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Part 1: Core

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- *OData Version 4.0 Part 1: Protocol Plus Errata 02* (this document). Edited by Michael Pizzo, Ralf Handl, and Martin Zurmuehl. 30 October 2014. OASIS Standard incorporating Approved Errata 02. http://docs.oasis-open.org/odata/odata/v4.0/errata02/os/complete/part1-protocol/odata-v4.0-errata02-os-part1-protocol-complete.html.
- *OData Version 4.0 Part 2: URL Conventions Plus Errata 02*. Edited by Michael Pizzo, Ralf Handl, and Martin Zurmuehl. 30 October 2014. OASIS Standard incorporating Approved

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Errata 02. http://docs.oasis-open.org/odata/odata/v4.0/errata02/os/complete/part2-url-conventions/odata-v4.0-errata02-os-part2-url-conventions-complete.html.

- *OData Version 4.0 Part 3: Common Schema Definition Language (CSDL) Plus Errata 02*. Edited by Michael Pizzo, Ralf Handl, and Martin Zurmuehl. 30 October 2014. OASIS Standard incorporating Approved Errata 02. http://docs.oasis-open.org/odata/odata/v4.0/errata02/os/complete/part3-csdl/odata-v4.0-errata02-os-part3-csdl-complete.html.
- ABNF components: OData ABNF Construction Rules Version 4.0 and OData ABNF Test Cases. http://docs.oasis-open.org/odata/odata/v4.0/errata02/os/complete/abnf/.
- Vocabulary components: OData Core Vocabulary, OData Measures Vocabulary and OData Capabilities Vocabulary. http://docs.oasis-open.org/odata/odata/v4.0/errata02/os/complete/vocabularies/.
- XML schemas: OData EDMX XML Schema and OData EDM XML Schema. http://docs.oasis-open.org/odata/odata/v4.0/errata02/os/complete/schemas/.
- OData Metadata Service Entity Model: http://docs.oasis-open.org/odata/odata/v4.0/errata02/os/complete/models/.
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This specification is related to:

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- *OData Atom Format Version 4.0*. Edited by Martin Zurmuehl, Michael Pizzo, and Ralf Handl. Latest version. http://docs.oasis-open.org/odata/odata-atom-format/v4.0/odata-atom-format-v4.0.html.
- *OData JSON Format Version 4.0*. Edited by Ralf Handl, Michael Pizzo, and Mark Biamonte. Latest version. http://docs.oasis-open.org/odata/odata-json-format/v4.0/odata-json-format-v4.0.html.

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- http://docs.oasis-open.org/odata/ns/edmx
- http://docs.oasis-open.org/odata/ns/edm

Abstract:

The Open Data Protocol (OData) enables the creation of REST-based data services, which allow resources, identified using Uniform Resource Locators (URLs) and defined in an Entity Data Model (EDM), to be published and edited by Web clients using simple HTTP messages. This document defines the core semantics and facilities of the protocol.

Status:

This document was last revised or approved by the OASIS Open Data Protocol (OData) TC on the above date. The level of approval is also listed above. Check the “Latest version” location noted above for possible later revisions of this document. Any other numbered Versions and other technical work produced by the Technical Committee (TC) are listed at https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=odata#technical.

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Appendix B. Revision History 73

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1 Introduction

The Open Data Protocol (OData) enables the creation of REST-based data services, which allow resources, identified using Uniform Resource Locators (URLs) and defined in a data model, to be published and edited by Web clients using simple HTTP messages. This specification defines the core semantics and the behavioral aspects of the protocol.

The **[OData-URL]** specification defines a set of rules for constructing URLs to identify the data and metadata exposed by an OData service as well as a set of reserved URL query options.

The **[OData-CSDL]** specification defines an XML representation of the entity data model exposed by an OData service.

The **[OData-Atom]** and **[OData-JSON]** documents specify the format of the resource representations that are exchanged using OData.

1.1 Terminology

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]**.

1.2 Normative References

[OData-ABNF] *OData ABNF Construction Rules Version 4.0*.
See link in "Additional artifacts" section on cover page.

[OData-Atom] *OData ATOM Format Version 4.0*.
See link in "Related work" section on cover page.

[OData-CSDL] *OData Version 4.0 Part 3: Common Schema Definition Language (CSDL)*.
See link in "Additional artifacts" section on cover page.

[OData-JSON] *OData JSON Format Version 4.0.*
See link in "Related work" section on cover page.

[OData-URL] *OData Version 4.0 Part 2: URL Conventions*.
See link in "Additional artifacts" section on cover page.

[OData-VocCap] *OData Capabilities Vocabulary.*
See link in "Additional artifacts" section on cover page.

[OData-VocCore] *OData Core Vocabulary.*
See link in "Additional artifacts" section on cover page.

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1.3 Typographical Conventions

Keywords defined by this specification use this `monospaced` font.

