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OSLC Performance Monitoring Specification Version 2.0

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Open Services for Lifecycle Collaboration Performance Monitoring Specification Version 2.0

This Version

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Previous Version

- This is the first version.

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Notation and Conventions

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119](#) (<http://www.ietf.org/rfc/rfc2119.txt>). Domain name examples use [RFC2606](#) (<http://tools.ietf.org/html/rfc2606>).

Introduction

(this section is informative)

This specification builds on the [OSLC Core Specification](#) (<http://open-services.net/bin/view/Main/OslcCoreSpecification>) to define the resources and operations supported by an Open Services for Lifecycle Collaboration (OSLC) Performance Monitoring provider. This version of the specification has version 2.0 to indicate that it is an [OSLC Core 2.0](#) (<http://open-services.net/bin/view/Main/OslcCoreSpecification>) compliant specification.

Performance Monitoring resources define records whose content is most useful in the testing and operational stages of the software development, test, and deployment lifecycle. They represent individual resources as well as their relationships to other resources and to other linked resources outside of the Performance Monitoring domain. The intent of this specification is to define the set of HTTP-based RESTful interfaces in terms of HTTP methods: GET, POST, PUT and DELETE, HTTP response codes, MIME type handling and resource formats. The capabilities of the interface definitions are driven by key integration scenarios and therefore do not represent a complete set of operations on resources or resource types. The resource formats and operations may not exactly match the native models supported by existing implementations, but are intended to be compatible with them.

Performance Monitoring, as referenced in this specification, refers to the collection of data about Information Technology (IT) systems such as servers, workstations, services, and transactions to assess their operational health and enable proactive manual human intervention before emerging problems escalate into widespread degradation or outages. See the [Performance Monitoring Scenarios \(http://open-services.net/wiki/performance-monitoring/Performance-Monitoring-Scenarios\)](http://open-services.net/wiki/performance-monitoring/Performance-Monitoring-Scenarios) page for several specific examples.

Terminology

Service Provider - an implementation of the OSLC Performance Monitoring specification as a server. OSLC Performance Monitoring clients consume these services.

Performance Monitoring Record - Defines the unit of information made available by a Performance Monitoring service provider. The information could be numeric metrics, status, or some other kind of property of interest to monitoring consumers.

Monitored resource - An entity such as a software server or computer system that is monitored by a software agent to ensure its performance and availability. In this specification when we use the word ‘resource’ to mean a monitored resource rather than an OSLC resource, we try to qualify the word to make our intent clear.

Base Requirements

Compliance

This specification is based on [OSLC Core Specification \(http://open-services.net/bin/view/Main/OslcCoreSpecification\)](http://open-services.net/bin/view/Main/OslcCoreSpecification). OSLC Performance Monitoring consumers and service providers **MUST** be compliant with both the core specification and this Performance Monitoring specification, and **SHOULD** follow all the guidelines and recommendations in both these specifications.

The following table summarizes the requirements from OSLC Core Specification as well as some (but not all) additional requirements specific to Performance Monitoring. See the full content of the Performance Monitoring specification for all requirements. Note that this specification further restricts some of the requirements for OSLC Core Specification as noted in the Origin column of the compliance table. See further sections in this specification or the OSLC Core Specification to get further details on each of these requirements.

Any consumer or service provider behaviors are allowed unless explicitly prohibited by this or dependent specifications; conditional permissive requirements, especially those qualified with “MAY”, are implicitly covered by the preceding clause. While technically redundant in light of that broad permission, OSLC specifications do still make explicit MAY-qualified statements in cases where the editors believe doing so is likely to add clarity.

Requirements on OSLC Consumers

Requirement	Level	Origin(s)	Meaning
Unknown properties and content	MUST	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Unknown_properties_and_content)	OSLC clients MUST preserve unknown content

Requirements on OSLC Service Providers

Requirement	Level	Origin(s)	Meaning
Unknown properties and content	MAY	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Unknown_properties_and_content)	OSLC service providers MAY ignore unknown content
Unknown properties and content	MUST	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Unknown_properties_and_content)	OSLC service providers MUST return an error code if recognized content is invalid.
Resource Operations	MUST	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Resource_Operations)	OSLC service providers MUST support resource operations via standard HTTP operations
Resource Paging	MAY	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Resource_Paging)	OSLC services MAY provide paging for resources
Partial Resource Representations	MAY	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Selective_Property_Values)	OSLC service providers MAY support HTTP GET requests for retrieval of a subset of a resource’s properties via the oslc.properties URL parameter
Partial Resource Representations	MAY	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Selective_Property_Values)	OSLC service providers MAY support HTTP PUT requests for updating a subset of a resource’s properties via the oslc.properties URL parameter
Service Provider Resources	MAY	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Service_Provider_Resources)	OSLC service providers MAY provide a Service Provider Catalog resource
Service Provider Resources	MUST	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Service_Provider_Resources)	OSLC service providers MUST provide a Service Provider resource
Creation Factories	MAY	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Creation_Factories)	OSLC service providers MAY provide creation factories to enable resource creation via HTTP POST

