



# **File System Analytics**

## **ONTAP 9**

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# File System Analytics

## File System Analytics overview

File System Analytics (FSA) was first introduced in ONTAP 9.8 to provide real-time visibility into file usage and storage capacity trends inside ONTAP FlexGroup or FlexVol volumes. This native capability eliminates the need for external tools and provides key insights into how your storage is utilized and whether there are opportunities to optimize the storage for your business needs.

With FSA, you have visibility at all levels of a volume's file system hierarchy in NAS. For example, you can gain usage and capacity insights at the Storage VM (SVM), volume, directory, and file levels. You can use FSA to answer questions like:

- What is filling up my storage, and are there any large files I can move to another storage location?
- Which are my most active volumes, directories, and files? Is my storage performance optimized for the needs of my users?
- How much data was added in the last month?
- Who are my most active or least active storage users?
- How much inactive or dormant data is on my primary storage? Can I move that data to a lower cost cold tier?
- Will my planned quality-of-service changes negatively impact access to critical, frequently accessed files?

File System Analytics is integrated into ONTAP System Manager. Views within System Manager provide:

- Real-time visibility for effective data management and operation
- Real-time data collection and aggregation
- Subdirectory and file sizes and counts, together with associated performance profiles
- File age histograms for modify and access histories



## Supported volume types

File System Analytics is designed to provide visibility on volumes with active NAS data, with the exception of FlexCache caches and SnapMirror destination volumes.

## File System Analytics feature availability

Each ONTAP release expands the scope of File System Analytics.

|   | ONTAP 9.13.1 | ONTAP 9.12.1 | ONTAP 9.11.1 | ONTAP 9.10.1 | ONTAP 9.9.1 | ONTAP 9.8 |
|---|--------------|--------------|--------------|--------------|-------------|-----------|
| Visualization in System Manager                         | X            | X            | X            | X            | X           | X         |
| Capacity analytics                                      | X            | X            | X            | X            | X           | X         |
| Inactive data information                               | X            | X            | X            | X            | X           | X         |
| Support for volumes transitioned from Data ONTAP 7-Mode | X            | X            | X            | X            | X           |           |
| Ability to customize inactive period in System Manager  | X            | X            | X            | X            | X           |           |
| Volume-level Activity Tracking                          | X            | X            | X            | X            |             |           |

|   | ONTAP 9.13.1 | ONTAP 9.12.1 | ONTAP 9.11.1 | ONTAP 9.10.1 | ONTAP 9.9.1 | ONTAP 9.8 |
|---|--------------|--------------|--------------|--------------|-------------|-----------|
| Download Activity Tracking data to CSV            | X            | X            | X            | X            |             |           |
| SVM-level Activity Tracking                       | X            | X            | X            |              |             |           |
| Timeline  | X            | X            | X            |              |             |           |
| Usage Analytics                                   | X            | X            |              |              |             |           |
| Option to enable File System Analytics by default | X            |              |              |              |             |           |

## Learn more about File System Analytics

### ONTAP File System Analytics

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### Further Reading

- [TR 4687: Best-practice guidelines for ONTAP File System Analytics](#)
- [Knowledge Base: High or fluctuating latency after turning on NetApp ONTAP File System Analytics](#)

## Enable File System Analytics

To collect and display usage data such as capacity analytics, you need to enable File System Analytics on a volume.

### About this task

- Beginning with ONTAP 9.8, you can enable File System Analytics on a new or existing volume. If you upgrade a system to ONTAP 9.8 or later, ensure that all upgrade processes have completed before you enable File System Analytics.

- Depending on the size and contents of the volume, enabling analytics may take time while ONTAP processes existing data in the volume. System Manager displays progress and presents analytics data when complete. If you need more precise information about initialization progress, you can use the ONTAP CLI command `volume analytics show`.

For additional considerations related to the initialization scan, see [Scan considerations](#).

## Steps

You can enable File System Analytics with ONTAP System Manager or the CLI.

### System Manager

| In ONTAP 9.8 and 9.9.1   | Beginning in ONTAP 9.10.1   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Select <b>Storage &gt; Volumes</b>.</li> <li>2. Select the desired volume, then select <b>Explorer</b>.</li> <li>3. Select <b>Enable Analytics</b> or <b>Disable Analytics</b>.</li> </ol> | <ol style="list-style-type: none"> <li>1. Select <b>Storage &gt; Volumes</b>.</li> <li>2. Select the desired volume. From the individual volume menu, select <b>File System &gt; Explorer</b>.</li> <li>3. Select <b>Enable Analytics</b> or <b>Disable Analytics</b>.</li> </ol> |

### CLI

#### Enable File System Analytics with the CLI

1. Run the following command:  

```
volume analytics on -vserver svm_name -volume volume_name [-foreground {true|false}]
```

By default, the command runs in the foreground; ONTAP displays progress and presents analytics data when complete. If you need more precise information, you can run the command in the background by using the `-foreground false` option and then use the `volume analytics show` command to display initialization progress in the CLI.
2. After successfully enabling File System Analytics, use System Manager or the ONTAP REST API to display the analytic data.