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Normative source code uses this paragraph style.
```

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Example 1: text describing an example uses this paragraph style

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2 Overview

The OData Protocol is an application-level protocol for interacting with data via RESTful interfaces. The protocol supports the description of data models and the editing and querying of data according to those models. It provides facilities for:

- Metadata: a machine-readable description of the data model exposed by a particular data provider.
- Data: sets of data entities and the relationships between them.
- Querying: requesting that the service perform a set of filtering and other transformations to its data, then return the results.
- Editing: creating, updating, and deleting data.
- Operations: invoking custom logic
- Vocabularies: attaching custom semantics

The OData Protocol is different from other REST-based web service approaches in that it provides a uniform way to describe both the data and the data model. This improves semantic interoperability between systems and allows an ecosystem to emerge.

Towards that end, the OData Protocol follows these design principles:

- Prefer mechanisms that work on a variety of data stores. In particular, do not assume a relational data model.
- Extensibility is important. Services should be able to support extended functionality without breaking clients unaware of those extensions.
- Follow REST principles.
- OData should build incrementally. A very basic, compliant service should be easy to build, with additional work necessary only to support additional capabilities.
- Keep it simple. Address the common cases and provide extensibility where necessary.

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3 Data Model

This section provides a high-level description of the *Entity Data Model (EDM)*: the abstract data model that is used to describe the data exposed by an OData service. An OData Metadata Document is a representation of a service's data model exposed for client consumption.

The central concepts in the EDM are entities, relationships, entity sets, actions, and functions.

Entities are instances of entity types (e.g. `Customer`, `Employee`, etc.).

Entity types are named structured types with a key. They define the named properties and relationships of an entity. Entity types may derive by single inheritance from other entity types.

The *key* of an entity type is formed from a subset of the primitive properties (e.g. `CustomerId`, `OrderId`, `LineId`, etc.) of the entity type.

Complex types are keyless named structured types consisting of a set of properties. These are value types whose instances cannot be referenced outside of their containing entity. Complex types are commonly used as property values in an entity or as parameters to operations.

Properties declared as part of a structured type's definition are called *declared properties*. Instances of structured types may contain additional undeclared *dynamic properties*. A dynamic property cannot have the same name as a declared property. Entity or complex types which allow clients to persist additional undeclared properties are called *open types*.

Relationships from one entity to another are represented as *navigation properties.* Navigation properties are generally defined as part of an entity type, but can also appear on entity instances as undeclared *dynamic navigation properties*. Each relationship has a cardinality.

Enumeration types are named primitive types whose values are named constants with underlying integer values.

Type definitions are named primitive types with fixed facet values such as maximum length or precision. Type definitions can be used in place of primitive typed properties, for example, within property definitions.

Entity sets are named collections of entities (e.g. `Customers` is an entity set containing `Customer` entities). An entity's key uniquely identifies the entity within an entity set. If multiple entity sets use the same entity type, the same combination of key values can appear in more than one entity set and identifies different entities, one per entity set where this key combination appears. Each of these entities has a different entity-id. Entity sets provide entry points into the data model.

Operations allow the execution of custom logic on parts of a data model. *Functions* are operations that do not have side effects and may support further composition, for example, with additional filter operations, functions or an action. *Actions* are operations that allow side effects, such as data modification, and cannot be further composed in order to avoid non-deterministic behavior. Actions and functions are either *bound* to a type, enabling them to be called as members of an instance of that type, or unbound, in which case they are called as static operations. *Action imports* and *function imports* enable unbound actions and functions to be called from the service root.

Singletons are single entities which are accessed as children of the entity container.

An OData *resource* is anything in the model that can be addressed (an entity set, entity, property, or operation).

Refer to **[OData-CSDL]** for more information on the OData entity data model.

3.1 Annotations

Model and instance elements can be decorated with *Annotations*.

Annotations can be used to specify an individual fact about an element, such as whether it is read-only, or to define a common concept, such as a person or a movie.

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Applied *annotations* consist of a *term* (the namespace-qualified name of the annotation being applied), a *target* (the model or instance element to which the term is applied), and a *value*. The value may be a static value, or an expression that may contain a path to one or more properties of an annotated entity.

Annotation terms are defined in metadata and have a name and a type.

A set of related terms in a common namespace comprises a *Vocabulary*.

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4 Service Model

OData services are defined using a common data model. The service advertises its concrete data model in a machine-readable form, allowing generic clients to interact with the service in a well-defined way.

An OData service exposes two well-defined resources that describe its data model; a service document and a metadata document.

The *service document* lists entity sets, functions, and singletons that can be retrieved. Clients can use the service document to navigate the model in a hypermedia-driven fashion.

The *metadata document* describes the types, sets, functions and actions understood by the OData service. Clients can use the metadata document to understand how to query and interact with entities in the service.

In addition to these two "fixed" resources an OData service consists of dynamic resources. The URLs for many of these resources can be computed from the information in the metadata document.

See Requesting Data and Data Modification for details.

4.1 Entity-Ids and Entity References

Whereas entities within an entity set are uniquely identified by their key values, entities are also uniquely identified by a durable, opaque, globally unique *entity-id*. The entity-id MUST be an IRI as defined in **[RFC3987]** and MAY be expressed in payloads and URLs as a relative reference as appropriate. While the client MUST be prepared to accept any IRI, services MUST use valid URIs in this version of the specification since there is currently no lossless representation of an IRI in the `OData-EntityId` header.

Services are strongly encouraged to use the canonical URL for an entity as defined in **OData-URL** as its entity-id, but clients cannot assume the entity-id can be used to locate the entity unless the `Core.DereferenceableIDs` term is applied to the entity container, nor can the client assume any semantics from the structure of the entity-id. The canonical resource `$entity` provides a general mechanism for resolving an entity-id into an entity representation.

Services that use the standard URL conventions for entity-ids annotate their entity container with the term `Core.ConventionalIDs`, see **[OData-VocCore]**.

Entity references refer to an entity using the entity's entity-id.

4.2 Read URLs and Edit URLs

The read URL of an entity is the URL that can be used to read the entity.

The edit URL of an entity is the URL that can be used to update or delete the entity.

The edit URL of a property is the edit URL of the entity with appended segment(s) containing the path to the property.

Services are strongly encouraged to use the canonical URL for an entity as defined in **OData-URL** for both the read URL and the edit URL of an entity, with a cast segment to the type of the entity appended to the canonical URL if the type of the entity is derived from the declared type of the entity set. However, clients cannot assume this convention and must use the links specified in the payload according to the appropriate format as the two URLs may be different from one another, or one or both of them may differ from convention.

4.3 Transient Entities

Transient entities are instances of an entity type that are "calculated on the fly" and only exist within a single payload. They cannot be reread or updated and consequently possess neither a stable entity-id nor a read URL or an update URL.

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5 Versioning

Versioning enables clients and services to evolve independently. OData defines semantics for both protocol and data model versioning.

5.1 Protocol Versioning

OData requests and responses are versioned according to the `OData-Version` header.

OData clients include the `OData-MaxVersion` header in requests in order to specify the maximum acceptable response version. Services respond with the maximum supported version that is less than or equal to the requested `OData-MaxVersion`, using decimal comparison. The syntax of the `OData-Version` and `OData-MaxVersion` header fields is specified in **[OData-ABNF]**.

This version of the specification defines data service version value `4.0`.

5.2 Model Versioning

The Data Model exposed by an OData Service defines a contract between the OData service and its clients. Services are allowed to extend their model only to the degree that it does not break existing clients. Breaking changes, such as removing properties or changing the type of existing properties, require that a new service version is provided at a different service root URL for the new model.

The following Data Model additions are considered safe and do not require services to version their entry point.

- Adding a property that is nullable or has a default value; if it has the same name as an existing dynamic property, it must have the same type (or base type) as the existing dynamic property
- Adding a navigation property that is nullable or collection-valued; if it has the same name as an existing dynamic navigation property, it must have the same type (or base type) as the existing dynamic navigation property
- Adding a new entity type to the model
- Adding a new complex type to the model
- Adding a new entity set
- Adding a new singleton
- Adding an action, a function, an action import, or function import
- Adding an action parameter that is nullable
- Adding a type definition or enumeration
- Adding any annotation to a model element that does not need to be understood by the client in order to correctly interact with the service

Clients SHOULD be prepared for services to make such incremental changes to their model. In particular, clients should be prepared to receive properties and derived types not previously defined by the service.

Services SHOULD NOT change their data model depending on the authenticated user. If the data model is user or user group dependent, all changes MUST be *safe changes* as defined in this section when comparing the full model to the model visible to users with restricted authorizations.

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6 Extensibility

The OData protocol supports both user- and version-driven extensibility through a combination of versioning, convention, and explicit extension points.

6.1 Query Option Extensibility

Query options within the request URL can control how a particular request is processed by the service.

OData-defined system query options are prefixed with "`$`". Services may support additional custom query options not defined in the OData specification, but they MUST NOT begin with the "`$`" or "`@`" character.

OData services SHOULD NOT require any query options to be specified in a request. Services SHOULD fail any request that contains query options that they do not understand and MUST fail any request that contains unsupported OData query options defined in the version of this specification supported by the service.

In many cases OData services return URLs to identify resources that are later requested by clients. Where possible, interoperability is enhanced by providing all identifying information in the path portion of the URL. However, clients should be prepared for such URLs to include custom query options and propagate any such custom query options in future requests to the identified resource.

6.2 Payload Extensibility

OData supports extensibility in the payload, according to the specific format.

Regardless of the format, additional content MUST NOT be present if it needs to be understood by the receiver in order to correctly interpret the payload according to the specified `OData-Version` header. Thus, clients and services MUST be prepared to handle or safely ignore any content not specifically defined in the version of the payload specified by the `OData-Version` header.

6.3 Action/Function Extensibility

Actions and Functions extend the set of operations that can be performed on or with a service or resource. Actions can have side-effects. For example, Actions can be used to modify data or to invoke custom operations. Functions MUST NOT have side-effects. Functions can be invoked from a URL that addresses a resource or within an expression to a `$filter` or `$orderby` system query option.

Fully qualified action and function names include a namespace or alias prefix. The `Edm`, `odata` and `geo` namespaces are reserved for the use of this specification.

An OData service MUST fail any request that contains actions or functions that it does not understand.

6.4 Vocabulary Extensibility

The set of annotations defined within a schema comprise a *vocabulary*. Shared vocabularies provide a powerful extensibility point for OData.

Metadata annotations can be used to define additional characteristics or capabilities of a metadata element, such as a service, entity type, property, function, action or parameter. For example, a metadata annotation could define ranges of valid values for a particular property.

Instance annotations can be used to define additional information associated with a particular result, entity, property, or error; for example whether a property is read-only for a particular instance.

Where annotations apply across all instances of a type, services are encouraged to specify the annotation in metadata rather than repeating in each instance of the payload. Where the same annotation is defined at both the metadata and instance level, the instance-level annotation overrides the one specified at the metadata level.

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A service MUST NOT require the client to understand custom annotations in order to accurately interpret a response.

OData defines a `Core` vocabulary with a set of basic terms describing behavioral aspects along with terms that can be used in defining other vocabularies; see **[OData-VocCore]**.

6.5 Header Field Extensibility

OData defines semantics around certain HTTP request and response headers. Services that support a version of OData conform to the processing requirements for the headers defined by this specification for that version.

Individual services may define custom headers. These headers MUST NOT begin with `OData` . Custom headers SHOULD be optional when making requests to the service. A service MUST NOT require the client to understand custom headers to accurately interpret the response.

6.6 Format Extensibility

An OData service MUST support at least one of **[OData-JSON]**ODataJSONRef**OData-JSON** or **[OData-Atom]****OData-Atom**, and MAY support additional formats for both request and response bodies.

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7 Formats

The client MAY request a particular response format through the `Accept` header, as specified in **[RFC7231]**, or through the system query option $format

In the case that both the `Accept` header and the `$format` query option are specified on a request, the value specified in the `$format` query option MUST be used.

If the service does not support the requested format, it replies with a `406 Not Acceptable` error response.

Services SHOULD advertise their supported formats by annotating their entity container with the term `Capabilities.SupportedFormats`, as defined in **[OData-VocCap]**, listing all available formats and combinations of supported format parameters.

See the format specifications (**[OData-JSON]OData-JSON**, **[OData-Atom]OData-Atom**) for details.

Client libraries MUST retain the order of objects within an array in JSON responses, and elements in document order for ATOM and XML responses, including CSDL documents.

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8 Header Fields

OData defines semantics around the following request and response headers. Additional headers may be specified, but have no unique semantics defined in OData.

8.1 Common Headers

The `Content-Type`, `Content-Length`, and `OData-Version` headers are common between OData requests and responses.

8.1.1 Header `Content-Type`

As specified in **[RFC7231]**, the format of an individual request or response body MUST be specified in the `Content-Type` header of the request or response.

The specified format MAY include format parameters. Clients MUST be prepared for the service to return custom format parameters not specified in OData. Custom format parameters MUST NOT start with "odata" and services MUST NOT require generic OData consumers to understand custom format parameters in order to correctly interpret the payload.

See the format-specific specifications (**[OData-JSON]**, **[OData-Atom]**) for details.

8.1.2 Header `Content-Encoding`

As specified in **[RFC7231]**, the `Content-Encoding` header field is used as a modifier to the media-type (as indicated in the `Content-Type`). When present, its value indicates what additional content codings have been applied to the entity-body.
A service MAY specify a list of acceptable content codings using an annotation with term `Capabilities.AcceptableEncodings`, see **[OData-VocCap]**.

8.1.3 Header `Content-Language`

As specified in **[RFC7231]**, a request or response can include a `Content-Language` header to indicate the natural language of the intended audience for the enclosed message body. OData does not add any additional requirements over HTTP for including `Content-Language`. OData services can annotate model elements whose content depends on the content language with the term `Core.IsLanguageDependent`, see **[OData-VocCore]**.

8.1.4 Header `Content-Length`

As specified in **[RFC7230]**, a request or response SHOULD include a `Content-Length` header when the message's length can be determined prior to being transferred. OData does not add any additional requirements over HTTP for writing `Content-Length`.

8.1.5 Header `OData-Version`

OData clients SHOULD use the `OData-Version` header on a request to specify the version of the protocol used to generate the request.

If present on a request, the service MUST interpret the request according to the rules defined in the specified version of the protocol, or fail the request with a `4xx` response code.

If not specified in a request, the service MUST assume the request is generated using the minimum of the `OData-MaxVersion`, if specified, and the maximum version of the protocol that the service understands.

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OData services MUST include the `OData-Version` header on a response to specify the version of the protocol used to generate the response. The client MUST interpret the response according to the rules defined in the specified version of the protocol.

For more details, see Versioning.

8.2 Request Headers

In addition to the Common Headers, the client may specify any combination of the following request headers.

8.2.1 Header `Accept`

As specified in **[RFC7231]**, the client MAY specify the set of accepted formats with the `Accept` Header.

Services MUST reject formats that specify unknown or unsupported format parameters.

If a media type specified in the `Accept` header includes a `charset` format parameter and the request also contains an `Accept-Charset` header, then the `Accept-Charset` header MUST be used.

If the media type specified in the `Accept` header does not include a `charset` format parameter, then the `Content-Type` header of the response MUST NOT contain a `charset` format parameter.

8.2.2 Header `Accept-Charset`

As specified in. **[RFC7231]**, the client MAY specify the set of accepted character sets with the `Accept-Charset` header.

8.2.3 Header `Accept-Language`

As specified in **[RFC7231]**, the client MAY specify the set of accepted natural languages with the `Accept-Language` header.

8.2.4 Header `If-Match`

As specified in **[RFC7232]**, a client MAY include an `If-Match` header in a request to `GET`, `PUT`, `PATCH` or `DELETE`. The value of the `If-Match` request header MUST be an ETag value previously retrieved for the entity, or `"*"` to match any value.

If an operation on an existing entity requires an ETag, (see `Core.OptimisticConcurrency` in **[OData-VocCore]**) and the client does not specify an `If-Match` request header in a Data Modification Request or in an Action Request bound to the entity, the service responds with a `428 Precondition Required` and MUST ensure that no observable change occurs as a result of the request.

If specified, the request MUST only be processed if the specified value matches the current ETag value of the target entity, using the weak comparison function (see **[RFC7230]**). If the value does not match the current ETag value of the entity for a Data Modification Request or Action Request, the service MUST respond with `412 Precondition Failed` and MUST ensure that no observable change occurs as a result of the request. In the case of an upsert, if the addressed entity does not exist the provided ETag value is considered not to match.

The client MAY include an `If-Match` header in a `PUT` or `PATCH` request in order to ensure that the request is handled as an update and not an upsert.

8.2.5 Header `If-None-Match`

As specified in **[RFC7232]**, a client MAY include an `If-None-Match` header in a request to `GET`, `PUT`, `PATCH` or `DELETE`. The value of the `If-None-Match` request header MUST be an ETag value previously retrieved for the entity, or `"*"`.

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If specified, the request MUST only be processed if the specified value does not match the current ETag value of the entity, using the weak comparison function (see **[RFC7230]**). If the value matches the current ETag value of the entity, then for a `GET` request, the service SHOULD respond with `304 Not Modified`, and for a Data Modification Request or Action Request, the service MUST respond with `412 Precondition Failed` and MUST ensure that no observable change occurs as a result of the request.

An `If-None-Match` header with a value of `"*"` in a `PUT` or `PATCH` request results in an upsert request being processed as an insert and not an update.

8.2.6 Header `OData-Isolation`

The `OData-Isolation` header specifies the isolation of the current request from external changes. The only supported value for this header is `snapshot`.

If the service doesn't support `OData-Isolation:snapshot` and this header was specified on the request, the service MUST NOT process the request and MUST respond with `412 Precondition Failed`.

Snapshot isolation guarantees that all data returned for a request, including multiple requests within a batch or results retrieved across multiple pages, will be consistent as of a single point in time. Only data modifications made within the request (for example, by a data modification request within the same batch) are visible. The effect is as if the request generates a "snapshot" of the committed data as it existed at the start of the request.

The `OData-Isolation` header may be specified on a single or batch request. If it is specified on a batch then the value is applied to all statements within the batch.

Next links returned within a snapshot return results within the same snapshot as the initial request; the client is not required to repeat the header on each individual page request.

The `OData-Isolation` header has no effect on links other than the next link. Navigation links, read links, and edit links return the current version of the data.

A service returns `410 Gone` or `404 Not Found` if a consumer tries to follow a next link referring to a snapshot that is no longer available.

The syntax of the `OData-Isolation` header is specified in **[OData-ABNF]**.

A service MAY specify the support for `OData-Isolation:snapshot` using an annotation with term `Capabilities.IsolationSupport`, see **[OData-VocCap]**.

8.2.7 Header `OData-MaxVersion`

Clients SHOULD specify an `OData-MaxVersion` request header.

If specified the service MUST generate a response with an `OData-Version` less than or equal to the specified `OData-MaxVersion`.

If `OData-MaxVersion` is not specified, then the service SHOULD interpret the request as having an `OData-MaxVersion` equal to the maximum version supported by the service.

For more details, see Versioning.

8.2.8 Header `Prefer`

The `Prefer` header, as defined in **[RFC7240]**, allows clients to request certain behavior from the service. The service MUST ignore preference values that are either not supported or not know by the service.

The value of the `Prefer` header is a comma-separated list of *preferences*. The following subsections describe preferences whose meaning in OData is defined by this specification.

In response to a request containing a `Prefer` header, the service MAY return the `Preference-Applied` Header.

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8.2.8.1 Preference `odata.allow-entityreferences`

The `odata.allow-entityreferences` preference indicates that the service is allowed to return entity references in place of entities that have previously been returned, with at least the properties requested, in the same response (for example, when serializing the expanded results of many-to-many relationships). The service MUST NOT return entity references in place of requested entities if `odata.allow-entityreferences` has not been specified in the request, unless explicitly defined by other rules in this document. The syntax of the `odata.allow-entityreferences` preference is specified in **[OData-ABNF]**.

In the case the service applies the `odata.allow-entityreferences` preference it MUST include a `Preference-Applied` response header containing the `odata.allow-entityreferences` preference to indicate that entity references MAY be returned in place of entities that have previously been returned.

8.2.8.2 Preference `odata.callback`

For scenarios in which links returned by the service are used by the client to poll for additional information, the client can specify the `odata.callback` preference to request that the service notify the client when data is available.

The `odata.callback` preference can be specified:

- when requesting asynchronous processing of a request with the `respond-async` preference, or
- on a `GET` request to a delta link.

The `odata.callback` preference MUST include the parameter `url` whose value is the URL of a callback endpoint to be invoked by the OData service when data is available. The syntax of the `odata.callback` preference is specified in **[OData-ABNF]**.

For HTTP based callbacks, the OData service executes an HTTP `GET` request against the specified URL.

Services that support `odata.callback` SHOULD support notifying the client through HTTP. Services can advertise callback support using the `Capabilities.CallbackSupport` annotation term defined in **[OData-VocCap]**.

If the service applies the `odata.callback` preference it MUST include the `odata.callback` preference in the `Preference-Applied` response header.

When the `odata.callback` preference is applied to asynchronous requests, the OData service invokes the callback endpoint once it has finished processing the request. The status monitor resource, returned in the `Location` header of the previously returned `202 Accepted` response, can then be used to retrieve the results of the asynchronously executed request.

When the `odata.callback` preference is specified on a `GET` request to a delta link and there are no changes available, the OData service returns a `202 Accepted` response with a `Location` header specifying the delta link to be used to check for future updates. The OData service then invokes the specified callback endpoint once new changes become available.

Combining `respond-async`, `odata.callback` and `odata.track-changes` preferences on a `GET` request to a delta-link might influence the response in a couple of ways.

- If the service processes the request synchronously, and no updates are available, then the response is the same as if the `respond-async` hadn't been specified and results in a response as described above.
- If the service processes the request asynchronously, then it responds with a `202 Accepted` response specifying the URL to the status monitor resource as it would have with any other asynchronous request. Once the service has finished processing the asynchronous request to the delta link resource, if changes are available it invokes the specified callback endpoint. If no changes are available, the service SHOULD wait to notify the client until changes are available. Once notified, the client uses the status monitor resource from the `Location` header of the previously returned `202 Accepted` response to retrieve the results. In case no updates were

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available after processing the initial request, the result will contain no updates and the client can use the delta-link contained in the result to retrieve the updates that have since become available.

If the consumer specifies the same URL as callback endpoint in multiple requests, the service MAY collate them into a single notification once additional data is available for any of the requests. However, the consumer MUST be prepared to deal with receiving up to as many notifications as it requested.

Example 2: using a HTTP callback endpoint to receive notification