Query Capabilities	SHOULD ¹	Perf Mon, Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Query_Capabilities)	OSLC service providers SHOULD provide query capabilities to enable clients to query for resources
Query Syntax	MUST ²	Perf Mon, Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Query_Syntax)	If a service provider supports a OSLC query capability, its query capabilities MUST support the OSLC Core Query Syntax
Delegated UI Dialogs	SHOULD	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Delegated_User_Interface_Dialogs)	OSLC service providers SHOULD allow clients to discover, via their service provider resources, any Delegated UI Dialogs they offer.
Delegated UI Dialogs	SHOULD	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Delegated_User_Interface_Dialogs)	OSLC service providers SHOULD offer delegated UI dialogs for resource creation
Delegated UI Dialogs	SHOULD	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Delegated_User_Interface_Dialogs)	OSLC service providers SHOULD offer delegated UI dialogs for resource selection
UI Preview	SHOULD	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#User_Interface_Previews)	OSLC Services SHOULD offer UI previews for resources that may be referenced by other resources
HTTP Basic Authentication	MAY	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#HTTP_Basic_Authentication)	OSLC Services MAY support Basic Auth
HTTP Basic Authentication	SHOULD	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#HTTP_Basic_Authentication)	OSLC Services SHOULD support Basic Auth only over HTTPS
OAuth Authentication	MAY	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#OAuth_Authentication)	OSLC service providers MAY support OAuth
OAuth Authentication	SHOULD	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#OAuth_Authentication)	OSLC service providers that support OAuth SHOULD allow clients to discover the required OAuth URLs via their service provider resource
Error Responses	MAY	Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#Error_Responses)	OSLC service providers MAY provide error responses using Core-defined error formats
RDF/XML Representations	MUST ³	Perf Mon, Core (http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations#Guidelines_for_application_rdf_x)	OSLC service providers MUST offer an RDF/XML representation for HTTP GET responses
RDF/XML Representations	MUST ³	Perf Mon, Core (http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations#Guidelines_for_application_rdf_x)	OSLC service providers MUST accept RDF/XML representations on PUT requests.
RDF/XML Representations	MUST ³	Perf Mon, Core (http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations#Guidelines_for_application_rdf_x)	RDF/XML representations on POST requests whose semantic intent is to create a new resource instance.
XML Representations	MAY ³	Perf Mon, Core (http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations#Guidelines_for_application_xml)	OSLC service providers MAY provide a XML representation for HTTP GET, POST and PUT requests that conform to the Core Guidelines for XML.
JSON Representations	MAY ³	Perf Mon, Core (http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations#Guidelines_for_JSON)	OSLC service providers MAY provide JSON representations for HTTP GET, POST and PUT requests that conform to the Core Guidelines for JSON
HTML Representations	SHOULD ³	Perf Mon, Core (http://open-services.net/bin/view/Main/OslcCoreSpecification#OSLC_Defined_Resource_Representa)	OSLC service providers SHOULD provide HTML representations for HTTP GET requests

- ¹The OSLC Core Specification indicates service providers MAY provide Query Capabilities. This specification strengthens the requirement.
- ²The OSLC Core Specification indicates service providers MAY support the OSLC Query Syntax. This specification makes OSLC Query Syntax support a MUST requirement for service providers providing query capabilities.
- ³Support for all common HTTP methods is not required for all resources defined by this specification. See the [HTTP Method support table](#) for details.

Specification Versioning

See [OSLC Core Specification Versioning section](http://open-services.net/bin/view/Main/OslcCoreSpecification#Specification_Versioning) (http://open-services.net/bin/view/Main/OslcCoreSpecification#Specification_Versioning).

Namespaces

Defined

OSLC Performance Monitoring defines the namespace shown in the table below. This namespace URI and prefix are used to designate the resources and their properties defined in this specification.

Use of the suggested prefix is RECOMMENDED, because doing so aids debugging and other situations where humans read the data.

Suggested namespace prefix	Namespace URI
pm	http://open-services.net/ns/perfmon#

Re-used from other specifications

In addition to the namespace URIs and namespace prefixes defined in the [OSLC Core specification \(http://open-services.net/bin/view/Main/OslcCoreSpecification\)](http://open-services.net/bin/view/Main/OslcCoreSpecification), OSLC Performance Monitoring also re-uses vocabulary terms from other namespaces. The namespace prefixes in the table below are used in this specification, and match the recommendations made by the specification that defines each.

Namespace prefix used	Namespace URI	Usage
ems	http://open-services.net/ns/ems#	Vocabulary is required for Performance Monitoring providers to expose metrics. Defined in the OSLC Estimation and Measurement (http://open-services.net/wiki/estimation-and-measurement/) domain.
crtv	http://open-services.net/ns/crtv#	Vocabulary is expected to be commonly used by Performance Monitoring providers, but is not required. Defined in the OSLC Reconciliation (http://open-services.net/wiki/reconciliation/) domain.

Resource Formats

In addition to the requirements for [OSLC Defined Resource Representations \(http://open-services.net/bin/view/Main/OslcCoreSpecification#OSLC_Defined_Resource_Representa\)](http://open-services.net/bin/view/Main/OslcCoreSpecification#OSLC_Defined_Resource_Representa), this section outlines further refinements and restrictions.

See [HTTP Method support table](#) for further clarification on support for HTTP methods and media types for each OSLC Performance Monitoring resource.

