



# **FSx for ONTAP Monitoring and Auto-Resizing using AWS Lambda Function**

## **NetApp Solutions**

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# FSx for ONTAP Monitoring and Auto-Resizing using AWS Lambda Function

## Overview: Monitoring and Auto-Resizing FSx for ONTAP via AWS Lambda function

FSx for ONTAP is a first-party enterprise-grade cloud storage service available on AWS that provides highly reliable, scalable, high-performing and feature-rich file storage built on the popular NetApp ONTAP file system.

FSx for ONTAP provides a seamless deployment and management experience. No storage expertise is required to get started. To simplify monitoring, an AWS lambda function (to automate resizing of total storage capacity, volume size or LUN size based on threshold) can be used. This document provides a step-by-step guide to creating an automated setup that monitors FSx for ONTAP at regular intervals, notifies and resizes when a user-specified threshold is crossed and notifies the administrator of the resizing activity.

### Features

The solution provides the following features:

- Ability to monitor:
  - Usage of overall Storage Capacity of FSx for ONTAP
  - Usage of each volume (thin provisioned / thick provisioned)
  - Usage of each LUN (thin provisioned / thick provisioned)
- Ability to resize any of the above when a user-defined threshold is breached
- Alerting mechanism to receive usage warnings and resizing notifications via email
- Ability to delete snapshots older than the user-defined threshold
- Ability to get a list of FlexClone volumes and snapshots associated
- Ability to monitor the checks at a regular interval
- Ability to use the solution with or without internet access
- Ability to deploy manually or using AWS CloudFormation Template
- Ability to monitor multiple FSx for ONTAP filesystems in a single VPC