## Modify default File System Analytics settings

Beginning in ONTAP 9.13.1, you can modify SVM or clusters settings to enable File System Analytics by default on new volumes.

## System Manager

If you are using System Manager, you can modify the storage VM or cluster settings to enable capacity analytics and Activity Tracking at volume creation by default. Default enablement only applies to volumes created after you modify the settings, not existing volumes.

### Modify File System Analytics settings on a cluster

1. In System Manager, navigate to **Cluster settings**.
2. In **Cluster settings**, review the File System Settings tab. To modify the settings, select the  icon.
3. In the **Activity Tracking** field, enter the names of the SVMs to enable Activity Tracking for by default. Leaving the field blank will leave Activity Tracking disabled on all SVMs.

Uncheck the **Enable on new storage VMs** box to disable Activity Tracking by default on new storage VMs.

4. In the **Analytics** field, enter the names of the storage VMs you want capacity analytics enabled for by default. Leaving the field blank will leave capacity analytics disabled on all SVMs.

Uncheck the **Enable on new storage VMs** box to disable capacity analytics by default on new storage VMs.

5. Select **Save**.

### Modify File System Analytics settings on an SVM

1. Select the SVM you want to modify then **Storage VM settings**.
2. In the **File System Analytics** card, use the toggles to enable or disable Activity Tracking and capacity analytics for all new volumes on the storage VM.

## CLI

You can configure the storage VM to enable File System Analytics by default on new volumes using the ONTAP CLI.

### Enable File System Analytics by default on an SVM

1. Modify the SVM to enable capacity analytics and Activity Tracking by default on all newly created volumes:  

```
vserver modify -vserver svm_name -auto-enable-activity-tracking true -auto-enable-analytics true
```

## View file system activity

After File System Analytics (FSA) is enabled, you can view the root directory contents of a selected volume sorted by the space used in each subtree.

Select any file system object to browse the file system and to display detailed information about each object in a directory. Information about directories can also be displayed graphically. Over time, historical data is displayed for each subtree. Space used is not sorted if there are more than 3000 directories.

## Explorer

The File System Analytics **Explorer** screen consists of three areas:

- Tree view of directories and subdirectories; expandable list showing name, size, modify history, and access history.
- Files; showing name, size, and accessed time for the object selected in the directory list.
- Active and inactive data comparison for the object selected in the directory list.

Beginning with ONTAP 9.9.1, you can customize the range to be reported. The default value is one year. Based on these customizations, you can take corrective actions, such as moving volumes and modifying the tiering policy.

Accessed time is shown by default. However, if the volume default has been altered from the CLI (by setting the `-atime-update` option to `false` with the `volume modify` command), then only last modified time is shown. For example:

- The tree view will not display the **access history**.
- The files view will be altered.
- The active/inactive data view will be based on modified time (`mtime`).

Using these displays, you can examine the following:

- File system locations consuming the most space
- Detailed information about a directory tree, including file and subdirectory count within directories and subdirectories
- File system locations that contain old data (for example, scratch, temp, or log trees)

Keep the following points in mind when interpreting FSA output:

- FSA show where and when your data is in use, not how much data is being processed. For example, large space consumption by recently accessed or modified files does not necessarily indicate high system processing loads.
- The way that the **Volume Explorer** tab calculates space consumption for FSA might differ from other tools. In particular, there could be significant differences compared to the consumption reported in the **Volume Overview** if the volume has storage efficiency features enabled. This is because the **Volume Explorer** tab does not include efficiency savings.
- Due to space limitations in the directory display, it is not possible to view a directory depth greater than 8 levels in the *List View*. To view directories more than 8 levels deep, you must switch to *Graphical View*, locate the desired directory, then switch back to *List View*. This will allow additional screen space in the display.