For HTTP GET requests on all OSLC Performance Monitoring and OSLC Core defined resource types,

- Performance Monitoring Providers **MUST** provide RDF/XML representations. If provided, the RDF/XML representation **SHOULD** follow the guidelines outlined in the [OSLC Core Representations Guidance for RDF/XML \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations#Guidelines_for_application_rdf_x\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations#Guidelines_for_application_rdf_x).
- Performance Monitoring Providers **MAY** provide XML and JSON representations. The XML and JSON representations **SHOULD** follow the guidelines outlined in the [OSLC Core Representations Guidance \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations).
- Performance Monitoring Consumers requesting RDF/XML **SHOULD** be prepared for any valid RDF/XML document. Performance Monitoring Consumers requesting XML **SHOULD** be prepared for representations that follow the guidelines outlined in the [OSLC Core Representations Guidance \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations).
- Performance Monitoring Providers **SHOULD** support an [X]HTML representation and a user interface (UI) preview as defined by [UI Preview Guidance \(http://open-services.net/bin/view/Main/OslcCoreUiPreview\)](http://open-services.net/bin/view/Main/OslcCoreUiPreview).

For HTTP PUT/POST request formats for Performance Monitoring resources,

- Performance Monitoring Providers **MUST** accept RDF/XML representations and **MAY** accept XML representations. Performance Monitoring Providers accepting RDF/XML **SHOULD** be prepared for any valid RDF/XML document. If XML is accepted, Performance Monitoring Providers **SHOULD** be prepared for representations that follow the guidelines outlined in the [OSLC Core Representations Guidance \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations).
- Performance Monitoring Providers **MAY** accept XML and JSON representations. Performance Monitoring Providers accepting XML or JSON **SHOULD** be prepared for representations that follow the guidelines outlined in the [OSLC Core Representations Guidance \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations).

For HTTP GET response formats for Query requests,

- Performance Monitoring Providers **MUST** provide RDF/XML and **MAY** provide JSON, XML, and Atom Syndication Format XML.

When Performance Monitoring Consumers request:

- `application/rdf+xml` Performance Monitoring Providers **MUST** respond with RDF/XML representation without restrictions.
- `application/xml` Performance Monitoring Providers **SHOULD** respond with OSLC-defined abbreviated XML representation as defined in the [OSLC Core Representations Guidance \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations).
- `application/atom+xml` Performance Monitoring Providers **SHOULD** respond with Atom Syndication Format XML representation as defined in the [OSLC Core Representations Guidance \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations).
- If supported, the Atom Syndication Format XML representation **SHOULD** use RDF/XML representation without restrictions for the atom:content entries representing the resource representations.

Authentication

See [OSLC Core Authentication section \(http://open-services.net/bin/view/Main/OslcCoreSpecification#Authentication\)](http://open-services.net/bin/view/Main/OslcCoreSpecification#Authentication). This specification puts no additional constraints on authentication.

Error Responses

See [OSLC Core Error Responses section](http://open-services.net/bin/view/Main/OslcCoreSpecification#Error_Responses) (http://open-services.net/bin/view/Main/OslcCoreSpecification#Error_Responses). This specification puts no additional constraints on error responses.

Pagination

Performance Monitoring Providers **SHOULD** support pagination of query results and **MAY** support pagination of a single resource's properties as defined by the OSLC Core Specification.

Labels for Relationships

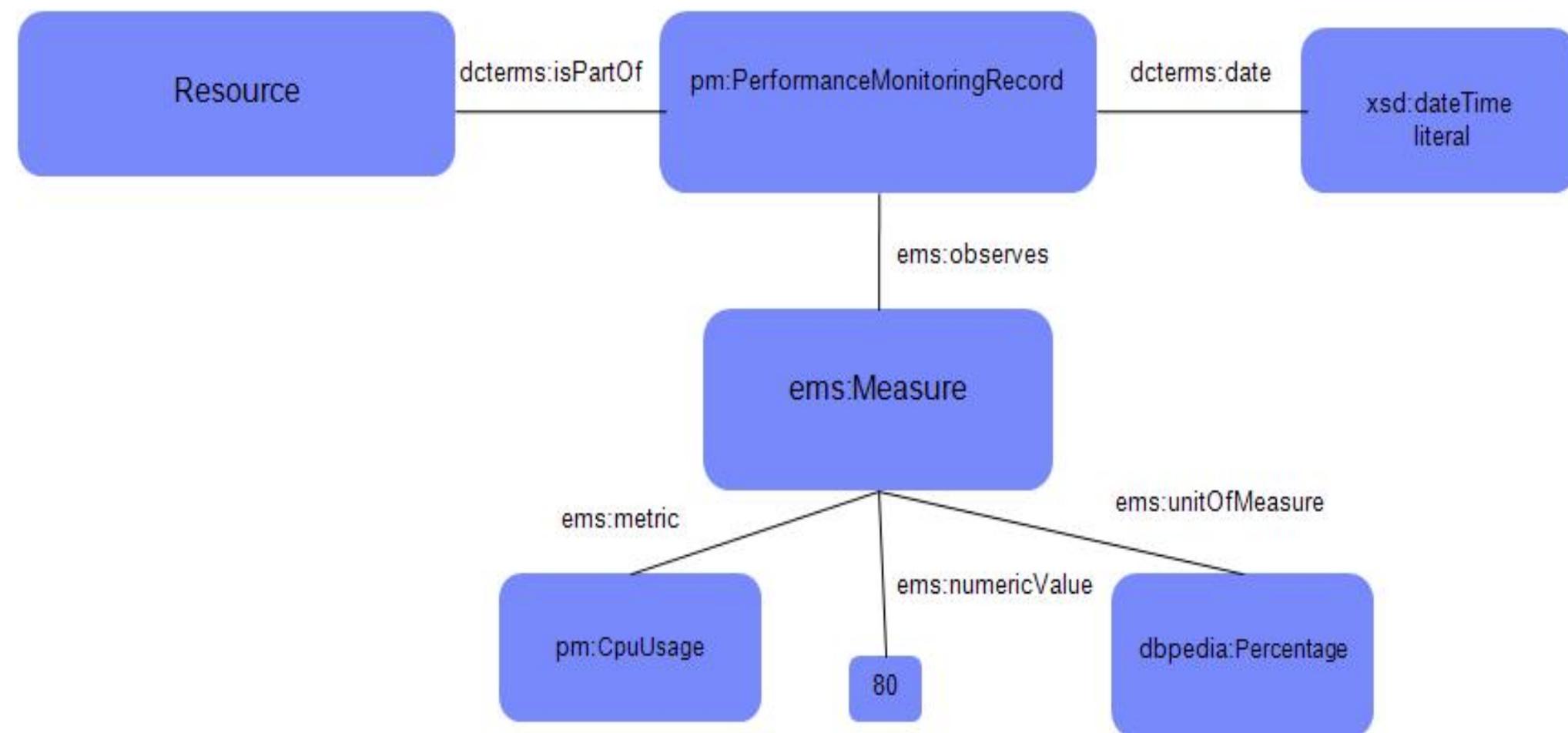
Relationships to other resources are represented as properties whose values are the URI of the object or target resource. When a relationship property is to be presented in a user interface, it may be helpful to provide an informative and useful textual label for that relationship instance. (This in addition to the relationship property URI and the object resource URI, which are also candidates for presentation to a user.) [OSLC Core Links Guidance](http://open-services.net/bin/view/Main/OslcCoreSpecAppendixLinks) (<http://open-services.net/bin/view/Main/OslcCoreSpecAppendixLinks>) allows OSLC providers to support a `dcterms:title` link property in resource representations, using the anchor approach (reification), but this specification discourages its use (providers **SHOULD NOT** use it, and consumers **SHOULD NOT** depend on it). At the time this specification was written, the W3C RDF working group was on a path to remove reification from the next version of RDF, and it was noted that reification never was normatively defined even in the RDF/XML syntax W3C Recommendation, where it occurs informatively.