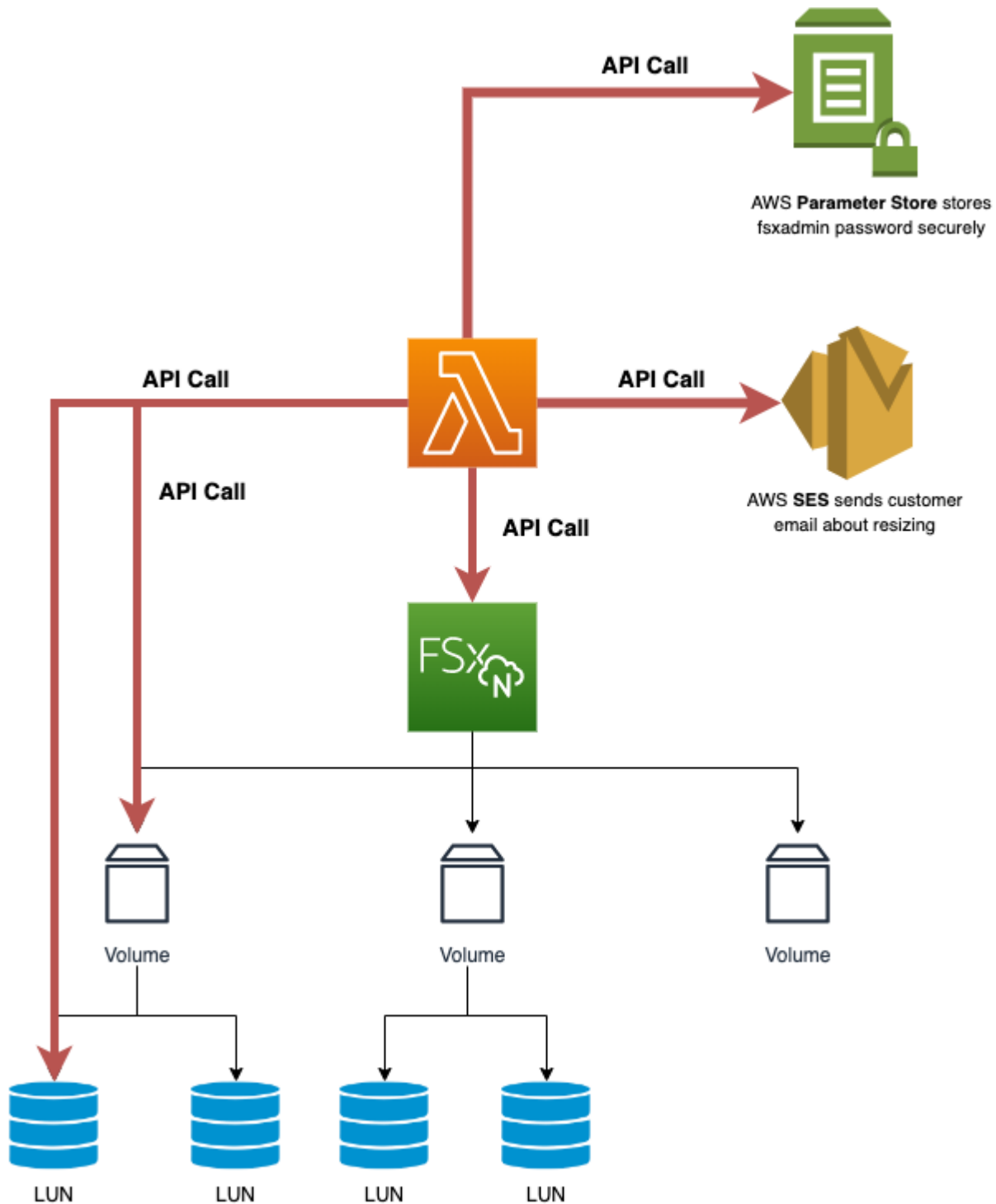
### Pre-requisites

Before you begin, ensure that the following prerequisites are met:

- FSx for ONTAP is deployed
- Private subnet with connectivity to FSx for ONTAP
- "fsxadmin" password has been set for FSx for ONTAP

## High-Level Architecture

- AWS Lambda Function makes API calls to FSx for ONTAP for retrieving and updating the size of Storage Capacity, Volumes and LUNs.
- "fsxadmin" password stored as secure string in AWS SSM Parameter Store for an added layer of security.
- AWS SES (Simple Email Service) is used to notify end-users when a resizing event occurs.
- If deploying the solution in a VPC without internet access, VPC Endpoints for AWS SSM, FSx and SES are set up to allow Lambda to reach these services via AWS internal network.



# Solution Deployment

## Automated Deployment



Covers single FSx for ONTAP filesystem.

Follow the series of steps to complete the automated deployment of this solution:

### Step 1: Clone the GitHub repository

Clone the GitHub repository on your local system:

```
git clone https://github.com/NetApp/fsxn-monitoring-auto-resizing.git
```

## Step 2: Setup an AWS S3 bucket

1. Navigate to AWS Console > **S3** and click on **Create bucket**. Create the bucket with the default settings.
2. Once inside the bucket, click on **Upload** > **Add files** and select **Utilities.zip** from the cloned GitHub repository on your system.

The screenshot shows the AWS S3 console interface. At the top, there's a navigation bar with the AWS logo, 'Services', a search bar, and a '[Option+S]' shortcut. Below the navigation bar, the breadcrumb trail reads 'Amazon S3 > Buckets > vedant-fsx-bucket > Upload'. The main heading is 'Upload' with an 'Info' link. A message states: 'Add the files and folders you want to upload to S3. To upload a file larger than 160GB, use the AWS CLI, AWS SDK or Amazon S3 REST API. [Learn more](#)'. Below this is a dashed box with the text: 'Drag and drop files and folders you want to upload here, or choose **Add files** or **Add folder**.' The 'Files and folders' section shows '1 Total, 27.4 MB'. It includes buttons for 'Remove', 'Add files', and 'Add folder'. A note says 'All files and folders in this table will be uploaded.' There's a search bar 'Find by name' and a pagination control '< 1 >'. A table lists the uploaded file:

<input type="checkbox"/>	Name	Folder	Type	Size
<input type="checkbox"/>	Utilities.zip	-	application/zip	27.4 MB

The 'Destination' section shows the path 's3://vedant-fsx-bucket' and a section for 'Destination details' with the text 'Bucket settings that impact new objects stored in the specified destination.'

### Step 3: AWS SES SMTP Setup (required if no internet access available)

Follow this step if you want to deploy the solution without internet access (Note: There will be added costs associated with VPC endpoints being set up.)

1. Navigate to AWS Console > **AWS Simple Email Service (SES)** > **SMTP Settings** and click on **Create SMTP credentials**
2. Enter an IAM User Name or leave it at the default value and click on **Create User**. Save the **SMTP user name** and **SMTP password** for further use.



Skip this step if SES SMTP setup is already in place.