### Steps

1. View the root directory contents of a selected volume:

| In ONTAP 9.8 and 9.9.1  | Beginning in ONTAP 9.10.1  |
|---|--|
| Click <b>Storage &gt; Volumes</b> , select the desired volume, then click <b>Explorer</b> . | Select <b>Storage &gt; Volumes</b> , select the desired volume. From the individual volume menu, select <b>File System &gt; Explorer</b> . |



# Enable Activity Tracking

Beginning with ONTAP 9.10.1, File System Analytics includes an Activity Tracking feature that allows you to identify hot objects and download the data as a CSV file. Beginning with ONTAP 9.11.1, Activity Tracking is expanded to the SVM scope. Also beginning in ONTAP 9.11.1, System Manager features a timeline for Activity Tracking, allowing you to look through up to five minutes of Activity Tracking data.

Activity Tracking enables monitoring in four categories:

- Directories
- Files
- Clients
- Users

For each category monitored, Activity Tracking will display read IOPs, write IOPs, read throughputs, and write throughputs. Queries on Activity Tracking refresh every 10 to 15 seconds pertaining to hot spots seen in the system over the previous five-second interval.

Activity tracking information is approximate, and the accuracy of the data depends on the distribution of the incoming I/O traffic.

When viewing Activity Tracking in System Manager at the volume level, only the menu of the expanded volume will actively refresh. If the view of any volumes are collapsed, they will not refresh until the volume display is expanded. You can stop the refreshes with the **Pause Refresh** button. Activity data can be downloaded in a CSV format that will display all the point-in-time data captured for the selected volume.

With the timeline feature available beginning in ONTAP 9.11.1, you can keep a record of hotspot activity on a volume or SVM, continuously updating approximately every five seconds and retaining the previous five minutes of data. Timeline data is only retained for fields that are visible area of the page. If you collapse a tracking category or scroll so the timeline is out of view, the timeline will stop collecting data. By default, timelines are disabled and will automatically be disabled when you navigate away from the Activity tab.

## Enable Activity Tracking for a single volume

You can enable Activity Tracking with ONTAP System Manager or the CLI.

### About this task

If you use RBAC with the ONTAP REST API or System Manager, you will need to create custom roles to manage access to Activity Tracking. See [Role-based access control](#) for this process.

## System Manager

### Steps

1. Select **Storage > Volumes**. Select the desired volume. From the individual volume menu, select File System and then select the Activity tab.
2. Ensure **Activity Tracking** is turned on to view individual reports on top directories, files, clients, and users.
3. To analyze data in greater depth without refreshes, select **Pause Refresh**. You can download the data to have a CSV record of the report as well.

## CLI

### Steps

1. Enable Activity Tracking:

```
volume activity-tracking on -vsserver svm_name -volume volume_name
```

2. Check if the Activity Tracking state for a volume is on or off with the command:

```
volume activity-tracking show -vsserver svm_name -volume volume_name -state
```

3. Once enabled, use ONTAP System Manager or the ONTAP REST API to display Activity Tracking data.

## Enable Activity Tracking for multiple volumes

You can enable Activity Tracking for multiple volumes at once with System Manager.

### About this task

If you use RBAC with the ONTAP REST API or System Manager, you will need to create custom roles to manage access to Activity Tracking. See [Role-based access control](#) for this process.

## System Manager

### Enable for specific volumes

1. Select **Storage > Volumes**. Select the desired volume. From the individual volume menu, select File System and then select the Activity tab.
2. Select the volumes that you want to enable Activity Tracking on. At the top of the volume list, select the **More Options** button. Select **Enable Activity Tracking**.
3. To view Activity Tracking at the SVM level, select the specific SVM you would like to view from **Storage > Volumes**. Navigate to the File System tab then Activity and you will see data for the volumes that have Activity Tracking enabled.

### Enable for all volumes

1. Select **Storage > Volumes**. Select an SVM from the menu.
2. Navigate to the **File System** tab, choose the **More** tab to enable Activity Tracking on all volumes in the SVM.

## CLI

Beginning in ONTAP 9.13.1, you can enable Activity Tracking for multiple volumes using the ONTAP CLI.

### Steps

1. Enable Activity Tracking:

```
volume activity-tracking on -vserver svm_name -volume [*|!volume_names]
```

Use **\*** to enable Activity Tracking for all volumes on the specified storage VM.

Use **!** followed by volume names to enable Activity Tracking for all volumes on the SVM except the named volumes.

2. Confirm the operation succeeded:

```
volume show -fields activity-tracking-state
```

3. Once enabled, use ONTAP System Manager or the ONTAP REST API to display Activity Tracking data.

## Enable usage analytics

Tracking directories by size enables you to capture important data about the directories in a volume using the most space. Tracking directories by size is available beginning in ONTAP 9.12.1 and provides:

- The total number of directories in the volume
- The total number of files in the volume
- A bar chart identifying the largest directories in the volume by size in descending order

Tracking for large directories will refresh every 15 minutes. File System Analytics limits reporting of large directories to the 25 directories consuming the most space.

