

OData Version 4.0 Part 1: Protocol

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Additional artifacts:

This prose specification is one component of a Work Product ~~which consists of~~ that also includes:

- *OData Version 4.0 Part 1: Protocol* (this document). ~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd01/part1-protocol/odata-v4.0-csprd01-part1-protocol.html>~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd02/part1-protocol/odata-v4.0-csprd02-part1-protocol.html>
- ~~*OData Version 4.0 Part 2: URL Conventions*. <http://docs.oasis-open.org/odata/odata/v4.0/csprd01/part2-url-conventions/odata-v4.0-csprd01-part2-url-conventions.html>~~
- *OData Version 4.0 Part 2: URL Conventions*. <http://docs.oasis-open.org/odata/odata/v4.0/csprd02/part2-url-conventions/odata-v4.0-csprd02-part2-url-conventions.html>
- *OData Version 4.0 Part 3: Common Schema Definition Language (CSDL)*. ~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd01/part3-csdl/odata-v4.0-csprd01-part3-csdl.html>~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd02/part3-csdl/odata-v4.0-csprd02-part3-csdl.html>
- ABNF components: *OData ABNF Construction Rules Version 4.0* and *OData ABNF Test Cases*. ~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd01/abnf/>~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd02/abnf/>
- Vocabulary components: *OData Core Vocabulary* ~~and~~ *OData Measures Vocabulary*. ~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd01/vocabularies/>~~ and *OData Capabilities Vocabulary*. <http://docs.oasis-open.org/odata/odata/v4.0/csprd02/vocabularies/>
- XML schemas: *OData EDMX XML Schema* and *OData EDM XML Schema*. ~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd01/schemas/>~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd02/schemas/>
- OData Metadata Service Entity Model: ~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd01/models/MetadataService.edmx>~~<http://docs.oasis-open.org/odata/odata/v4.0/csprd02/models/MetadataService.edmx>

Related work:

This specification is related to:

- *OData Atom Format Version 4.0*. Latest version. ~~<http://docs.oasis-open.org/odata/odata-atom-format/v4.0/odata-atom-format-v4.0.html>~~<http://docs.oasis-open.org/odata/odata-atom-format/v4.0/odata-atom-format-v4.0.html>.
- *OData JSON Format Version 4.0*. Latest version. ~~<http://docs.oasis-open.org/odata/odata-json-format/v4.0/odata-json-format-v4.0.html>~~<http://docs.oasis-open.org/odata/odata-json-format/v4.0/odata-json-format-v4.0.html>.

Declared XML namespaces:

- ~~<http://docs.oasis-open.org/odata/ns/edmx>~~
- ~~<http://docs.oasis-open.org/odata/ns/edm>~~
- <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 Identifiers (URIs) 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~~ OData version 4.0 defines the core semantics and facilities of the protocol, a set of recommended (but not required) rules for constructing URLs to identify the data and metadata exposed by an OData service as well as a set of reserved URL query string operators, an Entity Data Model (EDM), and an XML representation of the entity data model exposed by an OData service. OData Atom Format version 4.0 extends the former by defining representations for OData requests and responses using an Atom format.

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.

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When referencing this specification the following citation format should be used:

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1 Introduction

~~All text is normative unless otherwise labeled.~~

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] | <i>OData ABNF Construction Rules Version 4.0.</i>
See link in "Additional artifacts" section on cover page. |
| [OData-Atom] | <i>OData ATOM Format Version 4.0.</i>
See link in "Related work" section on cover page. |
| [OData-CSDL] | <i>OData Version 4.0 Part 3: Common Schema Definition Language (CSDL).</i>
See link in "Additional artifacts" section on cover page. |
| [OData-JSON] | <i>OData JSON Format Version 4.0.</i>
See link in "Related work" section on cover page. |
| [OData-URL] | <i>OData Version 4.0 Part 2: URL Conventions.</i>
See link in "Additional artifacts" section on cover page. |
| [OData-VocCap] | <i>OData Capabilities Vocabulary.</i>
See link in "Additional artifacts" section on cover page. |
| [OData-VocCore] | <i>OData Core Vocabulary.</i>
See link in "Additional artifacts" section on cover page. |
| [RFC2046] | Freed, N. and N. Borenstein, "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types", RFC 2046, November, 1996.
http://www.ietf.org/rfc/rfc2046.txt http://www.ietf.org/rfc/rfc2046.txt . |
| [RFC2119] | Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
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[HTTP-Semantics]	Fielding, R., Ed. and J. Reschke, Ed., "Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content" draft-ietf-httpbis-p2-semantics-22, 23 February 2013 https://datatracker.ietf.org/doc/draft-ietf-httpbis-p2-semantics/ https://datatracker.ietf.org/doc/draft-ietf-httpbis-p2-semantics/ .