```
Prefer: odata.callback; url="http://myserver/notfication/token/12345"
```

8.2.8.3 Preference `odata.continue-on-error`

The `odata.continue-on-error` preference on a batch request is used to request that, upon encountering a request within the batch that returns an error, the service return the error for that request and continue processing additional requests within the batch. The syntax of the `odata.continue-on-error` preference is specified in **[OData-ABNF]**.

If not specified, upon encountering an error the service MUST return the error within the batch and stop processing additional requests within the batch.

A service MAY specify the support for the `odata.continue-on-error` preference using an annotation with term `Capabilities.BatchContinueOnErrorSupported`, see **[OData-VocCap]**.

8.2.8.4 Preference `odata.include-annotations`

The `odata.include-annotations` preference in a request for data or metadata is used to specify the set of annotations the client requests to be included, where applicable, in the response.

The value of the `odata.include-annotations` preference is a comma-separated list of namespaces or namespace qualified term names to include or exclude, with "*" representing all. The full syntax of the `odata.include-annotations` preference is defined in **[OData-ABNF]**.

The most specific identifier always takes precedence. If the same identifier value is requested to both be excluded and included the behavior is undefined; the service MAY return or omit the specified vocabulary but MUST NOT raise an exception.

Example 3: a `Prefer` header requesting all annotations within a metadata document to be returned