#### Specify user details

##### Create user for SMTP

Create an IAM user with SMTP credentials for SMTP authentication with Amazon SES.

User name

ses-smtp-user.20230904-201255

The user name can have up to 64 characters. Valid characters: A-Z, a-z, 0-9, and \* , \_ , @ , - (hyphen)

##### Permissions policy for user

This permissions policy gives the user permissions to access AWS SES.

```
1- {  
2-   "Version": "2012-10-17",  
3-   "Statement": [  
4-     {  
5-       "Effect": "Allow",  
6-       "Action": "ses:SendRawEmail",  
7-       "Resource": "*" }  
8-   ]  
9- }  
10 }
```

##### Tags - optional

Tags are key-value pairs you can add to AWS resources to help identify, organize, or search for resources. Choose any tags you want to associate with this user.

No tags associated with the resource.

Add new tag

You can add up to 50 more tags.

Cancel

Create user

## Step 4: AWS CloudFormation Deployment

1. Navigate to AWS Console > **CloudFormation** > Create stack > With New Resources (Standard).

```
Prepare template: Template is ready
Specify template: Upload a template file
Choose file: Browse to the cloned GitHub repo and select fsxn-
monitoring-solution.yaml
```

The screenshot shows the 'Create stack' wizard in the AWS CloudFormation console. The left sidebar indicates the current step is 'Step 1: Create stack'. The main content area is titled 'Create stack' and contains a 'Prerequisite - Prepare template' section. Under 'Prepare template', the 'Template is ready' radio button is selected. Below this is the 'Specify template' section, which includes a 'Template source' section where 'Upload a template file' is selected. The 'Upload a template file' section shows a 'Choose file' button and the filename 'fsxn-monitoring-solution.yaml'. At the bottom, the 'S3 URL' is displayed, and a 'View in Designer' button is available. 'Cancel' and 'Next' buttons are at the bottom right.

Click on Next

2. Enter the stack details. Click on Next and check the checkbox for "I acknowledge that AWS CloudFormation might create IAM resources" and click on Submit.



If "Does VPC have internet access?" is set to False, "SMTP Username for AWS SES" and "SMTP Password for AWS SES" are required. Otherwise, they can be left empty.

The screenshot shows the 'Specify stack details' step of the 'Create stack' wizard. The left sidebar indicates the current step is 'Step 2: Specify stack details'. The main content area is titled 'Specify stack details' and contains a 'Stack name' section where 'DemoFxnMonitoringSolution' is entered. Below this is the 'Parameters' section, which includes a 'Network Configuration' section. The 'Network Configuration' section has three dropdown menus: 'VPC', 'Private Subnet 1', and 'Private Subnet 2'. The 'VPC' dropdown is currently set to 'vpc-'. The 'Private Subnet 1' and 'Private Subnet 2' dropdowns are currently set to 'subnet-'. The 'Cancel' and 'Next' buttons are at the bottom right.



**FSx for ONTAP Configuration**

**Management IP address**  
Enter the "Management endpoint - IP address" from the FSx for ONTAP console on AWS.

10.10.10.10

**File System ID**  
Enter the "File system ID" from the FSx for ONTAP console on AWS.

fs-██████████

**ONTAP Administrator Username**  
Enter the FSx for ONTAP "ONTAP administrator username" from FSx for ONTAP console on AWS.

fsxadmin

**Password for ONTAP Administrator Account**  
Enter the password set for ONTAP Administrator user for FSx for ONTAP.

\*\*\*\*\*

**Resize Threshold (%)**  
Enter the threshold percentage from 0-100. This threshold will be used to measure Storage Capacity, Volume and LUN usage and when the % use of any increases above this threshold, resize activity will occur.

90

**Enable Warning Notifications**  
Set this variable to True to receive notification when Storage Capacity/Volume/LUN usage exceeds 75% but is less than threshold.

True

**Enable Snapshot Deletion**  
Set this variable to True to enable volume level snapshot deletion for snapshots older than the value specified in "Snapshot Age Threshold for Deletion (No. of Days)".

True

**Snapshot Age Threshold for Deletion (No. of Days)**  
Enter the number of days of volume level snapshots you want to retain. Any snapshots older than the value provided will be deleted and the same will be notified via email.

30

**General Configuration**

**S3 Bucket Name**  
Enter the name of the S3 Bucket where paramiko.zip and requests.zip is uploaded. Ensure S3 key for paramiko.zip is paramiko.zip and for requests.zip is requests.zip.