Resource Definitions

A list of properties is defined for each type of resource. Most of these properties are identified in [OSLC Core Appendix A: Common Properties](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixA) (<http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixA>). Any exceptions are noted. Relationship properties refer to other resources. These resources **MAY** be any resource; that is, they **MAY** or **MAY NOT** be in any OSLC domain, including Performance Monitoring. Likewise, they **MAY** or **MAY NOT** be HTTP or RDF resources.

The diagram below shows an example of one way that a Performance Monitoring Record resource may relate to the resources it describes. With this option, the Performance Monitoring record uses the `isPartOf` predicate to refer to the monitored resource its describing.

Another option is described near the bottom of this specification in the section entitled [Performance Monitoring Specification Guidelines](http://open-services.net/wiki/performance-monitoring/Performance-Monitoring-Specification-Guidelines) (<http://open-services.net/wiki/performance-monitoring/Performance-Monitoring-Specification-Guidelines>).



For all resource types defined in this specification, all **required** properties (those defined with an occurrence of **exactly-one** or **one-or-many**) **MUST** exist for each resource and **MUST** be provided when requested. All other properties are optional, and might not exist on some or any resources; those that do not exist will not be present in the returned representation even if requested, while those that do exist **MUST** be provided if requested. Providers **MAY** define additional provider-specific properties; providers **SHOULD** use their own namespaces for such properties, or use standard Dublin Core or RDF namespaces and properties where appropriate.

If no specific set of properties is requested, **all** properties are returned - both those defined in this specification as well as any provider-specific ones. See [Selective Property Values](http://open-services.net/bin/view/Main/OslcCoreSpecification#Selective_Property_Values) (http://open-services.net/bin/view/Main/OslcCoreSpecification#Selective_Property_Values) in the OSLC Core Specification.

Resource: Performance Monitoring Record

- **Name:** `PerformanceMonitoringRecord`
- **Description:** A resource representing performance monitoring information. This could be numeric metrics, status, or some other kind of property of interest to monitoring consumers.
- **Type URI** <http://open-services.net/ns/perfmon#PerformanceMonitoringRecord>

PerformanceMonitoringRecord Properties

Prefix Name	Occurs	Read-only	Value-type	Representation	Range	Description
OSLC Core: Common Properties						
rdf:type	zero-or-many		unspecified Resource	Reference	n/a	The resource type URIs (RDF). A name given to the resource (reference: Dublin Core). The title of the resource represented as rich text in XHTML content. Its value SHOULD include only content that is valid inside an XHTML element (OSLC Core - Common).
dcterms:title	zero-or-one		unspecified XMLLiteral	n/a	n/a	An account of the resource (Dublin Core). The value SHOULD be represented as rich text in XHTML syntax, and SHOULD include only content that is valid and suitable inside an XHTML <div> element (OSLC Core - Common).
dcterms:description	zero-or-one		unspecified XMLLiteral	n/a	n/a	An unambiguous reference to the resource within a given context (Dublin Core). A unique identifier for a resource. Typically read-only and assigned by the service provider when a resource is created. Not typically intended for
dcterms:identifier	zero-or-one	True	String	n/a	n/a	

end-user display (OSLC Core - Common).

Timestamp of resource creation (Dublin Core)

Date on which the resource was changed (Dublin Core).

Timestamp of latest resource modification (OSLC Core - Common).

A link to the resource's OSLC Resource Shape that describes the possible properties, occurrence, value types, allowed values and labels. This shape information is useful in displaying the subject resource as well as guiding clients in performing modifications (OSLC Core - Common).

