

Lenovo Technical Brief for

AWS ECS-A and EKS-A Hybrid Cloud Services Running on Lenovo Servers

Lenovo™

Virtualization sprawl problem and a solution

As virtualization environments continue to expand organizations are looking for more efficient and manageable platforms for their critical data and applications. The ease of deploying a virtual machine or container can result in a disorganized spread of virtual devices and resources. This can result in security vulnerabilities and wasted resources.

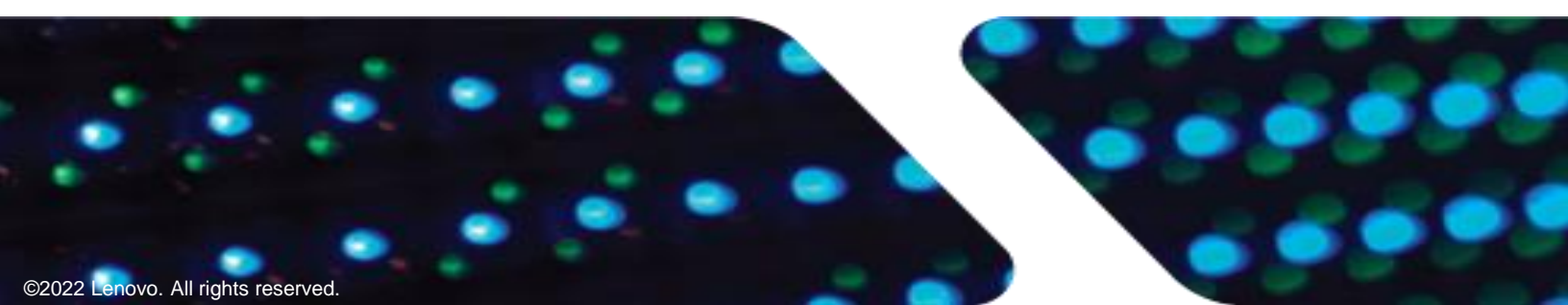
Amazon's Elastic Container Service - Anywhere (ECS-A) on Lenovo ThinkAgile VX systems is a container orchestration solution that runs the AWS ECS cloud service in your own data center. ECS makes deploying, managing and scaling containerized workloads easier.

Additionally, Amazon Elastic Kubernetes Service – Anywhere (EKS-A) on Lenovo servers is a fully managed Kubernetes solution based on AWS EKS cloud service for running Kubernetes clusters on-premises. EKS-A can run on a VMware vSphere 7.0 cluster environment or on a bare metal server running a recent Linux distribution, although the recommended one is Ubuntu 20.04.

A Lenovo deployment guide is planned in the coming months, covering detailed installation and configuration steps for both ECS-A and EKS-A on Lenovo ThinkAgile VX systems hosting VMware clusters and EKS-A bare metal on Lenovo ThinkSystem SR650 V2.

Lenovo Solutions for Amazon ECS and EKS Anywhere leverage the ThinkAgile VX7531 Certified Node (built on the ThinkSystem SR650 V2 and highly optimized for VMware virtualization environments) or the ThinkSystem SR650 V2 system itself. The systems are dual-socket 2u rack mount enterprise servers configured with 3rd Generation Intel® Xeon® Scalable processors, TruDDR4 3200MHz memory, 440-16i or 440-8i SAS HBAs, Mellanox CX6 (RoCE) or Qlogic (iWARP) RDMA NICs and a variety of storage options, including support for the PCIe 4.0 standard for I/O. These new processors from Intel offer up to 40 cores and 16x 3200 MHz DDR4 per socket.

The VX7531/SR650 V2 systems are ideal for virtualized environments with their storage dense offering, 28 different drive bays in the front, middle and rear of the server and 5 different slot configurations at the rear of the server. Onboard NVMe PCIe ports allow direct connections to 12x NVMe SSDs, which frees up PCIe slots and lowers NVMe solution acquisition costs.



AMAZON ELASTIC CONTAINER SERVICE - ANYWHERE

Amazon ECS-A is an expanded feature of the proven ECS solution that runs in the AWS Cloud. It takes that same service and makes it easy to run and manage container-based applications on your own managed infrastructure.