DemoFSxMonitoringBucket

**Does VPC have Internet access?**  
Set this variable to True if the VPC used for deploying this solution has access to Internet. Set to False otherwise.

True

**Does SSM VPC Endpoint already exist for the selected VPC?**  
If Internet access is not available, set this variable to True if the VPC Endpoint for SSM already exists in the VPC. Set to False otherwise.

False

**Does FSx VPC Endpoint already exist for the selected VPC?**  
If Internet access is not available, set this variable to True if the VPC Endpoint for FSx already exists in the VPC. Set to False otherwise.

False

**Does SES VPC Endpoint already exist for the selected VPC?**  
If Internet access is not available, set this variable to True if the VPC Endpoint for SES already exists in the VPC. Set to False otherwise.

False

**SMTP Username for AWS SES**  
If Internet access is not available, enter the smtp username for AWS SES.

Enter String

**SMTP Password for AWS SES**  
If Internet access is not available, enter the smtp password for AWS SES.

Enter String

**Sender Email ID**  
Enter the email ID registered on SES that will be used by the lambda function to send notification alerts related to monitoring and resizing.

abc@xyz.com

**Receiver Email ID**  
Enter the email ID on which you want to receive the alert notifications.

abc@xyz.com

**Schedule Expression for frequency of running the solution**  
Self-trigger your target on an automated schedule using Cron or rate expressions. Cron expressions are in UTC. e.g. rate(1 day), cron(0 17 ? \* MON-FRI ?).

rate(1 day)

Cancel Previous **Next**

- Once the CloudFormation deployment starts, the email ID mentioned in the "sender email ID" will get an email asking them to authorize the use of the email address with AWS SES. Click on the link to verify the email address.
- Once the CloudFormation stack deployment is completed, if there are any warnings/notifications, an email will be sent to the recipient email ID with the notification details.

## FSx for ONTAP Monitoring

### File System Storage Capacity Notification

Storage Capacity used is greater than 90%. File System Storage Capacity resized to: 1240 GB

### Volume Notification

Volume Name	Use %	Notification Type	Updated Size
clonevol3	88.39%	Warning	
vol2	88.39%	Warning	
clonevol2	88.39%	Warning	
vol1	78.43%	Warning	

### Snapshot Notification

Snapshot Name	Volume Name	Snapshot Age	Space Freed Up	Status
clone_clonevol2.2023-03-22_095434.0	vol2	1 day	296KB	Deleted
clone_clonevol3.2023-03-22_170720.0	clonevol2	1 day	392KB	Deleted

### Clone Information

Volume Name	Parent Snapshot	Snapshot Size
clonevol2	clone_clonevol3.2023-03-22_170720.0	392.0KB
vol2	clone_clonevol2.2023-03-22_095434.0	296.0KB

## Manual Deployment



Supports monitoring multiple FSx for ONTAP filesystems in a single VPC.

Follow the series of steps to complete the manual deployment of this solution:

### Step 1: Clone the GitHub repository

Clone the GitHub repository on your local system:

```
git clone https://github.com/NetApp/fsxn-monitoring-auto-resizing.git
```

## Step 2: AWS SES SMTP Setup (required if no internet access available)

Follow this step if you want to deploy the solution without internet access (Note: There will be added costs associated with VPC endpoints being set up.)

1. Navigate to AWS Console > **AWS Simple Email Service (SES)** > SMTP Settings and click on **Create SMTP credentials**
2. Enter an IAM User Name or leave it at the default value and click on Create. Save the username and password for further use.

### Specify user details

**Create user for SMTP**  
Create an IAM user with SMTP credentials for SMTP authentication with Amazon SES.

**User name**  
  
The user name can have up to 64 characters. Valid characters: A-Z, a-z, 0-9, and \* = , @ \_ - (hyphen)

**Permissions policy for user**  
This permissions policy gives the user permissions to access AWS SES.  

```
1 {  
2   "Version": "2012-10-17",  
3   "Statement": [  
4     {  
5       "Effect": "Allow",  
6       "Action": "ses:SendRawEmail",  
7       "Resource": "*" }  
8   ]  
9 }  
10 }
```

**Tags - optional**  
Tags are key-value pairs you can add to AWS resources to help identify, organize, or search for resources. Choose any tags you want to associate with this user.  
  
