Metrics and Telemetry in Swordfish

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Abstract: This paper defines the approach, infrastructure and mechanisms to use for Swordfish implementations, to capture and store historical metrics to present to Swordfish clients in a standardized fashion, using the Redfish telemetry service.

SNIA White Paper

This document has been released and approved by the SNIA. The SNIA believes that the ideas, methodologies, and technologies described in this document accurately represent the SNIA goals and are appropriate for widespread distribution. Suggestion for revision should be directed to http://www.snia.org/feedback/.

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USAGE

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Revision History

The evolution of this document is summarized in Table 1.

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<th>Date</th>
<th>Rev</th>
<th>Notes</th>
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<tr>
<td>12 April 2022</td>
<td>1.2.4</td>
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About SNIA

The Storage Networking Industry Association (SNIA) is a non-profit organization made up of member companies spanning information technology. A globally recognized
and trusted authority, SNIA’s mission is to lead the storage industry in developing and promoting vendor-neutral architectures, standards and educational services that facilitate the efficient management, movement and security of information.

Acknowledgements

The SNIA Scalable Storage Management Technical Work Group, which developed and reviewed this white paper, would like to recognize the significant contributions made by the following members listed in Table 2.

**Table 2: Contributors**

<table>
<thead>
<tr>
<th>Member</th>
<th>Representatives (* – prior employer)</th>
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<td>Intel Corporation</td>
<td>Richelle Ahlvers</td>
</tr>
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1 Executive Summary

This paper defines the approach, infrastructure and mechanisms to use for Swordfish implementations, to capture and store historical metrics to present to Swordfish clients in a standardized fashion, using the Redfish telemetry service.

Using capacity metrics use cases, we will highlight the expected standard usage of the telemetry service to enable standard client interactions across implementations. We will also provide guidance for expected base functionality, as well as describing how the implementations can provide additional value-add capability accessible to the clients.
2 Management Demands Metrics

Storage management clients rely on detailed, historical information in several areas of the overall system to watch for issues, perform diagnostics and system reconfigurations, provide data for billing and usage forecasting, and other actions.

Some storage-specific areas of interest are performance analysis and capacity utilization trend analysis. Analysis of both of these areas generally requires ongoing data trend analysis, provided over time by historical data logging of specific attributes and values. Note: While systems can provide a single “point-in-time” representation of these attributes, we are referring here to the need for more advanced data representation and analysis. The mechanism to provide collection, storage, and presentation of such information within the Redfish and Swordfish ecosystem is the telemetry service.
# 3 Telemetry Model

## 3.1 Overview

The Redfish telemetry service provides the instantiation of the Redfish telemetry model. It includes multiple components; we will focus on the metrics (MetricDefinitions, MetricReportDefinitions, and MetricReports) for the purposes of this paper.

The interactions of interest, and basic dependencies, in the telemetry service with properties in Redfish/Swordfish objects are shown in Figure 1.

![Figure 1: Using the telemetry service to manage metrics](image_url)

For a more detailed overview of the Redfish telemetry model, you can review the “Redfish Telemetry White Paper” (DSP2051). It will provide a general overview of the model, as well as the properties of each component in the model. [https://www.dmtf.org/sites/default/files/standards/documents/DSP2051_1.0.0.pdf]

## 3.2 MetricDefinitions

The data retrieved from a Redfish/Swordfish object is discrete, point in time, observations. A metric is defined as a time series, trend of data, with the capability of combining multiple discrete points of data into a richer set of available information.

For a property (or set of properties) of interest, there will be a corresponding MetricDefinition. There may be more than one MetricDefinition that points to a given property or set of properties, using different calculations or analyses.

The MetricDefinition provides context around the properties that metrics refer to, building a framework for developing any analysis or context for the data. A MetricDefinition contains references to the properties it relates to, as well as information about...
the appropriate type and description of calculations for these properties, any data
manipulation required (e.g., data offset, calibration), the data type, min and max
values, and additional similar descriptive attributes. It also contains pointers to any,
or every, occurrence of the property or set of properties in the system.

The **MetricDefinition** can be thought of having two sections:

- **Header** - contains all of the supporting property definitions
- **Location** - contains the **Wildcards** and **MetricProperties** definitions, which
  provide information about properties and their specific referenced locations in
  the system

The following **MetricDefinition** provides a sample usage for a Capacity Metric.