The setup process to get it up and running can be done without a lot of effort. The high-level steps are as follows

On the Management system:

1. Install the AWS CLI on a Linux management server or vm on-premises. The following steps are all completed from the management system CLI
2. Set AWS variables for your environment
3. Create an SSM Trust Policy
4. Create an IAM role using the trust policy key
5. Create an ECS-A cluster
6. Create an SSM activation ID code

The next steps below are completed on the Linux server that will run ECS-A.

On the ECS-A Lenovo server:

1. SSH into the server to set the activation ID
2. Download the ECS-A installation script
3. Run the installation script
4. Exit the SSH session and return to the management server

The remaining steps are completed from the management server.

1. Setup the task by editing a JSON file. Tasks are how containers are defined and deployed in ECS-A
2. Register the task
3. Run task. This launches the container, our POC used nginx
4. From the AWS Console, the cluster resource can be viewed and observe the running container

The server configuration features the following main components:

- **Server:** Lenovo ThinkAgile VX7531
- **Processor:** 2x 3rd Gen Intel Xeon Scalable, 40 core
- **Memory:** 1 TB of TRUDDR4 3200 MHz memory
- **Primary Storage:** 8x Intel P4510 4TB NVMe SSDs
- **Secondary Storage:** 2x Intel Optane p4800x 750GB NVMe SSD Raid1
- **OS Storage:** 2x 480GB M.2 SATA SSDs for the operating system (RAID 1)
- **Software:**
 - Ubuntu 20.04 LTS
 - Amazon ECS-A solution

The screenshot displays the AWS Management Console interface for an ECS cluster. At the top, the cluster name 'Invo-ecsa-poc' is shown with 'Update Cluster' and 'Delete Cluster' buttons. Below this, a summary of cluster resources is provided, including the Cluster ARN, Status (ACTIVE), and counts for registered container instances, pending tasks, running tasks, active services, and draining services. A navigation bar allows switching between Services, Tasks, ECS Instances, Metrics, Scheduled Tasks, Tags, and Capacity Providers. The 'Tasks' tab is active, showing a 'Run new Task' button and a 'Stop' button. The 'Desired task status' is set to 'Running'. A table lists the tasks, with one task in the 'RUNNING' state. The table columns include Task ID, Task definition, Container instance ID, Last status, Desired status, Started at, Started By, Group, Launch type, and Platform version.

Task	Task defini...	Container i...	Last status	Desired st...	Started at	Started By	Group	Launch type	Platform v...
89467ed24...	nginx:1	ad20cb0390...	RUNNING	RUNNING	2021-12-09 ...		family:nginx	EXTERNAL	--

AMAZON EKS-A WITH VMWARE

Amazon Elastic Kubernetes Service – Anywhere with VMware is also an expanded feature of the proven EKS solution that runs in the AWS cloud. It takes the same service and creates an easily managed Kubernetes cluster environment in your data center.

The main difference when installing EKS-A is that it does not run on a single system or VM. It currently requires a VMware vSphere 7 cluster to support all the control plane and worker nodes for Kubernetes.

The deployment process includes the following main steps:

1. Create a bootstrap cluster on the administrative machine
2. Create the EKS-A workload cluster in vSphere
3. Create the EKS-A control plane
4. Create the EKS-A worker nodes
5. Setup networking
6. Setup storage

All of this is setup automatically based on cluster config file settings.

With the EKS Connector, EKS-A on-premise cluster can be registered and viewed in the Amazon Console > Container Services.

The EKS-A installation starts with a Linux administrative machine, which can be a VM on the VMware cluster. It uses the eksctl executable to build a Kubernetes cluster on your systems.

The current version of EKS-A deploys two clusters. One is the management cluster, which is also the bootstrap cluster. The other is the workloads cluster. This is a recent change from the initial release that used only one cluster for everything.

On the Administrative machine:

1. Install the EKS-A CLI tools
2. Generate the management cluster config file
3. Set credential variables for the VMware environment
4. Set License environment variable
5. Create the management cluster
6. Setup KUBECONFIG
7. Verify the management cluster nodes using kubectl
8. Verify the management cluster's CRD

At this point the management cluster is ready to deploy the workload cluster.

The next steps create the workloads cluster.