A link to the resource's OSLC Service Provider (OSLC Core - Common).

dcterms:created zero-or-one True DateTime n/a n/a

dcterms:modified zero-or-one True DateTime n/a n/a

oslc:instanceShape zero-or-one True Resource Reference oslc:ResourceShape (http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixA#oslc_ResourceShape_Resource)

oslc:serviceProvider zero-or-one True Resource Reference oslc:ServiceProvider (http://open-services.net/bin/view/Main/OslcCoreSpecification#Service_Provider_Resources)

Prefix Name	Occurs	Read-only	Value-type	Representation	Range	Description
OSLC Performance Monitoring: Start of additional properties						
dcterms:date	zero-or-one	True	dateTime	n/a	n/a	The time at which the record was collected (Dublin Core). Performance Monitoring service providers MUST provide an explicit time zone facet value (Performance Monitoring). This requirement is necessary to avoid differences in interpretation between servers and clients in different time zones; it is functionally equivalent to using the dateTimeStamp datatype from XML Schema 1.1 (http://www.w3.org/TR/xmlschema11-2/#dateTimeStamp), but avoids any side effects on SPARQL queries.
ems:observes	zero-or-many	True	Resource	Either	n/a	Something observed and measured about a resource (EMS) (http://open-services.net/bin/view/Main/MetricsEmsMeasurement?sortcol=table;up=#ems_observes). The ems:observes object will typically be of type ems:Measure (http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-Specification-Version-2.0/#Resource.3A-ems.3AMeasure), but it MAY be of any type (Core) (http://open-services.net/bin/view/Main/OslcCoreSpecification?sortcol=table;table=up#OSLC_Defined_Resources), (Core Links) (http://open-services.net/bin/view/Main/OslcCoreSpecAppendixLinks?)

sortcol=table;up=#Don't make assumptions about the). When the resource is of type `ems:Measure` (<http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-Specification-Version-2.0/#Resource.3A-ems.3AMeasure>), that resource **SHOULD** contain an `ems:Metric` predicate whose object is of class `pm:Metric` (either directly or indirectly).

A related resource in which the described resource is physically or logically included ([Dublin Core](#)). The related resource typically has one or more of the following types, although it **MAY** be of any type(s): `crtv:Process`, `crtv:StorageVolume`, `crtv:ComputerSystem`, `crtv:SoftwareServer`, `crtv:Database`, `crtv:SoftwareModule`, `crtv:ResourcePool`, `foaf:Agent`.

`dcterms:isPartOf` exactly-one True Resource Reference n/a

Resource: `ems:Measure`

The [OSLC Estimation and Measurement \(EMS\)](http://open-services.net/wiki/estimation-and-measurement/) (<http://open-services.net/wiki/estimation-and-measurement/>) domain defines `ems:Measure` (<http://open-services.net/bin/view/Main/MetricsEmsMeasure>). This specification re-uses it without modifications, aside from defining additional metric subclasses in the Performance Monitoring vocabulary. Performance Monitoring Record instances will generally re-use units of measure from EMS and other vocabularies such as [QUDT](http://www.qudt.org/) (<http://www.qudt.org/>) and [dbpedia](http://dbpedia.org/) (<http://dbpedia.org/>).

An example instance, that conveys "Real Memory Utilization"=50% using Turtle syntax, might be:

```
@prefix pm:      <http://open-services.net/ns/perfmon#> .
@prefix oslc:    <http://open-services.net/ns/core#> .
@prefix dcterms: <http://purl.org/dc/terms/> .
@prefix ems:     <http://open-services.net/ns/ems#> .
@prefix dbp:     <http://dbpedia.org/resource/>.

@base <http://perfmon-provider.example.org/> .

<rec001#realmemutil50>
    a                ems:Measure ; # rdf:type
    dcterms:title    "Real Memory Utilization" ;
    ems:metric       <pm:RealMemoryUsed> ;
    ems:unitOfMeasure <dbp:Percentage> ;
    ems:numericValue 50 ;
.
```

Equivalent RDF/XML for the preceding example:

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:owl="http://www.w3.org/2002/07/owl#"
  xmlns:dcterms="http://purl.org/dc/terms/"
  xmlns:rddl="http://www.rddl.org/"
  xmlns:qudt="http://qudt.org/1.1/schema/qudt"
  xmlns:pm="http://open-services.net/ns/perfmon#"
  xmlns:ems="http://open-services.net/ns/ems#">
  <rdf:Description rdf:about="http://perfmon-provider.example.org/rec001#realmemutil50">
    <rdf:type rdf:resource="http://open-services.net/ns/ems#Measure" />
    <dcterms:title>Real Memory Utilization</dcterms:title>
    <ems:metric rdf:resource="pm:RealMemoryUsed" />
    <ems:unitOfMeasure rdf:resource="dbp:Percentage" />
    <ems:numericValue rdf:datatype="http://www.w3.org/2001/XMLSchema#double">
      50</ems:numericValue>
  </rdf:Description>
</rdf:RDF>
```

Metric Categories

This specification introduces metric categories, which *loosely* correspond to the major headings on the EMS working groups [Key Software Metrics page](http://open-services.net/wiki/estimation-and-measurement/EMS-1.0-REST-API-Key-Software-Metrics/) ([/wiki/estimation-and-measurement/EMS-1.0-REST-API-Key-Software-Metrics/](http://open-services.net/wiki/estimation-and-measurement/EMS-1.0-REST-API-Key-Software-Metrics/)): size, schedule, effort, and quality, derived. As the EMS work shows, categorization itself is not unique to Performance Monitoring. As was done in EMS, the categories defined by this specification are exposed to consumers via RDF Schema subclass annotations in the [vocabulary document](http://open-services.net/ns/perfmon#) (<http://open-services.net/ns/perfmon#>); an example is shown later in this section.

Exposing each metric's categorization in the vocabulary definition serves several purposes:

1. Clients can query for a subset of all metrics exposed in the `PerformanceMonitoringRecord` without having to enumerate the members of the subset explicitly.
2. Implementations and other specifications can define new metrics and categorize them, allowing clients unaware of the new metrics' property names to introspect some information that might influence how they are presented in a user interface.

A summary of the inheritance tree for categories defined by this specification is shown below. This shows, for example, that `pm:ResourceUsageMetrics` is a subclass of `pm:Metric`. Please consult the [vocabulary document](http://open-services.net/ns/perfmon#) (<http://open-services.net/ns/perfmon#>) for the authoritative set of relationships.