```
Prefer: odata.include-annotations="*"
```

Example 4: a `Prefer` header requesting that no annotations are returned

```
Prefer: odata.include-annotations="-*"
```

Example 5: a `Prefer` header requesting that all annotations defined under the "display" namespace (recursively) be returned

```
Prefer: odata.include-annotations="display.*"
```

Example 6: a `Prefer` header requesting that the annotation with the term name `subject` within the `display` namespace be returned if applied

```
Prefer: odata.include-annotations="display.subject"
```

The `odata.include-annotations` preference is only a hint to the service. The service MAY ignore the preference and is free to decide whether or not to return annotations not specified in the `odata.include-annotations` preference.

In the case that the client has specified the `odata.include-annotations` preference in the request, the service SHOULD include a `Preference-Applied` response header containing the `odata.include-annotations` preference to specify the annotations actually included, where applicable, in the response. This value may differ from the annotations requested in the `Prefer` header of the request.

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8.2.8.5 Preference `odata.maxpagesize`

The `odata.maxpagesize` preference is used to request that each collection within the response contain no more than the number of items specified as the positive integer value of this preference. The syntax of the `odata.maxpagesize` preference is specified in **[OData-ABNF]**.

Example 7: a request for customers and their orders would result in a response containing one collection with customer entities and for every customer a separate collection with order entities. The client could specify `odata.maxpagesize=50` in order to request that each page of results contain a maximum of 50 customers, each with a maximum of 50 orders.

If a collection within the result contains more than the specified `odata.maxpagesize`, the collection SHOULD be a partial set of the results with a next link to the next page of results. The client MAY specify a different value for this preference with every request following a next link.

In the example given above, the result page should include a next link for the customer collection, if there are more than 50 customers, and additional next links for all returned orders collections with more than 50 entities.

If the client has specified the `odata.maxpagesize` preference in the request, and the service limits the number of items in collections within the response through server-driven paging, the service MAY include a `Preference-Applied` response header containing the `odata.maxpagesize` preference and the maximum page size applied. This value may differ from the value requested by the client.

8.2.8.6 Preference `odata.track-changes`

The `odata.track-changes` preference is used to request that the service return a delta link that can subsequently be used to obtain changes (deltas) to this result. The syntax of the `odata.track-changes` preference is specified in **[OData-ABNF]**.

For paged results, the preference MUST be specified on the initial request. Services MUST ignore the `odata.track-changes` preference if applied to the next link.

The delta link MUST NOT be returned prior to the final page of results.

The service includes a `Preference-Applied` response header in the first page of the response containing the `odata.track-changes` preference to signal that changes are being tracked.

A service MAY specify the support for the `odata.track-changes` preference using an annotation with term `Capabilities.ChangeTrackingSupport`, see **[OData-VocCap]**.

8.2.8.7 Preference `return=representation` and `return=minimal`

The `return=representation` and `return=minimal` preferences are defined in **[RFC7240]**.

In OData, `return=representation` or `return=minimal` is defined for use with a `POST`, `PUT`, or `PATCH` Data Modification Request other than to a stream property, or to an Action Request. Specifying a preference of `return=representation` or `return=minimal` in a `GET` or `DELETE` request, or any request to a stream property, SHOULD return a `4xx Client Error`.

A preference of `return=representation` or `return=minimal` is allowed on an individual Data Modification Request or Action Request within a batch, subject to the same restrictions, but SHOULD return a `4xx Client Error` if specified on the batch request itself.

A preference of `return=minimal` requests that the service invoke the request but does not return content in the response. The service MAY apply this preference by returning `204 No Content` in which case it MAY include a `Preference-Applied` response header containing the `return=minimal` preference.

A preference of `return=representation` requests that the service invokes the request and returns the modified resource. The service MAY apply this preference by returning the representation of the successfully modified resource in the body of the response, formatted according to the rules specified for the requested format. In this case the service MAY include a `Preference-Applied` response header containing the `return=representation` preference.

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8.2.8.8 Preference `respond-async`

The `respond-async` preference, as defined in **[RFC7240]**, allows clients to request that the service process the request asynchronously.

If the client has specified `respond-async` in the request, the service MAY process the request asynchronously and return a `202 Accepted` response.

The `respond-async` preference MAY be used for batch requests, but the service MUST ignore the `respond-async` preference for individual requests within a batch request.

In the case that the service applies the `respond-async` preference it MUST include a `Preference-Applied` response header containing the `respond-async` preference.

A service MAY specify the support for the `respond-async` preference using an annotation with term `Capabilities.AsynchronousRequestsSupported`, see **[OData-VocCap]**.

Example 8: a service receiving the following header might choose to respond

- *asynchronously if the synchronous processing of the request will take longer than 10 seconds*
- *synchronously after 5 seconds*
- *asynchronously (ignoring the `wait` preference)*
- *synchronously after 15 seconds (ignoring `respond-`async preference and the `wait` preference)*