1. Generate a workload cluster config file. Its important to use a different cluster name than the management cluster, and different VMware resources
2. Create a workload cluster and use the management cluster's credentials. This will ensure that workload cluster is managed from the management cluster
3. Verify the workload cluster
4. Deploy a test application
5. It is common to deploy more than one workload cluster. This can be done by following the same steps and reusing the cluster config file after renaming it and modifying the resources section

After the workload clusters are deployed, the management cluster remains in place so it can be used to upgrade, modify or delete workload clusters.

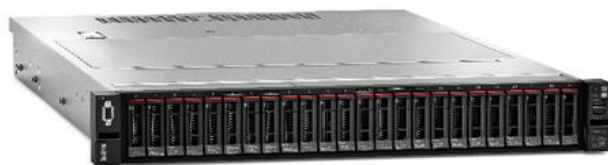
The screenshot shows the Amazon AWS Management Console interface for EKS Clusters. The top navigation bar includes the AWS logo, 'Services' dropdown, 'EKS' selected, a search bar, and the region 'Oregon (us-west-2)'. The left sidebar shows 'Amazon Container Services' with 'Amazon EKS' and 'Clusters' highlighted. The main content area is titled 'EKS > Clusters' and shows 'Clusters (2) info'. There are buttons for 'Refresh', 'Delete', and 'Add cluster'. A search bar is present with the text 'Filter cluster by name, status, kubernetes version, or provider'. Below is a table with the following data:

Cluster name	Status	Kubernetes version	Provider
eks-o	Active	1.21	EKS
eks-a-demo-clus	Active		EKS Anywhere

Best practices for Amazon ECS-A and EKS-A on ThinkSystem VX7531 servers

For a high-performance and reliable solution, implement the following best practices:

- Configure UEFI (Bios) settings to custom mode and set Operating mode to Maximum performance.
- Change UEFI processor mwait setting to **enabled**. By default, it is disabled. It must be in custom mode to allow this setting change. This is a VMware requirement to allow the VMware CLS system VMs to start.
- Use the recommended Linux OS to avoid command and syntax issues across distributions. The recommended distribution is currently Ubuntu 20.04 LTS.
- Use the recommended version of VMware, which is vSphere 7.0 or later.
- Neither solution is compatible with any other hypervisor other than VMware.
- Plan the backend storage for the virtual machines on faster storage for the more demanding workloads. This can be aligned when setting parameters in the EKS-A workload cluster generation file.
- EKS-A can only be setup on a VMware cluster, requiring multiple VMs to support Kubernetes.
- ECS-A can run on a stand-alone bare metal server or VM.
- Use a separate Linux management or administrative machine to deploy either solution.



Lenovo ThinkAgile VX7531

Solution Benefits

- **High performance and scalable virtualization platform from Lenovo**
- **Balanced and optimized configuration for demanding VMware clustered environments**
- **A high-performance solution with 3rd Generation Intel Xeon scalable processors, Intel P5600 NVMe storage for VMware vSphere virtualization environments**
- **Pre-tested for reduced time to value**

Configuration Options – Lenovo ThinkAgile VX7531

	VX7531
VX offering type	Certified Node
Target workloads	High performance
Base MTM	7Z63CTO5WW
Form Factor	2U
Base platform	SR650 V2
CPU	2x Intel Xeon SP Gen 3
Memory	32x DDR4 3200 MHz (4TB maximum)
Drive Bays	40x 2.5" SAS/SATA 32x 2.5" NVMe 16x 3.5" SAS/SATA
Drive configurations	All Flash Hybrid
Disk groups	1 to 5
HBA	440-16i HBA Int 430-8i HBA 430-16i HBA
Boot drives	2x M.2 SATA 2x 7mm hot-swap
OCP networking	1x OCP 3.0 adapter 10Gb, 25Gb
PCIe networking	Up to 8x adapters 10GBASE-T, 10G, 25G, 100G

EKS ANYWHERE BARE METAL - OVERVIEW

Amazon Elastic Kubernetes Service - Anywhere bare metal is an expanded feature of the proven EKS service that runs in the AWS cloud. It takes this same service and creates an easily managed Kubernetes cluster environment on-premise.

The architecture allows direct access to the underlying hardware resources, avoiding the virtualization layer of a hypervisor. It also eases the complexity of operating Kubernetes across cloud and on-premise environments, providing the same consistent experience.

The deployment uses an Ubuntu 20.04 admin machine to launch the installation.