**Sample MetricDefinition:**

The set of properties defined in the metric definition itself includes only those pro-
properties that describe the metric. For simple metrics such as the capacity metric in this
example, this simply includes a small set of properties describing the metric type,
units, and context.

```json
{
    "@odata.type": "#MetricDefinition.v1_1_0.MetricDefinition",
    "Id": "AllocatedBytes",
    "Name": "Allocated Bytes Metric Definition",
    "MetricType": "Numeric",
    "MetricDataType": "Integer",
    "LogicalContexts": ["Capacity", "Storage"],
    "Units": "Bytes"
}
```

The wildcards section has multiple purposes. This usage reflects the base implemen-
tation requirements. Refer to the value-add requirements section for additional usage
capabilities. Using the **Name** property (only) in conjunction with the **MetricProperties**
section below defines the scope of the metric definition to apply to all instances of
the metric within the Swordfish model.

```json
{
    "Wildcards": [{
        "Name": "SystemID"
    },
    {
        "Name": "StorageSystemID"
    },
    {
```
The MetricProperties section contains URI pointers to all potential locations in the system. The wildcards above are uniquely used in conjunction with these URI constructs to identify all of the potential locations for properties to which this metric type can apply, throughout the Redfish and Swordfish schema.

As noted in this example, the Swordfish templates will generally include all possible metric value locations as part of the base functionality. Implementations may choose to implement additional capabilities within the constraints already provided in the telemetry service to allow clients to restrict the application of the metric to subsets of the system.
3.3 MetricReportDefinitions

A MetricReportDefinition builds on a MetricDefinition, providing information and additional constraints in order to generate the metric reports themselves. These include specifying the frequency (and type) of data collection, metric calculation properties, information on, and reporting mechanisms with properties including metric logs specific to the metric. These can also include additional scope constraints above those specified in the metric definition.

The MetricReportDefinition can also be thought of having two sections:

- Header - contains all of the supporting property definitions
- Location - contains the Wildcards and MetricProperties definitions, which provide additional information and context about specific referenced locations in the system

The following MetricReportDefinition provides a sample usage for a capacity metric report.

The properties included in the MetricReportDefinition specify the scheduling parameters for gathering the metrics, including frequency and periodicity. They also include properties to specify what to do with the output: e.g., send as events, or send to logs. If logged, it includes where to log, and additional properties regarding log management.

```json
{
  "@odata.type": "#MetricReportDefinition.v1_3_0.MetricReportDefinition",
  "Id": "TotalAllocatedCapacity",
}
As with the underlying metric definitions, the metric report definitions also include information about the scope of the system to target. For the Swordfish templates, this scope will largely be identical to that of the underlying metric, covering the entire system. Implementations may choose to support customization here as well, both within individual metric reports, as well as supporting multiple metric reports against the same metrics with different scope, time intervals, report actions (destinations), or other properties varied.

```json
{
  "Wildcards": [
    {
      "Name": "SystemID"
    },
    {
      "Name": "StorageSystemID"
    },
    {
      "Name": "SystemStoragePoolID"
    },
    {
      "Name": "SystemVolumeID"
    },
    {
      "Name": "StorageID"
    }
  ]
}
```
The Metrics section of the report definition includes both pointers to the metrics in scope, as well as information about the data collection that needs to be done on each report generation cycle.

In this example, the data collection will be done once an hour, and the value at that point is of interest (e.g., no calculation of multiple sampled data across the hour is necessary; a simple data point collection will suffice).

```json
```
3.4 Metric Reports

Metric Reports are the output: they contain the output records, as specified in the corresponding Metric Report Definition. These can be from a single run, or a series over time, depending on the properties set in the Metric Report Definition.

Metrics can also be set to be sent via Redfish Events; reporting via events is not covered in detail in this white paper.

The following Metric Report shows a sample output for a Capacity Metric.