```
* `pm:Metric`
* `pm:CpuMetrics`
* `pm:DiskMetrics`
* `pm:MemoryMetrics`
  * `pm:BufferPoolMetrics`
* `pm:NetworkMetrics`
* `pm:RequestMetrics`
  * `pm:FailureMetrics`
  * `pm:ResponseTimeMetrics`
* `pm:ResourceAvailabilityMetrics`
* `pm:ResourceUsageMetrics`
  * `pm:ResourceExhaustionMetrics`
* `pm:ThreadPoolMetrics`
* `pm:VirtualizationMetrics`
```

As with RDF types, categories are additive and potentially multi-valued. In other words, a given metric may be a member of as many classes as are semantically sensible. The hierarchy summarized above is useful to reduce redundancy only. For example, if a given metric is defined to be in the category `pm:FailureMetrics`, then it is redundant (although technically permissible) to define it to be in the category `pm:RequestMetrics` as well. Specific metrics like `pm:RealMemoryUsed` are associated with metric categories via the vocabulary document for the namespace by annotating the `rdfs:Class` with `rdfs:subClassOf`; the following example shows how to categorize `pm:RealMemoryUsed` as a resource usage metric and as a memory metric.

In RDF/XML syntax:

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">

  <rdfs:Class rdf:about="http://open-services.net/ns/perfmon#RealMemoryUsed">
    <rdfs:isDefinedBy rdf:resource="http://open-services.net/ns/perfmon#" />
    <rdfs:subClassOf rdf:resource="http://open-services.net/ns/perfmon#ResourceUsageMetrics" />
    <rdfs:subClassOf rdf:resource="http://open-services.net/ns/perfmon#MemoryMetrics" />
    <rdfs:label>RealMemoryUsed</rdfs:label>
    <rdfs:comment>Real memory used.</rdfs:comment>
  </rdfs:Class>

</rdf:RDF>
```

In Turtle syntax:

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix pm: <http://open-services.net/ns/perfmon#> .