No tags associated with the resource.  

**Add new tag**

  
You can add up to 50 more tags.

Cancel Create user

### Step 3: Create SSM parameter for fsxadmin password

Navigate to AWS Console > **Parameter Store** and click on **Create Parameter**.

```
Name: <Any name/path for storing fsxadmin password>
Tier: Standard
Type: SecureString
KMS key source: My current account
    KMS Key ID: <Use the default one selected>
Value: <Enter the password for "fsxadmin" user configured on FSx for
ONTAP>
```

Click on **Create parameter**.

Repeat the above steps for all FSx for ONTAP filesystems to be monitored.

The screenshot shows the AWS Console interface for creating a new parameter. The breadcrumb navigation indicates the path: AWS Systems Manager > Parameter Store > Create parameter. The 'Create parameter' page has a 'Parameter details' section with the following fields and options:

- Name:** A text input field containing `/fsxn/password/`.
- Description — Optional:** An empty text input field.
- Tier:** Two radio button options: **Standard** (selected) and **Advanced**. The Standard tier description is: "Limit of 10,000 parameters. Parameter value size up to 4 KB. Parameter policies are not available. No additional charge." The Advanced tier description is: "Can create more than 10,000 parameters. Parameter value size up to 8 KB. Parameter policies are available. Charges apply."
- Type:** Three radio button options: **String**, **StringList**, and **SecureString** (selected). The SecureString option description is: "Encrypt sensitive data using KMS keys from your account or another account."
- KMS key source:** Two radio button options: **My current account** (selected) and **Another account**. The 'My current account' option description is: "Use the default KMS key for this account or specify a customer-managed key for this account. [Learn more](#)".
- KMS Key ID:** A dropdown menu showing `alias/aws/ssm` and a refresh button.
- Value:** A text input field with masked characters (asterisks).

A blue information box at the bottom of the 'KMS Key ID' section contains the following text: "You have selected the default AWS managed key. All users in the current AWS account and Region will have access to this parameter. To restrict access to the parameter, use a customer managed key (CMK) instead. [Learn more](#)".

Perform the same steps for storing smtp username and smtp password if deploying the solution without internet access. Otherwise, skip adding these 2 parameters.

## Step 4: Setup Email Service

Navigate to AWS Console > **Simple Email Service (SES)** and click on **Create Identity**.

Identity type: Email address

Email address: <Enter an email address to be used for sending resizing notifications>

Click on **Create identity**

The email ID mentioned in the "sender email ID" will get an email asking the owner to authorize the use of the email address with AWS SES. Click on the link to verify the email address.

The screenshot shows the AWS Management Console interface. At the top, there's a navigation bar with the AWS logo, 'Services', a search bar, and a '[Option+S]' button. Below this is a 'Resource Groups & Tag Editor' link. The main content area has a breadcrumb trail: 'Amazon SES > Configuration: Verified identities > Create identity'. The title 'Create identity' is prominently displayed, followed by a descriptive paragraph about verified identities. The 'Identity details' section contains two radio buttons for 'Identity type': 'Domain' and 'Email address'. The 'Email address' option is selected. Below this is a text input field containing 'abc@xyz.com'. A checkbox for 'Assign a default configuration set' is also present. The 'Tags' section at the bottom indicates 'No tags associated with the resource' and includes an 'Add new tag' button. At the very bottom right, there are 'Cancel' and 'Create identity' buttons.

aws Services Search [Option+S]  
Resource Groups & Tag Editor

Amazon SES > Configuration: Verified identities > Create identity

### Create identity

A *verified identity* is a domain, subdomain, or email address you use to send email through Amazon SES. Identity verification at the domain level extends to all email addresses under one verified domain identity.

#### Identity details [Info](#)

**Identity type**

☐ Domain  
To verify ownership of a domain, you must have access to its DNS settings to add the necessary records.

☒ **Email address**  
To verify ownership of an email address, you must have access to its inbox to open the verification email.

**Email address**

abc@xyz.com

Email address can contain up to 320 characters, including plus signs (+), equals signs (=) and underscores (\_).

☐ **Assign a default configuration set**  
Enabling this option ensures that the assigned configuration set is applied to messages sent from this identity by default whenever a configuration set isn't specified at the time of sending.