```
Prefer: respond-async, wait=10
```

8.2.8.9 Preference `wait`

The `wait` preference, as defined in **[RFC7240]**, is used to establish an upper bound on the length of time, in seconds, the client is prepared to wait for the service to process the request synchronously once it has been received.

If the `respond-async` preference is also specified, the client requests that the service respond asynchronously after the specified length of time.

If the `respond-async` preference has not been specified, the service MAY interpret the `wait` as a request to timeout after the specified period of time.

8.3 Response Headers

In addition to the Common Headers, the following response headers have defined meaning in OData.

8.3.1 Header `ETag`

A request that returns an individual resource MAY include an `ETag` header in the response. Services MUST include this header in such a response if they require it to be specified when modifying the resource.

The value specified in the `ETag` header may be specified in the `If-Match` or `If-None-Match` header of a subsequent Data Modification Request or Action Request in order to apply optimistic concurrency in updating, deleting, or invoking the action bound to the entity.

As OData allows multiple formats for representing the same structured information, services SHOULD use weak ETags that only depend on the format-independent entity state is recommended. A strong ETag MUST change whenever the representation of an entity changes, so it has to depend on the `Content-Type`, the `Content-Language`, and potentially other characteristics of the response.

An `ETag` header MAY also be returned on a metadata document request or service document request to allow the client subsequently to make a conditional request for the metadata or service document. Clients can also compare the value of the `ETag` header returned from a metadata document request to the

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metadata ETag returned in a response in order to verify the version of the metadata used to generate that response.

8.3.2 Header `Location`

The `Location` header MUST be returned in the response from a Create Entity or Create Media Entity request to specify the edit URL, or for read-only entities the read URL, of the created entity, and in responses returning `202 Accepted` to specify the URL that the client can use to request the status of an asynchronous request.

8.3.3 Header `OData-EntityId`

A response to a create operation that returns `204 No Content` MUST include an `OData-EntityId` response header. The value of the header is the entity-id of the entity that was acted on by the request. The syntax of the `OData-EntityId` preference is specified in **[OData-ABNF]**.

8.3.4 Header `Preference-Applied`

In a response to a request that specifies a `Prefer` header, a service MAY include a `Preference-Applied` header, as defined in **[RFC7240]**, specifying how individual preferences within the request were handled.

The value of the `Preference-Applied` header is a comma-separated list of preferences applied in the response. For more information on the individual preferences, see the `Prefer` header.

8.3.5 Header `Retry-After`

A service MAY include a `Retry-After` header in `202 Accepted` and in `3xx Redirect` responses

The `Retry-After` header specifies the duration of time, in seconds, that the client is asked to wait before retrying the request or issuing a request to the resource returned as the value of the `Location` header.

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9 Common Response Status Codes

An OData service MAY respond to any request using any valid HTTP status code appropriate for the request. A service SHOULD be as specific as possible in its choice of HTTP status codes.

The following represent the most common success response codes. In some cases, a service MAY respond with a more specific success code.

9.1 Success Responses

The following response codes represent successful requests.

9.1.1 Response Code `200 OK`

A request that does not create a resource returns `200 OK` if it is completed successfully and the value of the resource is not `null`. In this case, the response body MUST contain the value of the resource specified in the request URL.

9.1.2 Response Code `201 Created`

A Create Entity, Create Media Entity, Create Link or Invoke Action request that successfully creates a resource returns `201 Created`. In this case, the response body MUST contain the resource created.

9.1.3 Response Code `202 Accepted`

`202 Accepted` indicates that the Data Service Request has been accepted and has not yet completed executing asynchronously. The asynchronous handling of requests is specified in section 11.6, and in section 11.7.5 for batch requests.

9.1.4 Response Code `204 No Content`

A request returns `204 No Content` if the requested resource has the `null` value, or if the service applies a `return=minimal` preference. In this case, the response body MUST be empty.

As defined in **[RFC7231]**, a Data Modification Request that responds with `204 No Content` MUST NOT include an `ETag` header unless the request's representation data was saved without any transformation applied to the body (i.e., the resource's new representation data is identical to the representation data received in the `PUT` request) and the `ETag` value reflects the new representation.

9.1.5 Response Code `3xx Redirection`

As per **[RFC7231]**, a `3xx Redirection` indicates that further action needs to be taken by the client in order to fulfill the request. In this case, the response SHOULD include a `Location` header, as appropriate, with the URL from which the result can be obtained; it MAY include a `Retry-After` header.

9.1.6 Response Code `304 Not Modified`

As per **[RFC7231]**, a `304 Not Modified` is returned when the client performs a `GET` request containing an `If-None-Match` header and the content has not changed. In this case the response SHOULD NOT include other headers in order to prevent inconsistencies between cached entity-bodies and updated headers.

The service MUST ensure that no observable change has occurred to the state of the service as a result of any request that returns a `304 Not Modified`.

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9.2 Client Error Responses

Error codes in the `4xx` range indicate a client error, such as a malformed request.

The service MUST ensure that no observable change has occurred to the state of the service as a result of any request that returns an error status code.

In the case that a response body is defined for the error code, the body of the error is as defined for the appropriate format.

9.2.1 Response Code `404 Not Found`

`404 Not Found` indicates that the resource specified by the request URL does not exist. The response body MAY provide additional information.

9.2.2 Response Code `405 Method Not Allowed`

`405 Method Not Allowed` indicates that the resource specified by the request URL does not support the request method. In this case the response MUST include an `Allow` header containing a list of valid request methods for the requested resource as specified in **[RFC7231]**.

9.2.3 Response Code `410 Gone`

`410 Gone` indicates that the requested resource is no longer available. This can happen if a client has waited too long to follow a delta link or a status-monitor-resource link, or a next link on a collection that was requested with snapshot isolation.

9.2.4 Response Code `412 Precondition Failed`

As specified in **[RFC7230]**, `412 Precondition Failed` indicates that the client has performed a conditional request and the resource fails the condition. The service MUST ensure that no observable change occurs as a result of the request.

9.3 Server Error Responses

As specified in **[RFC7231]**, error codes in the `5xx` range indicate service errors.

9.3.1 Response Code `501 Not Implemented`

If the client requests functionality not implemented by the OData Service, the service MUST respond with `501 Not Implemented` and the response body SHOULD describe the functionality not implemented.

9.4 In-Stream Errors

In the case that the service encounters an error after sending a success status to the client, the service MUST generate an error within the payload, which may leave the response malformed. Clients MUST treat the entire response as being in error.

This specification does not prescribe a particular format for generating errors within a payload.

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10 Context URL

The *context URL* describes the content of the payload. It consists of the canonical metadata document URL and a fragment identifying the relevant portion of the metadata document.

Request payloads generally do not require context URLs as the type of the payload can generally be determined from the request URL.

For details on how the context URL is used to describe a payload, see the relevant sections in the particular format.

The following subsections describe how the context URL is constructed for each category of payload by providing a *context URL template*. The context URL template uses the following terms:

- `{context-url}` is the canonical resource path to the `$metadata` document,
- `{entity-set}` is the name of an entity set or path to a containment navigation property,
- `{entity}` is the canonical URL for an entity,
- `{singleton}` is the canonical URL for a singleton entity,
- `{select-list}` is an optional parenthesized comma-separated list of selected properties, functions and actions,
- `{property-path}` is the path to a structural property of the entity,
- `{type-name}` is a qualified type name,
- `{/type-name}` is an optional type-cast segment containing the qualified name of a derived type prefixed with a forward slash.

The full grammar for the context URL is defined in **[OData-ABNF]**.

10.1 Service Document

Context URL template:

```
{context-url}
```

The context URL of the service document is the metadata document URL of the service.

Example 9: resource URL and corresponding context URL

```
http://host/service/
http://host/service/$metadata
```

10.2 Collection of Entities

Context URL template:

```
{context-url}#{entity-set}
```

```
{context-url}#Collection({type-name})
```

If all entities in the collection are members of one entity set, its name is the context URL fragment.

Example 10: resource URL and corresponding context URL

```
http://host/service/Customers
http://host/service/$metadata#Customers
```

If the entities are contained, then `entity-set` is the top-level entity set followed by the path to the containment navigation property of the containing entity.

Example 11: resource URL and corresponding context URL for contained entities

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```
http://host/service/Orders(4711)/Items
http://host/service/$metadata#Orders(4711)/Items
```

If the entities in the response are not bound to a single entity set, such as from a function or action with no entity set path, a function import or action import with no specified entity set, or a navigation property with no navigation property binding, the context URL specifies the type of the returned entity collection.

10.3 Entity

Context URL template:

```
{context-url}#{entity-set}/$entity
```

```
{context-url}#{type-name}
```

If a response or response part is a single entity of the declared type of an entity set, `/$entity` is appended to the context URL.

Example 12: resource URL and corresponding context URL

```
http://host/service/Customers(1)
http://host/service/$metadata#Customers/$entity
```

If the entity is contained, then `entity-set` is the canonical URL for the containment navigation property of the containing entity, e.g. Orders(4711)/Items.

Example 13: resource URL and corresponding context URL for contained entity

```
http://host/service/Orders(4711)/Items(1)
http://host/service/$metadata#Orders(4711)/Items/$entity
```

If the response is not bound to a single entity set, such as an entity returned from a function or action with no entity set path, a function import or action import with no specified entity set, or a navigation property with no navigation property binding, the context URL specifies the type of the returned entity.

10.4 Singleton

Context URL template:

```
{context-url}#{singleton}
```

If a response or response part is a singleton, its name is the context URL fragment.

Example 14: resource URL and corresponding context URL

```
http://host/service/Contoso
http://host/service/$metadata#Contoso
```

10.5 Collection of Derived Entities

Context URL template:

```
{context-url}#{entity-set}{/type-name}
```

If an entity set consists exclusively of derived entities, a type-cast segment is added to the context URL.