<http://open-services.net/ns/perfmon#RealMemoryUsed> a rdfs:Class ;
  rdfs:isDefinedBy pm: ;
  rdfs:subClassOf pm:ResourceUsageMetrics , pm:MemoryMetrics ;
  rdfs:label "RealMemoryUsed" ;
  rdfs:comment "Real memory used." .
```

Table of Performance Metric Category URIs

This is the set of RDFS Classes that are all of the following:

- sub-classes of `ems:Metric` (directly or indirectly)
- serve to define categories of metrics
- are actually sub-classed in the current vocabulary by more specific metrics, like `pm:AvgJmsGetTime`.

In other words, they are “leaf” RDFS Classes that group set of metrics. Leaf classes, like `pm:AvgJmsGetTime`, are defined exactly like the categories in the table, and could be used as metric categories themselves by other vocabularies or implementations that sub-class them.

URI	Description
http://open-services.net/ns/perfmon#BufferPoolMetrics (http://open-services.net/ns/perfmon#BufferPoolMetrics)	Metric category for buffer pool-related metrics.
http://open-services.net/ns/perfmon#CpuMetrics (http://open-services.net/ns/perfmon#CpuMetrics)	Metric category for CPU-related metrics.
http://open-services.net/ns/perfmon#DiskMetrics (http://open-services.net/ns/perfmon#DiskMetrics)	Metric category for disk-related metrics.
http://open-services.net/ns/perfmon#FailureMetrics (http://open-services.net/ns/perfmon#FailureMetrics)	Metric category for requests that fail.
http://open-services.net/ns/perfmon#MemoryMetrics (http://open-services.net/ns/perfmon#MemoryMetrics)	Metric category for memory-related metrics.
http://open-services.net/ns/perfmon#Metric (http://open-services.net/ns/perfmon#Metric)	Metric category for metrics defined in the Performance Monitoring vocabulary.
http://open-services.net/ns/perfmon#NetworkMetrics (http://open-services.net/ns/perfmon#NetworkMetrics)	Metric category for network-related metrics.

<http://open-services.net/ns/perfmon#RequestMetrics> (<http://open-services.net/ns/perfmon#RequestMetrics>)

<http://open-services.net/ns/perfmon#ResourceAvailabilityMetrics> (<http://open-services.net/ns/perfmon#ResourceAvailabilityMetrics>)

<http://open-services.net/ns/perfmon#ResourceExhaustionMetrics> (<http://open-services.net/ns/perfmon#ResourceExhaustionMetrics>)

<http://open-services.net/ns/perfmon#ResourceUsageMetrics> (<http://open-services.net/ns/perfmon#ResourceUsageMetrics>)

<http://open-services.net/ns/perfmon#ResponseTimeMetrics> (<http://open-services.net/ns/perfmon#ResponseTimeMetrics>)

<http://open-services.net/ns/perfmon#ThreadPoolMetrics> (<http://open-services.net/ns/perfmon#ThreadPoolMetrics>)

<http://open-services.net/ns/perfmon#VirtualizationMetrics> (<http://open-services.net/ns/perfmon#VirtualizationMetrics>)

Metric category for requests on a resource, originating from an end user or a system component.

Metric category for metrics that show resource availability.

Metric category for metrics that show resource consumption in excess of capacity.

Metric category for metrics that show resource usage.

Metric category for metrics that show time it takes for a response to be returned to a request.

Metric category for thread pool-related metrics.

Metric category for virtualization-related resource metrics.

Resource Properties

In addition to resource definitions, this specification defines properties below that can occur in any RDF resource. In the scenarios currently addressed, they are most commonly used with resources of types such as the following, but this list is exemplary, not limiting: `crtv:Process`, `crtv:StorageVolume`, `crtv:ComputerSystem`, `crtv:SoftwareServer`, `crtv:Database`, `crtv:SoftwareModule`, `crtv:ResourcePool`, `foaf:Agent`. Not all properties will be semantically sensible with all resource types.

Prefix	Prefixed Name	Occurs	Read-only	Value-type	Representation	Range	Description
pm	:process	zero-or-many	True	Resource	Either	n/a	A process running, for example, in a computer system. Typically refers to a resource with type <code>crtv:Process</code> , but it MAY refer to other resource types.
pm	:disk	zero-or-many	True	Resource	Either	n/a	A disk attached, for example, to a computer system. Typically refers to a resource with type <code>crtv:StorageVolume</code> , but it MAY refer to other resource types.
pm	:monitoringAgent	zero-or-many	True	Resource	Either	n/a	Software that monitors a resource's availability, performance, capacity, or utilization. Typically refers to a resource with type <code>foaf:Agent</code> , but it MAY refer to other resource types.
pm	:mobilityEnabled	zero-or-one	True	boolean	Inline	n/a	An indication about whether the resource, for example a virtual computer system, can move about dynamically.
pm	:tableReorganizationNeeded	zero-or-one	True	boolean	Inline	n/a	Indicates whether a database's tables need to be reorganized.
pm	:availabilityStatus	zero-or-many	True	Resource	Reference	n/a	An indication of availability. If any value is present, then at least one of them MUST be from the list of URIs defined below. Additional values MAY be present from other namespaces, e.g. to provide more detailed product-specific status. All values present SHOULD be semantically compatible.

Availability Status Property Values

OSLC Performance Monitoring service providers can identify the `availabilityStatus` using references to property values in the OSLC Performance Monitoring vocabulary or to property values that are not in the Performance Monitoring vocabulary (i.e. in the service provider's own vocabulary). It is expected that the `availabilityStatus` values will be URI references to property values, but inline resources defining the `availabilityStatus` property values are also valid.

The resource shape governs occurrence constraints within PM. They say `0:* pm:availabilityStatus`.

Hence:

- if a provider has ≥ 1 `pm:availabilityStatus` predicate, then
 - all objects must be non-conflicting
 - at least one of them must be from the PM vocabulary so that clients knowing **ONLY** the PM spec are “guaranteed” to find at least one value useful.

The property values for `pm:availabilityStatus` are:

URI	Description
http://open-services.net/ns/perfmon#NotRunning (http://open-services.net/ns/perfmon#NotRunning)	Not running in its host environment
http://open-services.net/ns/perfmon#Running (http://open-services.net/ns/perfmon#Running)	Running in its host environment
http://open-services.net/ns/perfmon#Unknown (http://open-services.net/ns/perfmon#Unknown)	Unknown

Performance Monitoring Service Provider Capabilities

Service Discovery and Description

Resource Shapes

Performance Monitoring service providers **MAY** support [Resource Shapes \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixA#oslc_ResourceShape_Resource\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixA#oslc_ResourceShape_Resource) as defined in [OSLC Core Specification Appendix A \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixA\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixA).

Service Provider Resource