#### Tags - optional [Info](#)

You can add one or more tags to help manage and organize your resources, including identities.

No tags associated with the resource.

**Add new tag**

You can add 50 more tags.

Cancel **Create identity**

### Step 5: Setup VPC Endpoints (required if no internet access is available)



Required only if deployed without internet access. There will be additional costs associated with VPC endpoints.

1. Navigate to AWS Console > **VPC** > **Endpoints** and click on **Create Endpoint** and enter the following details:

```
Name: <Any name for the vpc endpoint>
Service category: AWS Services
Services: com.amazonaws.<region>.fsx
vpc: <select the vpc where lambda will be deployed>
subnets: <select the subnets where lambda will be deployed>
Security groups: <select the security group>
Policy: <Either choose Full access or set your own custom policy>
```

Click on Create endpoint.

[VPC](#) > [Endpoints](#) > Create endpoint

## Create endpoint [Info](#)

There are three types of VPC endpoints – Interface endpoints, Gateway Load Balancer endpoints, and Gateway endpoints. Interface endpoints and Gateway Load Balancer endpoints are powered by AWS PrivateLink, and use an Elastic Network Interface (ENI) as an entry point for traffic destined to the service. Interface endpoints are typically accessed using the public or private DNS name associated with the service, while Gateway endpoints and Gateway Load Balancer endpoints serve as a target for a route in your route table for traffic destined for the service.

### Endpoint settings

#### Name tag - optional

Creates a tag with a key of 'Name' and a value that you specify.

#### Service category

Select the service category



##### AWS services

Services provided by Amazon



##### PrivateLink Ready partner services

Services with an AWS Service Ready designation



##### AWS Marketplace services


Services that you've purchased through AWS Marketplace



##### Other endpoint services

Find services shared with you by service name

### Services (1/1)

< 1 >  

Service Name	Owner	Type
 com.amazonaws.us-west-1.fsx	amazon	Interface

## VPC

Select the VPC in which to create the endpoint

### VPC

The VPC in which to create your endpoint.

vpc- [REDACTED] (DemoFSxN-vpc) ▼



► Additional settings

### Subnets ( 2/2 ) Info

<input checked="" type="checkbox"/>	Availability Zone ▼	Subnet ID ▼
<input checked="" type="checkbox"/>	us-west-1a (usw1-az3)	subnet-[REDACTED] ▼
<input checked="" type="checkbox"/>	us-west-1b (usw1-az1)	subnet-[REDACTED] ▼

subnet-[REDACTED] ✕  
DemoFSxN-subnet-private1-us-west-1a

subnet-[REDACTED] ✕  
DemoFSxN-subnet-private2-us-west-1b

#### IP address type

- ☒ IPv4  
☐ IPv6  
☐ Dualstack

### Security groups (1/1) Info

Find resources by attribute or tag

< 1 > ⚙

<input checked="" type="checkbox"/>	Group ID ▼	Group name ▼	VPC ID ▼
<input checked="" type="checkbox"/>	sg-[REDACTED]	default	vpc-[REDACTED]

sg-[REDACTED] ✕

- Follow the same process for creating SES and SSM VPC endpoints. All parameters remain the same as above except Services which will correspond to **com.amazonaws.<region>.smtp** and **com.amazonaws.<region>.ssm** respectively.



## Step 6: Create and setup the AWS Lambda Function

1. Navigate to AWS Console > **AWS Lambda > Functions** and click on **Create function** in the same region as FSx for ONTAP
2. Use the default **Author from scratch** and update the following fields:

Function name: <Any name of your choice>  
Runtime: Python 3.9  
Architecture: x86\_64  
Permissions: Select "Create a new role with basic Lambda permissions"  
Advanced Settings:  
    Enable VPC: Checked  
        VPC: <Choose either the same VPC as FSx for ONTAP or a VPC that can access both FSx for ONTAP and the internet via a private subnet>  
        Subnets: <Choose 2 private subnets that have NAT gateway attached pointing to public subnets with internet gateway and subnets that have internet access>  
        Security Group: <Choose a Security Group>

Click on **Create function**.

Resource Groups & Tag Editor

Advanced settings

☐ **Enable Code signing** [info](#)  
Use code signing configurations to ensure that the code has been signed by an approved source and has not been altered since signing.

☐ **Enable function URL** [info](#)  
Use function URLs to assign HTTPS endpoints to your Lambda function.