Example 15: resource URL and corresponding context URL

```
http://host/service/Customers/Model.VipCustomer
http://host/service/$metadata#Customers/Model.VipCustomer
```

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10.6 Derived Entity

Context URL template:

```
{context-url}#{entity-set}{/type-name}/$entity
```

If a response or response part is a single entity of a type derived from the declared type of an entity set, a type-cast segment is appended to the entity set name.

Example 16: resource URL and corresponding context URL

```
http://host/service/Customers(2)/Model.VipCustomer
http://host/service/$metadata#Customers/Model.VipCustomer/$entity
```

10.7 Collection of Projected Entities

Context URL templates:

```
{context-url}#{entity-set}{/type-name}{select-list}
```

```
{context-url}#Collection({type-name}){select-list}
```

If a result contains only a subset of properties, the parenthesized comma-separated list of the selected defined or dynamic properties, navigation properties, functions, and actions is appended to the `{entity-set}` after an optional type-cast segment, or the type of the entity collection if the response is not bound to a single entity set. The shortcut `*` represents the list of all structural properties. Properties defined on types derived from the declared type of the entity set (or type specified in the type-cast segment if specified) are prefixed with the qualified name of the derived type as defined in **[OData-ABNF]**OData-ABNF.

Example 17: resource URL and corresponding context URL

```
http://host/service/Customers?$select=Address,Orders
http://host/service/$metadata#Customers(Address,Orders)
```

10.8 Projected Entity

Context URL templates:

```
{context-url}#{entity-set}{/type-name}{select-list}/$entity
```

```
{context-url}#{singleton}{select-list}
```

```
{context-url}#{type-name}{select-list}
```

If a single entity contains a subset of properties, the parenthesized comma-separated list of the selected defined or dynamic properties, navigation properties, functions, and actions is appended to the `{entity-set}` after an optional type-cast segment and prior to appending `/$entity`. If the response is not bound to a single entity set, the `{select-list}` is instead appended to the `{type-name}` of the returned entity.

The shortcut `*` represents the list of all structural properties. Properties defined on types derived from the type of the entity set (or type specified in the type-cast segment if specified) are prefixed with the qualified name of the derived type as defined in **[OData-ABNF]**OData-ABNF. Note that expanded properties are implicitly selected.

Example 18: resource URL and corresponding context URL

```
http://host/service/Customers(1)?$select=Name,Rating
http://host/service/$metadata#Customers(Name,Rating)/$entity
```

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10.9 Collection of Projected Expanded Entities

Context URL template:

```
{context-url}#{entity-set}{/type-name}{select-list}
```

```
{context-url}#Collection({type-name}){select-list}
```

If a navigation property is explicitly selected, the parenthesized comma-separated list of properties includes the name of the selected navigation property with no parenthesis. If a `$expand` contains a nested `$select`, the navigation property appears suffixed with the parenthesized comma-separated list of properties selected (or expanded, containing a `$select`) from the related entities. Additionally, if the expansion is recursive for nested children, a plus sign (+) is infixed between the navigation property name and the list of properties.

Example 19: resource URL and corresponding context URL

```
http://host/service/Customers$select=Name&$expand=Address/Country
http://host/service/$metadata#Customers(Name,Address/Country)
```

Example 20: resource URL and corresponding context URL

```
http://host/service/Employees/Sales.Manager?$select=DirectReports
                &$expand=DirectReports($select=FirstName,LastName;$levels=4)
http://host/service/$metadata
                #Employees/Sales.Manager(DirectReports,
                                         DirectReports+(FirstName,LastName))
```

10.10 Projected Expanded Entity

Context URL template:

```
{context-url}#{entity-set}{/type-name}{select-list}/$entity
```

```
{context-url}#{singleton}{select-list}
```

```
{context-url}#{type-name}{select-list}
```

If a single entity is expanded and projected (or contains a `$expand` with a `$select` expand option), the parenthesized comma-separated list of selected properties includes the name of the expanded navigation properties containing a nested `$select`, each suffixed with the parenthesized comma-separated list of properties selected (or expanded with a nested `$select`) from the related entities.

Example 21: resource URL and corresponding context URL

```
http://host/service/Employees(1)/Sales.Manager?
                  $expand=DirectReports($select=FirstName,LastName;$levels=4)
http://host/service/$metadata
       #Employees/Sales.Manager(DirectReports+(FirstName,LastName))/$entity
```

10.11 Collection of Entity References

Context URL template:

```
{context-url}#Collection($ref)
```

If a response is a collection of entity references, the context URL does not contain the type of the referenced entities.

Example 22: resource URL and corresponding context URL for a collection of entity references

```
http://host/service/Customers('ALFKI')/Orders/$ref
http://host/service/$metadata#Collection($ref)
```

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10.12 Entity Reference

Context URL template:

```
{context-url}#$ref
```

If a response is a single entity reference, `$ref` is the context URL fragment.

Example 23: resource URL and corresponding context URL for a single entity reference

```
http://host/service/Orders(10643)/Customer/$ref
http://host/service/$metadata#$ref
```

10.13 Property Value

Context URL template:

```
{context-url}#{entity}/{property-path}{select-list}
```

If a response represents an individual property of an entity with a canonical URL, the context URL specifies the canonical URL of the entity and the path to the structural property of that entity. The path MUST include cast segments for properties defined on types derived from the expected type of the previous segment.

Example 24: resource URL and corresponding context URL

```
http://host/service/Customers(1)/Addresses
http://host/service/$metadata#Customers(1)/Addresses
```

10.14 Collection of Complex or Primitive Types

Context URL template:

```
{context-url}#Collection({type-name}){select-list}
```

If a response is a collection of complex types or primitive types that do not represent an individual property of an entity with a canonical URL, the context URL specifies the fully qualified type of the collection.

Example 25: resource URL and corresponding context URL

```
http://host/service/TopFiveHobbies()
http://host/service/$metadata#Collection(Edm.String)
```

10.15 Complex or Primitive Type

Context URL template:

```
{context-url}#{type-name}{select-list}
```

If a response is a complex type or primitive type that does not represent an individual property of an entity with a canonical URL, the context URL specifies the fully qualified type of the result.

Example 26: resource URL and corresponding context URL

```
http://host/service/MostPopularName()
http://host/service/$metadata#Edm.String
```

10.16 Operation Result

Context URL templates:

```
{context-url}#{entity-set}{/type-name}{select-list}
```

```
{context-url}#{entity-set}{/type-name}{select-list}/$entity
```

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```
{context-url}#{entity}/{property-path}{select-list}
```

```
{context-url}#Collection({type-name}){select-list}
```

```
{context-url}#{type-name}{select-list}
```

If the response from an action or function is a collection of entities or a single entity that is a member of an entity set, the context URL identifies the entity set. If the response from an action or function is a property of a single entity, the context URL identifies the entity and property. Otherwise, the context URL identifies the type returned by the operation. The context URL will correspond to one of the former examples.

Example 27: resource URL and corresponding context URL

```
http://host/service/TopFiveCustomers{}
http://host/service/$metadata#Customers
```

10.17 Delta Response

Context URL template:

```
{context-url}#{entity-set}{/type-name}{select-list}/$delta
```

The context URL of a delta response is the same as the context URL of the root entity set, followed by `/$delta`.

Example 28: resource URL and corresponding context URL

```
http://host/service/Customers?$deltaToken=1234
http://host/service/$metadata#Customers/$delta
```

10.18 Item in a Delta Response

Context URL templates:

```
{context-url}#{entity-set}/$deletedEntity
```

```
{context-url}#{entity-set}/$link
```

```
{context-type}#{entity-set}/$deletedLink
```

In addition to new or changed entities which have the canonical context URL for an entity a delta response can contain deleted entities, new links, and deleted links. They are identified by the corresponding context URL fragment. `{entity-set}` corresponds to the set of the deleted entity, or source entity for an added or deleted link.

10.19 `$all` Response

Context URL template:

```
{context-url}#Collection(Edm.EntityType)
```

Responses to requests to the virtual collection `$all` (see **[OData-URL]**) use the built-in abstract entity type. Each single entity in such a response has its individual context URL that identifies the entity set or singleton.

10.20 `$crossjoin` Response

Context URL template:

```
{context-url}#Collection(Edm.ComplexType)
```

Responses to requests to the virtual collections `$crossjoin(...)` (see **[OData-URL]**) use the built-in abstract complex type. Single instances in these responses do not have a context URL.

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11 Data Service Requests

11.1 Metadata Requests

An OData service is a self-describing service that exposes metadata defining the entity sets, relationships, entity types, and operations.

11.1.1 Service Document Request

Service documents enable simple hypermedia-driven clients to enumerate and explore the resources offered by the data service.

OData services MUST support returning a service document from the root URL of the service (the *service root*).

The format of the service document is dependent upon the format selected. For example, in Atom the service document is an AtomPub service document (as specified in **[RFC5023]**).

11.1.2 Metadata Document Request

An OData *Metadata Document* is a representation of the data model that describes the data and operations exposed by an OData service.

[OData-CSDL] describes an XML representation for OData metadata documents and provides an XML schema to validate their contents. The media type of the XML representation of an OData metadata document is `application/xml`.

OData services MUST expose a metadata document that describes the data model exposed by the service. The *Metadata Document URL* MUST be the root URL of the service with `$metadata` appended. To retrieve this document the client issues a `GET` request to the metadata document URL.

If a request for metadata does not specify a format preference (via `Accept` header or `$format`) then the XML representation MUST be returned.

11.1.3 Metadata Service Document Request

An OData Service MAY expose a Metadata Service. An OData *Metadata Service* is a representation of the data model that describes the data and operations exposed by an OData service as an OData service with a fixed (meta) data model.

A metadata service MUST use the schema defined in **[OData-CSDL]**. The root URL of the metadata service is the metadata document URL of the service with a forward slash appended. To retrieve this document the client issues a `GET` request to the metadata service root URL

11.2 Requesting Data

OData services support requests for data via HTTP `GET` requests.

The path of the URL specifies the target of the request (for example; the collection of entities, entity, navigation property, structural property, or operation). Additional query operators, such as filter, sort, page, and projection operations are specified through query options.

This section describes the types of data requests defined by OData. For complete details on the syntax for building requests, see **[OData-URL]**.

OData services are hypermedia driven services that return URLs to the client. If a client subsequently requests the advertised resource and the URL has expired, then the service SHOULD respond with `410 Gone`. If this is not feasible, the service MUST respond with `404 Not Found`.

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The format of the returned data is dependent upon the request and the format specified by the client, either in the `Accept` header or using the `$format` query option.

11.2.1 Evaluating System Query Options

OData defines a number of system query options that allow refining the request. The result of the request MUST be as if the system query options were evaluated in the following order.

Prior to applying any server-driven paging:

- `$search`
- `$filter`
- `$count`
- `$orderby`
- `$skip`
- `$top`

After applying any server-driven paging:

- `$expand`
- `$select`
- `$format`

11.2.2 Requesting Individual Entities

To retrieve an individual entity, the client makes a `GET` request to the read URL of an entity.

The read URL can be obtained from a response payload containing that instance, for example as a self-link in an **[OData-Atom]** payload. In addition, Services MAY support conventions for constructing a read URL using the entity's key value(s), as described in **[OData-URL]**.

The set of structural or navigation properties to return may be specified through `$select` or `$expand` system query options.

Clients MUST be prepared to receive additional properties in an entity or complex type instance that are not advertised in metadata, even for types not marked as open.

Properties that are not available, for example due to permissions, are not returned. In this case, the `Core.Permissions` annotation, defined in **[OData-VocCore]** MUST be returned for the property with a value of `Core.Permission'None'`.

If no entity exists with the key values specified in the request URL, the service responds with `404 Not Found`.

11.2.3 Requesting Individual Properties

To retrieve an individual property, the client issues a `GET` request to the property URL. The property URL is the entity read URL with "/" and the property name appended.

For complex typed properties, the path can be further extended with the name of an individual property of the complex type.

See **[OData-URL]** for details.

If the property is single-valued and has the `null` value, the service responds with `204 No Content`.

If the property is not available, for example due to permissions, the service responds with `404 Not Found`.

Example 29:

```
http://host/service/Products(1)/Name
```

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11.2.3.1 Requesting a Property's Raw Value using `$value`

To retrieve the raw value of a primitive type property, the client sends a `GET` request to the property value URL. See the **[OData-URL]** document for details.

The `Content-Type` of the response is determined using the `Accept` header and the `$format` system query option.

The default format for single primitive values except `Edm.Binary` and the `Edm.Geo` types is `text/plain`.

The default format for `Edm.Geo` types is `text/plain` using the WKT (well-known text) format, see rules `fullCollectionLiteral`, `fullLineStringLiteral`, `fullMultiPointLiteral`, `fullMultiLineStringLiteral`, `fullMultiPolygonLiteral`, `fullPointLiteral`, and `fullPolygonLiteral` in **[OData-ABNF]**.

The default format for `Edm.Binary` is the format specified by the `Core.MediaType` annotation of this property (see **[OData-VocCore]**) if this annotation is present. If not annotated, the format cannot be predicted by the client.

A `$value` request for a property that is `null` results in a `204 No Content` response.

If the property is not available, for example due to permissions, the service responds with `404 Not Found`.

Example 30:

```
http://host/service/Products(1)/Name/$value
```

11.2.4 Specifying Properties to Return

The `$select` and `$expand` system query options enable the client to specify the set of structural properties and navigation properties to include in a response. The service MAY include additional properties not specified in `$select` and `$expand`, including properties not defined in the metadata document.

11.2.4.1 System Query Option `$select`

The `$select` system query option requests that the service return only the properties, dynamic properties, actions and functions explicitly requested by the client. The service returns the specified content, if available, along with any available expanded navigation properties, and MAY return additional information.

The value of the `$select` query option is a comma-separated list of properties, qualified action names, qualified function names, the star operator (`*`), or the star operator prefixed with the namespace or alias of the schema in order to specify all operations defined in the schema.

Example 31: request only the `Rating` and `ReleaseDate` for the matching Products

```
http://host/service/Products?$select=Rating,ReleaseDate
```

It is also possible to request all structural properties, including any dynamic properties, using the star operator. The star operator SHOULD NOT introduce navigation properties, actions or functions not otherwise requested.

Example 32:

```
http://host/service/Products?$select=*
```

Properties of related entities can be specified by including the `$select` query option within the `$expand`.

Example 33:

```
http://host/service/Products?$expand=Category($select=Name)
```

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The properties specified in `$select` are in addition to any expanded navigation properties.

Example 34: these two requests are equivalent

```
http://host/service/Categories?$select=CategoryName&$expand=Products
http://host/service/Categories?$select=CategoryName,Products&$expand=Products
```

It is also possible to request all actions or functions available for each returned entity.

Example 35:

```
http://host/service/Products?$select=DemoService.*
```

If the `$select` query option is not specified, the service returns the full set of properties or a default set of properties. The default set of properties MUST include all key properties.

If the service returns less than the full set of properties, either because the client specified a select or because the service returned a subset of properties in the absence of a select, the context URL MUST reflect the set of selected properties and expanded navigation properties.

11.2.4.2 System Query Option `$expand`

The `$expand` system query option indicates the related entities that MUST be represented inline. The service MUST return the specified content, and MAY choose to return additional information.

The value of the `$expand` query option is a comma-separated list of navigation property names, optionally followed by a `/$ref` path segment or a `/$count` path segment, and optionally a parenthesized set of expand options (for filtering, sorting, selecting, paging, or expanding the related entities).

For a full description of the syntax used when building requests, see **[OData-URL]**.

Example 36: for each customer entity within the Customers entity set the value of all related Orders will be represented inline

```
http://host/service.svc/Customers?$expand=Orders
```

Example 37: for each customer entity within the Customers entity set the references to the related Orders will be represented inline

```
http://host/service.svc/Customers?$expand=Orders/$ref
```

11.2.4.2.1 Expand Options

The set of expanded entities can be further refined through the application of expand options, expressed as a semicolon-separated list of system query options, enclosed in parentheses, see **[OData-URL]**.

Allowed system query options are `$filter`, `$select`, `$orderby`, `$skip`, `$top`, `$count`, `$search`, `$expand`, and `$levels`.

Example 38: for each customer entity within the `Customers` entity set, the value of those related `Orders` whose `Amount` is greater than 100 will be represented inline

```
http://host/service.svc/Customers?$expand=Orders($filter=Amount gt 100)
```

Example 39: for each order within the `Orders` entity set, the following will be represented inline:

- *The `Items` related to the `Orders` identified by the resource path section of the URL and the products related to each order item.*
- *The `Customer` related to each order returned.*

```
http://host/service.svc/Orders?$expand=Items($expand=Product),Customer
```

Example 40: for each customer entity in the Customers entity set, the value of all related InHouseStaff will be represented inline if the entity is of type VipCustomer or a subtype of that. For entities that are not of type

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`VipCustomer`, or any of its subtypes, that entity may be returned with no inline representation for the expanded navigation property `InHouseStaff` (the service can always send more than requested)