You can monitor the most recent refresh by checking the **Last Refreshed** timestamp at the top of the page. You can additionally download tracking data to an Excel workbook with the **Download** button. The download operation will run in the background and present the most recently reported information for the selected volume.

If the scan returns without any results, ensure the volume is online. Events such as SnapRestore will cause File System Analytics to rebuild its list of large directories.

**Steps**

1. Select **Storage > Volumes**. Select the desired volume.
2. From the individual volume menu, select **File System**. Then select the **Usage** tab.
3. Toggle the **Analytics** switch to enable usage analytics.
4. System Manager will display a bar graph identifying the directories with the largest size in descending order.



ONTAP might display partial data or no data at all while the list of top directories is being collected. The progress of the scan can be in the **Usage** tab that displays during the scan.

Gain more insights about any directory by selecting the directory to go to the the Explorer tab. For more information about the **Explorer** tab, refer to [View activity on a file system](#).

## Take corrective action based on analytics

Beginning with ONTAP 9.9.1, you can take corrective actions based on current data and desired outcomes directly from the File System Analytics displays.

When analytics are enabled, you can take the following actions:

- Delete directories and files

In the Explorer display, you can select directories or individual files to delete. Directories are deleted with low-latency fast directory delete functionality. (Fast directory delete is also available beginning in ONTAP 9.9.1 without analytics enabled.)

- Assign media cost in storage tiers to compare costs of inactive data storage locations

Media cost is a value that you assign based on your evaluation of storage costs, represented as your choice of currency per GB. When set, System Manager uses the assigned media cost to project estimated savings when you move volumes.

The media cost you set is not persistent; it can only be set for a single browser session.

- Move volumes to reduce storage costs

Based on analytics displays and media cost comparisons, you can move volumes to less expensive storage in local tiers.

Only one volume at a time can be compared and moved.

| To perform this action... | Take these steps... |
|---------------------------|---------------------|
|---------------------------|---------------------|

|                                       |  |
|---------------------------------------|--|
| Delete directories or files           | <ol style="list-style-type: none"> <li>1. Click <b>Storage &gt; Volumes</b>, then click <b>Explorer</b>.</li> </ol> <p>When you hover over a file or folder, the option to delete appears. You can only delete one object at a time.</p> <div>  <p>When directories and files are deleted, the new storage capacity values are not displayed immediately.</p> </div>  |
| Enable media cost comparison          | <ol style="list-style-type: none"> <li>1. Click <b>Storage &gt; Tiers</b>, then click <b>Set Media Cost</b> in the desired local tier (aggregate) tiles.</li> </ol> <p>Be sure to select active and inactive tiers to enable comparison.</p> <ol style="list-style-type: none"> <li>2. Enter a currency type and amount.</li> </ol> <p>When you enter or change the media cost, the change is made in all media types.</p>   |
| Move volumes to a less expensive tier | <ol style="list-style-type: none"> <li>1. After enabling media cost display, click <b>Storage &gt; Tiers</b>, then click <b>Volumes</b>.</li> <li>2. To compare destination options for a volume, click  for the volume, then click <b>Move</b>.</li> <li>3. In the <b>Select Destination Local Tier</b> display, select destination tiers to display the estimated cost difference.</li> <li>4. After comparing options, select the desired tier and click <b>Move</b>.</li> </ol> |

## Role-based access control with File System Analytics

Beginning in ONTAP 9.12.1, ONTAP includes a predefined role-based access control (RBAC) role called `admin-no-fsa`. The `admin-no-fsa` role grants administrator-level privileges but prevents the user from performing operations related to the `files` endpoint (i.e. File System Analytics) in the ONTAP CLI, REST API, and in System Manager.

For more information on the `admin-no-fsa` role, refer to [Predefined roles for cluster administrators](#).

If you are using a version of ONTAP released prior to ONTAP 9.12.1, you will need to create a dedicated role to control access to File System Analytics. In versions of ONTAP prior to ONTAP 9.12.1, you must configure RBAC permissions through the ONTAP CLI or ONTAP REST API.

## System Manager

Beginning in ONTAP 9.12.1, you can configure RBAC permissions for File System Analytics using System Manager.