```json
{
  "Id": "TotalAllocatedCapacity",
  "Name": "Total Allocated Capacity Performance Metric Report",
  "ReportSequence": "18",
  "MetricReportDefinition": {
    "@odata.id": "/redfish/v1/TelemetryService/MetricReportDefinitions/TotalAllocatedCapacity",
    "@Redfish.Copyright": "Copyright 2014-2022 SNIA. All rights reserved."
  },
  "MetricValues": [
    {
      "MetricId": "TotalAllocatedCapacity",
      "MetricValue": "300067890136",
      "Timestamp": "2021-04-29T12:25:00-05:00",
      "MetricProperty": "/redfish/v1/Systems/Sys-1/Storage/DirectAttachStorageSystem/Volumes/Volume1/Capacity#/Data/AllocatedBytes"
    }
  ]
}
```
"MetricId": "TotalAllocatedCapacity",
"MetricValue": "300067890136",
"Timestamp": "2021-04-29T12:25:00-05:00",
"MetricProperty": "/redfish/v1/Systems/Sys-1/Storage/
DirectAttachStorageSystem/Volumes/Volume1/Capacity#/Data/
AllocatedBytes"
},
{
"MetricId": "TotalAllocatedCapacity",
"MetricValue": "300067890136",
"Timestamp": "2021-04-29T12:25:00-05:00",
"MetricProperty": "/redfish/v1/Systems/Sys-1/Storage/
DirectAttachStorageSystem/Volumes/Volume1/Capacity#/Data/
AllocatedBytes"
},
{
"MetricId": "TotalAllocatedCapacity",
"MetricValue": "300067890136",
"Timestamp": "2021-04-29T12:30:00-05:00",
"MetricProperty": "/redfish/v1/Systems/Sys-1/Storage/
DirectAttachStorageSystem/Volumes/Volume1/Capacity#/Data/
AllocatedBytes"
},
{
"MetricId": "TotalAllocatedCapacity",
"MetricValue": "300067890136",
"Timestamp": "2021-04-29T12:35:00-05:00",
"MetricProperty": "/redfish/v1/Systems/Sys-1/Storage/
DirectAttachStorageSystem/Volumes/Volume1/Capacity#/Data/
AllocatedBytes"
},
{
"MetricId": "TotalAllocatedCapacity",
"MetricValue": "300067890136",
"Timestamp": "2021-04-29T12:40:00-05:00",
"MetricProperty": "/redfish/v1/Systems/Sys-1/Storage/
DirectAttachStorageSystem/Volumes/Volume1/Capacity#/Data/
AllocatedBytes"
}
],
"@odata.id": "/redfish/v1/TelemetryService/MetricReports/
TotalAllocatedCapacity",
"@RedFish.Copyright": "Copyright 2014-2022 SNIA. All rights reserved."
4 Metrics and Telemetry Within Swordfish

4.1 Mechanisms for Resource Identification

There are three different permutations for determining the scope of applicability of the metrics or metrics definition.

1. Provide references to locations using the wildcards property in conjunction with the URIs specified in the Metrics (MetricProperties or Metric fields) using no explicitly named instances; this definition means that all instances in each location are in scope.

This mechanism is provided out-of-the-box, and balances between requiring the management of large data set storage and configuration scalability/volatility issues (e.g., changing configuration due to data protection functionality, or other applications causing dynamic file/volume/object reconfiguration).

2. Using a combination of the reference mechanism specified in #1, but add instances to reduce / focus the scope using the addition of the Name property within the wildcards section. This will filter the application of the scope to only the objects specifically named for each specific Wildcard reference in the URI.

This mechanism is preferred for implementations, particularly large implementations, as it provides the clients a balance of the out-of-the-box configuration provided above, with functionality available to all objects, but with the ability to apply more specifically to their known configuration. It balances the ability to automatically applies all metrics to all instances with the ability to supports scalability and volatile configurations (e.g., use of dynamic provisioning).

3. Do not use the wildcard reference section, and explicitly reference the instances desired in the Metric section.

This model is the most inflexible, and from a client perspective, does not work well for large, dynamic configurations. Explicit references require a significant amount of manual management, and will have issues with scalability and volatility of the configuration. This approach is only suitable for small, static configurations.

While implementations may choose to support an explicit reference model, it would not be compatible with the Swordfish templates, which follow the model specified in #1 above.
4.2 Value-add Customization

The Swordfish templates, provided as part of the Swordfish bundle, follow the model for resource identification specified above to identify every potential instance of the defined property throughout their implementation, and, as the default, support the metric report to be run as-is against these.

Implementations may want to support additional client customization on top of this base functionality. This may include the type of customization described above in the “Mechanisms for Resource Identification” section to support more targeted application of the metric reports, filtering the application to only those objects of interest.

Opportunities for value-add customization may also involve allowing clients to customize in other ways, such as supporting more frequent reporting, additional notification mechanisms (e.g., RedfishEvents), or adding additional customized metrics, report definitions, and reports to the standard set, as well as allowing clients to create their own. All of these may be supported without relying on OEM extensions.
For More Information

More information about Swordfish and the SNIA Scalable Storage Management API can be found at http://www.snia.org/swordfish.