Performance Monitoring service providers **MUST** provide a [Service Provider Resource \(http://open-services.net/bin/view/Main/OSLCCoreSpecification#Service_Provider_Resources\)](http://open-services.net/bin/view/Main/OSLCCoreSpecification#Service_Provider_Resources) that can be retrieved at a implementation dependent URI.

Performance Monitoring service providers **MAY** provide a [Service Provider Catalog Resource \(http://open-services.net/bin/view/Main/OSLCCoreSpecification#Service_Provider_Catalog_Resources\)](http://open-services.net/bin/view/Main/OSLCCoreSpecification#Service_Provider_Catalog_Resources) that can be retrieved at a implementation dependent URI.

Performance Monitoring service providers **MUST** provide a `oslc:serviceProvider` property for their defined resources that will be the URI to a [Service Provider Resource \(http://open-services.net/bin/view/Main/OSLCCoreSpecification#Service_Provider_Resources\)](http://open-services.net/bin/view/Main/OSLCCoreSpecification#Service_Provider_Resources).

Performance Monitoring service providers **SHOULD** expose resource types of type `pm:PerformanceMonitoringRecord` (http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-Specification-Version-2.0/#Performance_Monitoring_Record). Performance Monitoring service providers **SHOULD** include the type `pm:PerformanceMonitoringRecord` (http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-Specification-Version-2.0/#Performance_Monitoring_Record) on all resources that contain performance monitoring information.

Creation Factories

If an OSLC Performance Monitoring service provider supports the creation of resources, there **MUST** be at least one [Creation Factory \(http://open-services.net/bin/view/Main/OSLCCoreSpecification#Creation_Factories\)](http://open-services.net/bin/view/Main/OSLCCoreSpecification#Creation_Factories) entry in its Services definition.

See the [HTTP Method support table](#) for further clarification on support for HTTP methods and media types for each OSLC Performance Monitoring resource.

Query Capabilities

There **SHOULD** be at least one [Query Capability \(http://open-services.net/bin/view/Main/OSLCCoreSpecification#Query_Capabilities\)](http://open-services.net/bin/view/Main/OSLCCoreSpecification#Query_Capabilities) entry in the Services definition.

The Query Capability **MUST** support the `oslc.where` parameter and **SHOULD** support the `oslc.select` parameter. If the `oslc.where` parameter is supported, then the `oslc.prefix` parameter **MUST** be supported.

If shape information is NOT present with the Query Capability, service providers **SHOULD** use the default properties defined in [OSLC Core RDF/XML Examples \(http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations#Specifying_the_shape_of_a_query\)](http://open-services.net/bin/view/Main/OSLCCoreSpecAppendixRepresentations#Specifying_the_shape_of_a_query) to contain the result.

Delegated UIs

OSLC Performance Monitoring service providers support the selection and creation of Performance Monitoring resources as defined by [Delegated UIs \(http://open-services.net/bin/view/Main/OSLCCoreSpecification#Delegated_User_Interface_Dialogs\)](http://open-services.net/bin/view/Main/OSLCCoreSpecification#Delegated_User_Interface_Dialogs) in OSLC Core.

Performance Monitoring providers support requirements for delegated UIs as follows:

Performance Monitoring Resource Selection Creation

PerformanceMonitoringRecord	SHOULD	MAY
-----------------------------	--------	-----

Service Provider HTTP Method Support

Support for all HTTP methods in [the compliance table](#) is not required for all Performance Monitoring resources. The following table summarizes the requirements for each resource definition, HTTP method, and media type combination. A value of N/A means this specification does not impose any constraints on it.

Resource	RDF/XML	XML	JSON	HTML	Other
Performance Monitoring Record					
GET	MUST	MAY	SHOULD	SHOULD	MAY
PUT	MAY	MAY	MAY	N/A	MAY
POST	MAY	MAY	MAY	N/A	MAY
DELETE	N/A	N/A	N/A	N/A	N/A

Performance Monitoring service providers **SHOULD** support deletion of any resources for which they allow creation.

Performance Monitoring Specification Guidelines

(this section is informative)

Linking a Performance Monitoring Record to the Resource it Describes

In addition to a Performance Monitoring Record having a predicate to refer to the monitored resource is is part of using `pm:isPartOf`, a Performance Monitoring record may be a class type for a monitored resource, such that the `pm:isPartOf` predicate value refers to itself as the object value.

Extending Metrics

- Choose the correct metric categor(ies) for your metric.
- Decide whether your class should be part of the ‘perfmon’ namespace or a private namespace.
- Create an RDFS class for your metric.
- Create an instance of a PerformanceMonitoringRecord
- Put a timestamp on it to indicate when it was collected
- Put an `ems:observes` predicate in your PerformanceMonitoringRecord and have it refer to an `ems:Measure` instance
- Use your metric in the `ems:Measure` instance
- Use `ems:unitOfMeasure` to specify whether the metric is a rate, a ratio, a quantity, a time, etc.
- Relate PerformanceMonitoringRecord to monitored resource using `isPartOf` property

Appendix A: Samples

(this section is informative)

See [OSLC Performance Monitoring 2.0 Appendix A: Samples](http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-2.0-Appendix-A%3A-Samples) (<http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-2.0-Appendix-A%3A-Samples>).

Appendix B: Resource Shapes

(this section is informative)

See [OSLC Performance Monitoring 2.0 Appendix B: Resource Shapes](http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-2.0-Appendix-B%3A-Resource-Shapes) (<http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-2.0-Appendix-B%3A-Resource-Shapes>).

Appendix C: Notices and References

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Reporting Issues on the Specification

The working group participants who author and maintain this working draft specification, monitor a distribution list where issues or questions can be raised, see [Performance Monitoring Mailing List](http://open-services.net/mailman/listinfo/oslc-pm_open-services.net) (http://open-services.net/mailman/listinfo/oslc-pm_open-services.net).

Also the issues found with this specification and their resolution can be found at [OSLC Performance Monitoring 2.0 Issues](http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-2.0-Issues) (<http://open-services.net/wiki/performance-monitoring/OSLC-Performance-Monitoring-2.0-Issues>).

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- FOAF - [Friend of a Friend \(FOAF\) v0.98](http://xmlns.com/foaf/spec/20100809.html) (<http://xmlns.com/foaf/spec/20100809.html>)
- HTTP 1.1 - [Hyper-text Transfer Protocol \(HTTP/1.1\)](http://tools.ietf.org/html/rfc2616) (<http://tools.ietf.org/html/rfc2616>)
- OAuth 1.0a - [RFC5849 - The OAuth 1.0 Protocol](http://tools.ietf.org/html/rfc5849) (<http://tools.ietf.org/html/rfc5849>)
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