### Steps

1. Select **Cluster > Settings**. Under **Security**, navigate to **Users and Roles** and select [➔](#).
2. Under **Roles**, select [+ Add](#).
3. Provide a name for the role. Under Role Attributes, configure the access or restrictions for the user role by providing the appropriate [API endpoints](#). See the table below for primary paths and secondary paths to configure File System Analytics access or restrictions.

| Restriction                          | Primary Path         | Secondary Path  |
|--------------------------------------|----------------------|---|
| Activity Tracking on volumes         | /api/storage/volumes | <ul style="list-style-type: none"><li>• /:uuid/top-metrics/directories</li><li>• /:uuid/top-metrics/files</li><li>• /:uuid/top-metrics/clients</li><li>• /:uuid/top-metrics/users</li></ul> |
| Activity Tracking on SVMs            | /api/svm/svms        | <ul style="list-style-type: none"><li>• /:uuid/top-metrics/directories</li><li>• /:uuid/top-metrics/files</li><li>• /:uuid/top-metrics/clients</li><li>• /:uuid/top-metrics/users</li></ul> |
| All File System Analytics operations | /api/storage/volumes | /:uuid/files  |

You can use `/*` instead of an UUID to set the policy for all volumes or SVMs at the endpoint.

Choose the access privileges for each endpoint.

4. Select **Save**.
5. To assign the role to a user or users, see [Control administrator access](#).

### CLI

If you are using a version of ONTAP released prior to ONTAP 9.12.1, use the ONTAP CLI to create a custom-role.

### Steps

### 1. Create a default role to have access to all features.

This needs to be done before creating the restrictive role to ensure the role is only restrictive on the Activity Tracking:

```
security login role create -cmddirname DEFAULT -access all -role storageAdmin
```

### 2. Create the restrictive role:

```
security login role create -cmddirname "volume file show-disk-usage" -access none -role storageAdmin
```

### 3. Authorize roles to access the SVM's web services:

- rest for REST API calls
- security for password protection
- sysmgr for System Manager access

```
vserver services web access create -vserver svm-name -name _ -name rest -role storageAdmin
```

```
vserver services web access create -vserver svm-name -name security -role storageAdmin
```

```
vserver services web access create -vserver svm-name -name sysmgr -role storageAdmin
```

### 4. Create a user.

You must issue a distinct create command for each application you would like to apply to the user. Calling create multiple times on the same user simply applies all the applications to that one user and does not create a new user each time. The http parameter for application type applies for the ONTAP REST API and System Manager.

```
security login create -user-or-group-name storageUser -authentication -method password -application http -role storageAdmin
```

### 5. With the new user credentials, you can now log in to System Manager or use the ONTAP REST API to access File Systems Analytics data.

#### More information

- [Predefined roles for cluster administrators](#)
- [Control administrator access with System Manager](#)
- [Learn more about RBAC roles and the ONTAP REST API](#)

## Considerations for File System Analytics

You should be aware of certain usage limits and potential performance impacts associated with implementing File System Analytics.

## SVM-protected relationships

If you have enabled File System Analytics on volumes whose containing SVM is in a protection relationship, the analytics data is not replicated to the destination SVM. If the source SVM must be resynchronized in a recovery operation, you must manually reenables analytics on desired volumes after recovery.

## Performance considerations

In some cases, enabling File System Analytics could negatively impact performance during the initial metadata collection. This is most typically seen on systems that are at maximum utilization. To avoid enabling analytics on such systems, you can use ONTAP System Manager performance monitoring tools.

If you experience a notable increase in latency, refer to the Knowledge Base article [High or fluctuating latency after turning on NetApp ONTAP File System Analytics](#).

## Scan considerations

When you enable capacity analytics, ONTAP conducts an initialization scan. The scan accesses metadata for all files in volumes for which capacity analytics is enabled. No file data is read during the scan.

After the scan completes, File System Analytics is continuously updated in real time as the filesystem changes without the need to run the scan again.

The time required for the scan is proportional to the number of directories and files on the volume. Because the scan collects metadata, file size does not impact the scan time.

For more information about the initialization scan, see [TR-4867: Best practice guidelines for File System Analytics](#).

## Best practices

You should start the scan on volumes that do not share aggregates. You can see which aggregates are currently hosting which volumes using the command:

```
volume show -volume comma-separated-list_of_volumes -fields aggr-list
```

While the scan runs, volumes continue to serve client traffic. It's recommended you start the scan during periods where you anticipate lower client traffic.

If client traffic increases, it will consume system resources and cause the scan to take longer.

Beginning in ONTAP 9.12.1, you can pause data collection in System Manager and with the ONTAP CLI.

- If you are using the ONTAP CLI:
  - You can pause data collection with the command: `volume analytics initialization pause -vserver svm_name -volume volume_name`
  - Once client traffic has slowed, you can resume data collection with the command: `volume analytics initialization resume -vserver svm_name -volume volume_name`
- If you are using System Manager, in the **Explorer** view of the volume menu, you use the **Pause Data Collection** and **Resume Data Collection** buttons to manage the scan.



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