The first steps are to ensure the admin machine is prepared and the bare metal nodes are ready. The Tinkerbell infrastructure package runs on the admin machine as well and provides DHCP services for the nodes. It's recommended to run this on an isolated network to avoid DHCP conflicts.

There is a minimum of 2 bare metal nodes, to deploy a proof-of-concept cluster. In a production deployment, significantly more would be needed for multiple control plane and worker nodes.

The EKS Anywhere Bare Metal installation uses the eksctl-anywhere executable on the admin machine to build the Kubernetes cluster on your bare metal systems.

The solution creates two clusters during the deployment process. One is the admin cluster, also known as the bootstrap cluster. The other is the workloads cluster. The bootstrap cluster is created locally on the admin machine and is a temporary step in the deployment.

After the workload cluster is online, control is passed to the workload cluster. At this point the bootstrap cluster is removed.

High-level Deployment Steps

Confirm the bare metal nodes are ready, and powered off (see best practices section)

On the Admin machine:

1. Download the kubectl and eksctl-anywhere files
2. Create a hardware information CSV file with node MAC address, IP, credentials, etc.
3. Configure kubectl and Docker permissions
4. Install the AWS eksctl-anywhere executable
5. Enable Tinkerbell provider
6. Eksctl-anywhere generates the cluster configuration yaml file
7. Launch the eksctl-anywhere process to create the cluster. The installer automatically sets up the Tinkerbell stack on the admin machine.
8. After a series of system checks, it creates the bootstrap cluster on the admin machine.
9. It deploys the Ubuntu OS on the nodes, followed by the Kubernetes control plane and worker roles.
10. After the workload cluster is deployed the management cluster is removed
11. Verify the cluster and deploy a test application

The server configuration features the following components:

- **Server:** Lenovo ThinkSystem SR650 V2
- **Processor:** 2x 3rd Gen Intel Xeon Scalable, 40 core
- **Memory:** 1 TB of TRUDDR4 3200 MHz memory
- **Primary Storage:** 8x Intel P4510 4TB NVMe SSDs
- **Secondary Storage:** 2x Intel Optane p4800x 750GB NVMe SSD Raid1
- **OS Storage:** 2x 480GB M.2 SATA SSDs for the operating system (RAID 1)
- **Software:**
 - Ubuntu 20.04 LTS
 - AWS EKS Anywhere Bare Metal solution
 - Tinkerbell Infrastructure stack

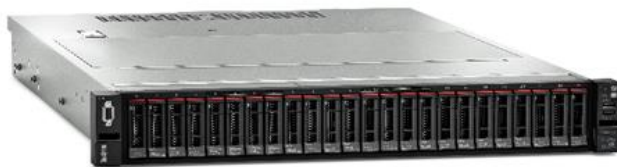
AWS EKS Anywhere Bare Metal Benefits:

- **Direct Access to underlying hardware resources**
- **Simplified Operations between cloud and on-premise**
- **Consistent experience between cloud and data center**
- **Leverage existing bare metal investments**
- **Reduced costs**
- **Open-Source software bundle**
- **Regulatory and data residency needs – cloud vs. on-premise**
- **EKS Dashboard on the AWS Console**

Best practices for Amazon EKS-A Bare Metal on ThinkSystem SR650 V2 servers

For a high-performance and reliable solution, implement the following best practices:

- Configure UEFI (Bios) Operating mode to Maximum performance on each node.
- Use a Layer 2 network switch for all the bare metal nodes.
- BMC and OS network connections must be on the same L2 network
- Use an admin machine on the same Layer 2 network, this can be a physical server or VM
- Use the recommended Linux OS for admin machine to avoid command and syntax issues across distributions. The recommended distribution is currently Ubuntu 20.04 LTS.
- Use the Docker version included with Ubuntu 20.04 on the admin machine, avoids syntax issues.
- Install Docker during the Ubuntu 20.04 install, it is listed as a package option.
- The solution requires the Tinkerbell Infrastructure stack on the admin machine (included)
- The bare metal SR650 V2 systems need to be in an isolated network, due to Tinkerbell using its own DHCP server.
- The bare metal nodes must be set to boot first with network PXE boot.
- The bare metal nodes should not have an existing OS them and have clean drive volumes without pre-existing partitions. This helps ensure a smooth automated install on the nodes.



