 Mini-PCI-E with mSATA support
  - 1 PCI-E 3.0 with 8 slots
- Onboard storage controller:
  - SoC controller for 4 x 6 Gbps SATA3 ports
- Connectivity:
  - 2 x 10 Gb SFP+
  - 2 x 10 Gb based-T
  - 4 x 1 GbE connectors
  - 1 dedicated IPMI LAN
  - 2 USB 3.0 ports
- VGA or audio:
  - VGA via BMC
- Management:
  - IPMI 2.0
- Drive bays:
  - 2 hot-swappable 2.5-inch drive trays
- Peripheral bays: N/A
- Power supply:
  - 300 W AC redundant PSU

- Cooling system:
  - 2 x 40 mm x 28 mm 4-PIN PWM fan (FAN-0065L4, 13K RPM)
- Form factor:
  - 1RU short depth rackmount
  - Enclosure: 437 mm x 43 mm x 249 mm (17.2 in. x 1.7 in. x 9.8 in.)
  - Package: 655 mm x 155 mm x 465 mm (25.8 in. x 6.1 in. x 18.3 in.)
- Weight:
  - Gross weight: 12 lb (5.44 kg)
  - Net weight: 8 lb (3.63 kg)

About Nutanix

Nutanix is a global leader in cloud software and a pioneer in hyperconverged infrastructure solutions, making clouds invisible and freeing customers to focus on their business outcomes. Organizations around the world use Nutanix software to leverage a single platform to manage any app at any location for their hybrid multicloud environments. Learn more at www.nutanix.com or follow us on Twitter @nutanix.

List of Figures