☐ **Enable tags** [info](#)  
A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources, track your AWS costs, and enforce attribute-based access control.

☒ **Enable VPC** [info](#)  
Connect your function to a VPC to access private resources during invocation.

**VPC**  
Choose a VPC for your function to access.

vpc: [selected VPC]

**Subnets**  
Select the VPC subnets for Lambda to use to set up your VPC configuration.

Choose subnets

subnet: [selected subnet] us-east-1a X subnet: [selected subnet] us-east-1d X

**Security groups**  
Choose the VPC security groups for Lambda to use to set up your VPC configuration. The table below shows the inbound and outbound rules for the security groups that you choose.

Choose security groups

sg: [selected security group] X  
default VPC security group

3. Navigate to the newly created Lambda function > Scroll down to the **Layers** section and click on **Add a layer**.

**Layers** [info](#) Edit Add a layer

Merge order	Name	Layer version	Compatible runtimes	Compatible architectures	Version ARN
There is no data to display.					

4. Click on **create a new layer** under **Layer source**
5. Create a Layer and upload **Utilities.zip** file. Select **Python 3.9** as the compatible runtime and click on **Create**.

aws

Services

Search

[Option+S]

Lambda > Layers > Create layer

## Create layer

### Layer configuration

Name

Utilities

Description - optional

Paramiko and Requests Libraries

☒ Upload a .zip file

☐ Upload a file from Amazon S3

Upload

Utilities.zip  
28.70 MB

For files larger than 10 MB, consider uploading using Amazon S3.

Compatible architectures - optional Info

Choose the compatible instruction set architectures for your layer.

☐ x86\_64

☐ arm64

Compatible runtimes - optional Info

Choose up to 15 runtimes.

Runtimes

Python 3.9

License - optional Info

6. Navigate back to AWS Lambda function > **Add Layer** > **Custom Layers** and add the utilities layer.

Services
Search
[Option+S]

Lambda > Layers > Add layer

## Add layer

### Function runtime settings

Runtime	Architecture
Python 3.9	x86_64

### Choose a layer

**Layer source** [Info](#)

Choose from layers with a compatible runtime and instruction set architecture or specify the Amazon Resource Name (ARN) of a layer version. You can also [create a new layer](#).

☐ **AWS layers**  
Choose a layer from a list of layers provided by AWS.

☒ **Custom layers**  
Choose a layer from a list of layers created by your AWS account or organization.

☐ **Specify an ARN**  
Specify a layer by providing the ARN.

#### Custom layers

Layers created by your AWS account or organization that are compatible with your function's runtime.

Utilities

Version  
2

Cancel
Add

Layers
[Info](#)

Edit
Add a layer

Merge order	Name	Layer version	Compatible runtimes	Compatible architectures	Version ARN
1	Utilities	2	python3.9	-	arn:aws:lambda:us-east-1:██████████:layer:Utilities:2

- Navigate to the **Configuration** tab of the Lambda function and click on **Edit** under **General Configuration**. Change the Timeout to **5 mins** and click **Save**.
- Navigate to **Permissions** tab of the Lambda function and click on the role assigned. In the permissions tab of the role, click on **Add permissions > Create Inline policy**.
  - Click on the JSON tab and paste the contents of the file policy.json from the GitHub repo.
  - Replace every occurrence of `${AWS::AccountId}` with your account ID and click on **Review Policy**
  - Provide a Name for the policy and click on **Create policy**
- Copy the contents of `fsxn_monitoring_resizing_lambda.py` from the git repo to `lambda_function.py` in the AWS Lambda function Code Source section.
- Create a new file in the same level as `lambda_function.py` and name it `vars.py` and copy the contents of vars.py from the git repo to the lambda function vars.py file. Update the variable values in vars.py. Reference variable definitions below and click on **Deploy**:

Name	Type	Description
<b>fsxList</b>	List	(Required) List of all FSx for ONTAP filesystems to be monitored. Include all the file systems in the list for monitoring and auto-resizing.
<b>fsxMgmtIp</b>	String	(Required) Enter the "Management endpoint - IP address" from the FSx for ONTAP console on AWS.
<b>fsxId</b>	String	(Required) Enter the "File system ID" from the FSx for ONTAP console on AWS.
<b>username</b>	String	(Required) Enter the FSx for ONTAP "ONTAP administrator username" from FSx for ONTAP console on AWS.
<b>resize_threshold</b>	Integer	(Required) Enter the threshold percentage from 0-100. This threshold will be used to measure Storage Capacity, Volume and LUN usage and when the % use of any increases above this threshold, resize activity will occur.
<b>fsx_password_ssm_parameter</b>	String	(Required) Enter the path name used in AWS Parameter Store for storing "fsxadmin" password.
<b>warn_notification</b>	Bool	(Required) Set this variable to True to receive a notification when Storage Capacity/Volume/LUN usage exceeds 75% but is less than the threshold.
<b>enable_snapshot_deletion</b>	Bool	(Required) Set this variable to True to enable volume level snapshot deletion for snapshots older than the value specified in "snapshot_age_threshold_in_days".
<b>snapshot_age_threshold_in_days</b>	Integer	(Required) Enter the number of days of volume level snapshots you want to retain. Any snapshots older than the value provided will be deleted and the same will be notified via email.

<b>internet_access</b>	Bool	(Required) Set this variable to True if internet access is available from the subnet where this lambda is deployed. Otherwise set it to False.
<b>smtp_region</b>	String	(Optional) If "internet_access" variable is set to False, enter the region in which lambda is deployed. E.g. us-east-1 (in this format)
<b>smtp_username_ssm_parameter</b>	String	(Optional) If "internet_access" variable is set to False, enter the path name used in AWS Parameter Store for storing the SMTP username.
<b>smtp_password_ssm_parameter</b>	String	(Optional) If "internet_access" variable is set to False, enter the path name used in AWS Parameter Store for storing the SMTP password.
<b>sender_email</b>	String	(Required) Enter the email ID registered on SES that will be used by the lambda function to send notification alerts related to monitoring and resizing.
<b>recipient_email</b>	String	(Required) Enter the email ID on which you want to receive the alert notifications.

```

1 # Copyright NetApp 2023. Developed by NetApp Solutions Engineering Team
2 #
3 # Description: This Lambda function can be used to automate the monitoring and autoscaling of
4 # FSX ONTAP Storage Capacity based on volume usage.
5 # Pre-requisites for running this template
6 # - Create lambda in a private subnet with nat gateway for internet access
7 # - Update all values in vars.py with the required inputs.
8 # - FSX File System and Volumes should be created with FSX API password set.
9 # - Ensure that Lambda function has connectivity to FSX by attaching FSX VPC and subnets to lambda with appropriate security group.
10 # - Increase the default timeout for Lambda function from 3 secs. to 5 mins.
11 # - Create a new requests layer and a prometheus layer for this lambda function with python 3.9. (Use the zip files to create the layers)
12 # - Create a new trigger with event bridge and select schedule expression and enter rate(1 day) to ensure this function runs once every day.
13 # - Allow lambda to create the default role while creating lambda function and add a new inline policy using "policy.txt" file in this folder. Ensure to replace "${AWS::AccountId}" with your account ID.
14 # - Ensure that the Sender Email is verified in Amazon SES before using it in this lambda function.
15 # - Save the password for fsxadmin in SSM parameter store and provide the path in fsx_password_ssm_parameter variable in vars.py.
16 import json
17 import requests
18 requests.packages.urllib3.disable_warnings()
19 import base64
20 import logging
21 import vars
22 import math
23 import time
24 logger = logging.getLogger()
25 logger.setLevel(logging.INFO)
26 import boto3
27 import botoecore
28 import paramiko
29 import re
30 def lambda_handler(event, context):
31
32     #Retrieve fsx password

```

- Click on **Test**, create a test event with an empty JSON object and run the test by clicking **Invoke** to check if the script is running properly.
- Once tested successfully, navigate to **Configuration > Triggers > Add Trigger**.

Select a Source: EventBridge  
Rule: Create a new rule  
Rule name: <Enter any name>  
Rule type: Schedule expression  
Schedule expression: <Use "rate(1 day)" if you want the function to run daily or add your own cron expression>

Click on Add.

## Conclusion

With the provided solution, it is easy to set up a monitoring solution that regularly monitors FSx for ONTAP Storage, resizes it based on a user-specified threshold and provides an alerting mechanism. This makes the process of using and monitoring FSx for ONTAP seamless freeing up administrators to focus on business-critical activities while storage grows automatically when required.

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