Lenovo ThinkSystem SR650 V2

Solution Benefits

- **High performance and scalable virtualization platform from Lenovo**
- **Balanced and optimized configuration for demanding virtualized environments**
- **A high-performance solution with 3rd Generation Intel Xeon scalable processors, Intel Optane P4800X storage or Intel P4610 NVMe storage**
- **Pre-tested for reduced time to value**

Bill of Materials – Lenovo SR650 V2

7Z73CTO1WW	Server : ThinkSystem SR650 V2-3yr Warranty	1
BH8H	ThinkSystem 2U 2.5" Chassis with 8, 16 or 24 Bays	1
BB2V	Intel Xeon Platinum 8352Y 32C 205W 2.2GHz Processor	2
B964	ThinkSystem 32GB TruDDR4 3200 MHz (2Rx4 1.2V) RDIMM	16
B8NW	ThinkSystem RAID 940-8i 8GB Flash PCIe Gen4 12Gb Adapter	1
B9X7	Intel VROC (VMD NVMe RAID) Intel SSD Only	1
BCFV	ThinkSystem 2.5" U.2 P5600 1.6TB Mixed Use NVMe PCIe 4.0 x4 HS SSD	2
B49C	ThinkSystem 2.5" S4510 3.84TB Read Intensive SATA 6Gb HS SSD	6
B5XH	ThinkSystem M.2 SATA 2-Bay RAID Enablement Kit	1
B919	ThinkSystem M.2 5300 480GB SATA 6Gbps Non-Hot Swap SSD (OS Drives)	2
BH8D	ThinkSystem 2U/4U 8x2.5" NVMe Backplane	1
B8LU	ThinkSystem 2U 8x2.5" SAS/SATA Backplane	1
B93E	ThinkSystem Intel I350 1GbE RJ45 4-port OCP Ethernet Adapter	1
B652	ThinkSystem Marvell QL41232 10/25GbE SFP28 2-Port PCIe Ethernet Adapter	1
B8LL	ThinkSystem 2U PCIe Gen3 x16/x8/x8 Riser 1 or 2	1
B8LR	ThinkSystem 2U PCIe Gen4 x16/x16 Slot 2&3 Riser 1 or 2	1
BHS9	ThinkSystem 1100W (230V/115V) v2 Platinum Hot-Swap Power Supply	2
BH8E	ThinkSystem 2U Performance Fan	6
BA29	ThinkSystem 1U SuperCap Cable from Riser3 to SFF RAID	1
BAJ7	ThinkSystem 2U M.2 Cable	1
BACP	ThinkSystem SR665/SR650 V2 Power Cable from MB to Front 2.5" BP	2
BH8S	ThinkSystem SR650 V2 MB PCIe 3/4 to Front 8x2.5" BP2 (NVMe4-7)SL	1
BH8T	ThinkSystem SR650 V2 MB PCIe 1/2 to Front 8x2.5" BP2 (NVMe0-3)SL	1
BETS	ThinkSystem SR650 V2 SFF C0 (RAID) to Front 8x2.5" BP1	1
B976	ThinkSystem SR650 V2 Standard Heatsink	2
BHWJ	ThinkSystem 2U MS 3FH Riser1 Cage v2	1
BHWL	ThinkSystem 2U MS 3FH Riser2 new Cage	1

Optimized container orchestration and management solutions with Lenovo systems featuring Intel 3rd Gen Xeon Scalable processors and NVMe SSDs



Why Lenovo?

Lenovo is a US\$70 billion revenue Fortune Global 500 company serving customers in 180 markets around the world. Focused on a bold vision to deliver smarter technology for all, we are developing world-changing technologies that power (through devices and infrastructure) and empower (through solutions, services and software) millions of customers every day.

For More Information

To learn more about this Lenovo solution contact your Lenovo Business Partner or visit:

<https://www.lenovo.com/us/en/servers-storage/solutions/>

References:

Lenovo ThinkAgile VX Systems

<https://lenovopress.com/lp1480-thinkagile-vx3530-g-vx5530-vx7530-vx7531>

Lenovo SR650 V2 Systems

<https://www.lenovo.com/us/en/p/servers-storage/servers/racks/thinksystem-sr650-v2/77xx7sr65v2>

Amazon AWS ECS-Anywhere

<https://aws.amazon.com/ecs/anywhere/>

Amazon AWS EKS-Anywhere

<https://aws.amazon.com/eks/eks-anywhere/>

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