```
http://host/service.svc/Customers?$expand=SampleModel.VipCustomer/InHouseStaff
```

11.2.4.2.1.1 Expand Option `$levels`

The `$levels` expand option can be used to specify the number of levels of recursion for a hierarchy in which the related entity type is the same as, or can be cast to, the source entity type. The same expand options are applied at each level of the hierarchy.

Services MAY support the symbolic value `max` in addition to numeric values. In that case they MUST solve circular dependencies by injecting an entity reference somewhere in the circular dependency.

Clients using `$levels=max` MUST be prepared to handle entity references in cases were a circular reference would occur otherwise.

Example 41: return each employee from the Employees entity set and, for each employee that is a manager, return all direct reports, recursively to four levels

```
http://contoso.com/HR/Employees?$expand=Model.Manager/DirectReports($levels=4)
```

11.2.5 Querying Collections

OData services support querying collections of entities, complex type instances, and primitive values.

The target collection is specified through a URL, and query operations such as filter, sort, paging, and projection are specified as *system query options* provided as query options. The names of all system query options are prefixed with a dollar (`$`) character.

The same system query option MUST NOT be specified more than once for any resource.

An OData service MAY support some or all of the system query options defined. If a data service does not support a system query option, it MUST fail any request that contains the unsupported option and SHOULD return `501 Not Implemented`.

11.2.5.1 System Query Option `$filter`

The `$filter` system query option restricts the set of items returned.

Example 42: return all Products whose `Price` is less than $10.00

```
http://host/service/Products?$filter=Price lt 10.00
```

The `$count` segment may be used within a `$filter` expression to limit the items returned based on the exact count of related entities or items within a collection-valued property.

Example 43: return all Categories with less than 10 products

```
http://host/service/Categories?$filter=Products/$count lt 10
```

The value of the `$filter` option is a Boolean expression as defined in **[OData-ABNF]**.

11.2.5.1.1 Built-in Filter Operations

OData supports a set of built-in filter operations, as described in this section. For a full description of the syntax used when building requests, see **[OData-URL]**.

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Operator	Description	Example
Comparison Operators		
`eq`	Equal	`Address/City eq 'Redmond'`
`ne`	Not equal	`Address/City ne 'London'`
`gt`	Greater than	`Price gt 20`
`ge`	Greater than or equal	`Price ge 10`
`lt`	Less than	`Price lt 20`
`le`	Less than or equal	`Price le 100`
`has`	Has flags	`Style has Sales.Color'Yellow'`
Logical Operators		
`and`	Logical and	`Price le 200 and Price gt 3.5`
`or`	Logical or	`Price le 3.5 or Price gt 200`
`not`	Logical negation	`not endswith(Description,'milk')`
Arithmetic Operators		
`add`	Addition	`Price add 5 gt 10`
`sub`	Subtraction	`Price sub 5 gt 10`
`mul`	Multiplication	`Price mul 2 gt 2000`
`div`	Division	`Price div 2 gt 4`
`mod`	Modulo	`Price mod 2 eq 0`
Grouping Operators		
`( )`	Precedence grouping	`(Price sub 5) gt 10`

11.2.5.1.2 Built-in Query Functions

OData supports a set of built-in functions that can be used within `$filter` operations. The following table lists the available functions. For a full description of the syntax used when building requests, see **[OData-URL]**.

OData does not define an ISNULL or COALESCE operator. Instead, there is a `null` literal that can be used in comparisons.

Function	Example

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Function	Example
String Functions	
contains	contains(CompanyName,'freds')
endswith	endswith(CompanyName,'Futterkiste')
startswith	startswith(CompanyName,'Alfr')
length	length(CompanyName) eq 19
indexof	indexof(CompanyName,'lfreds') eq 1
substring	substring(CompanyName,1) eq 'lfreds Futterkiste'
tolower	tolower(CompanyName) eq 'alfreds futterkiste'
toupper	toupper(CompanyName) eq 'ALFREDS FUTTERKISTE'
trim	trim(CompanyName) eq 'Alfreds Futterkiste'
concat	concat(concat(City,', '), Country) eq 'Berlin, Germany'
Date Functions	
year	year(BirthDate) eq 0
month	month(BirthDate) eq 12
day	day(StartTime) eq 8
hour	hour(StartTime) eq 1
minute	minute(StartTime) eq 0
second	second(StartTime) eq 0
fractionalseconds	second(StartTime) eq 0
date	date(StartTime) ne date(EndTime)
time	time(StartTime) le StartOfDay
totaloffsetminutes	totaloffsetminutes(StartTime) eq 60
now	StartTime ge now()
mindatetime	StartTime eq mindatetime()
maxdatetime	EndTime eq maxdatetime()
Math Functions	
round	round(Freight) eq 32
floor	floor(Freight) eq 32
ceiling	ceiling(Freight) eq 33

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Function	Example
Type Functions	
`cast`	`cast(ShipCountry,Edm.String)`
`isof`	`isof(NorthwindModel.Order)`
`isof`	`isof(ShipCountry,Edm.String)`
Geo Functions	
`geo.distance`	`geo.distance(CurrentPosition,TargetPosition)`
`geo.length`	`geo.length(DirectRoute)`
`geo.intersects`	`geo.intersects(Position,TargetArea)`

11.2.5.1.3 Parameter Aliases

Parameter aliases can be used in place of literal values in function parameters or within a `$filter` or `$orderby` expression. Parameters aliases are names beginning with an at sign (`@`).

Actual parameter values are specified as query options in the query part of the request URL. The query option name is the name of the parameter alias, and the query option value is the value to be used for the specified parameter alias.

Example 44: returns all employees whose Region property matches the string parameter value "WA"

```
http://host/service.svc/Employees?$filter=Region eq @p1&@p1='WA'
```

Parameter aliases allow the same value to be used multiple times in a request and may be used to reference primitive values, complex, or collection values.

If a parameter alias is not given a value in the Query part of the request URL, the value MUST be assumed to be null. A parameter alias can be used in multiple places within a request URL but its value MUST NOT be specified more than once.

11.2.5.2 System Query Option `$orderby`

The `$orderby` System Query option specifies the order in which items are returned from the service.

The value of the `$orderby` System Query option contains a comma-separated list of expressions whose primitive result values are used to sort the items. A special case of such an expression is a property path terminating on a primitive property. A type cast using the qualified entity type name is required to order by a property defined on a derived type.

The expression can include the suffix `asc` for ascending or `desc` for descending, separated from the property name by one or more spaces. If `asc` or `desc` is not specified, the service MUST order by the specified property in ascending order.

Null values come before non-null values when sorting in ascending order and after non-null values when sorting in descending order.

Items are sorted by the result values of the first expression, and then items with the same value for the first expression are sorted by the result value of the second expression, and so on.

Example 45: return all Products ordered by release date in ascending order, then by rating in descending order

```
http://host/service/Products?$orderby=ReleaseDate asc, Rating desc
```

Related entities may be ordered by specifying `$orderby` within the `$expand` clause.

Example 46: return all Categories, and their Products ordered according to release date and in descending order of rating

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```
http://host/service/Categories?
   $expand=Products($orderby=ReleaseDate asc, Rating desc)
```

`$count` may be used within a `$orderby` expression to order the returned items according to the exact count of related entities or items within a collection-valued property.

Example 47: return all Categories ordered by the number of Products within each category

```
http://host/service/Cateoriges?$orderby=Products/$count
```

11.2.5.3 System Query Option `$top`

The `$top` system query option specifies a non-negative integer n that limits the number of items returned from a collection. The service returns the number of available items up to but not greater than the specified value n.

Example 48: return only the first five products of the Products entity set

```
http://host/service/Products?$top=5
```

If no unique ordering is imposed through an `$orderby` query option, the service MUST impose a stable ordering across requests that include `$top`.

11.2.5.4 System Query Option `$skip`

The `$skip` system query option specifies a non-negative integer n that excludes the first n items of the queried collection from the result. The service returns items starting at position n+1.

Example 49: return products starting with the 6th product of the `Products` entity set

```
http://host/service/Products?$skip=5
```

Where `$top` and `$skip` are used together, `$skip` MUST be applied before `$top`, regardless of the order in which they appear in the request.

Example 50: return the third through seventh products of the `Products` entity set

```
http://host/service/Products?$top=5&$skip=2
```

If no unique ordering is imposed through an `$orderby` query option, the service MUST impose a stable ordering across requests that include `$skip`.

11.2.5.5 System Query Option `$count`

The `$count` system query option with a value of `true` specifies that the total count of items within a collection matching the request be returned along with the result.

Example 51: return, along with the results, the total number of products in the collection

```
http://host/service/Products?$count=true
```

The count of related entities can be requested by specifying the `$count` query option within the `$expand` clause.

Example 52:

```
http://host/service/Categories?$expand=Products($count=true)
```

A `$count` query option with a value of `false` (or not specified) hints that the service SHOULD NOT return a count.

The service returns an HTTP Status code of `400 Bad Request` if a value other than `true` or `false` is specified.

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