1.3 Examples

[HTTP-Conditional]	Fielding, R., Ed. and J. Reschke, Ed., "Hypertext Transfer Protocol (HTTP/1.1): Conditional Requests" draft-ietf-httpbis-p4-conditional-22, 23 February 2013 https://datatracker.ietf.org/doc/draft-ietf-httpbis-p4-conditional/ .
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1.3 Typographical Conventions

Keywords defined by this specification use this monospaced font.

Normative source code uses this paragraph style.

Some sections of this specification are illustrated with non-normative examples.

Example 1: text describing an example OData request and response payloads. However, the text of this specification provides the definition of conformance uses this paragraph style

Non-normative examples use this paragraph style.

All ~~code~~ examples in this document are non-normative and informative only.

All other text is normative unless otherwise labeled.

2 Overview

The OData Protocol is an application-level protocol for interacting with data via RESTful ~~web services~~~~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 ~~unless there is a good and specific reason not to~~.
- 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.

3 Data Model

This section provides a high-level description of the *Entity Data Model (EDM)*: the abstract data model that ~~MUST be~~ used to describe the data exposed by an OData service. ~~An OData Metadata Document~~ 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, ~~operations~~ actions, and ~~containers~~ functions.

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

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

The ~~entity~~ 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 ~~nominal~~ named structured types consisting of a set of properties. These are value types ~~that lack identity~~ 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~~ may contain additional undeclared *dynamic properties*. A dynamic property ~~MUST NOT~~ cannot have the same name as a declared property. Entity or complex types which allow clients to persist additional undeclared properties are called *open-entity 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 ~~that MAY have~~ 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 containers and entity sets describe how entities are grouped.~~

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. An entity can be a member of at most one entity set: at any given point in time. Entity sets provide entry points into the data model.

Operations allow the execution of custom logic on parts of a data model. ~~Functions~~ Functions are operations that do not have side effects and can be further composed, for example, with additional filter operations, functions or an action. ~~Actions~~ Actions are operations that allow side effects, such as data modification, and ~~MUST NOT~~ 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.

~~Actions and functions are global to the service and MAY be bound to a type, enabling them to be called as members of an instance of that type. Action imports and function imports enable actions and functions to be called from an entity container.~~

~~Named entities are singleton entities that can be referenced from an entity container.~~

~~Named entity containers aggregate entity sets, named entities, function imports and action imports.~~

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]~~**[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.

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*.

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~~[service document](#) lists entity sets, functions, and ~~named entities~~[singletons](#) that can be retrieved. Clients can use the service document to navigate the model in a hypermedia-driven fashion.

The ~~metadata document~~[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~~[Requesting Data](#) and ~~Data Modification~~[Data Modification](#) for details.

4.1 Entity Ids and Resource Entity References

Whereas entities in the ~~data model~~[Data Model](#) are uniquely identified by their key values within an entity set, ~~entity instances~~[entities](#) within a payload are identified by a durable, opaque, globally unique *entity-id*. The entity-id MUST be an IRI as defined in [\[RFC3987\]](#). ~~Services are strongly encouraged to use URLs for entity-ids, but consumers MUST NOT assume this IRI can be used to locate the entity, nor assume any semantics from its structure.~~ 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.

~~Resource~~[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 ~~any addressable resource, such as an entity or the property of an entity.~~ *Entity references are resource references that 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.

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.

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 ~~SHOULD be~~are versioned according to the ~~OData-Version header.~~OData-Version header.

~~An OData client~~ includes the ~~OData-client SHOULD use the OData-MaxVersion-MaxVersion~~ header in requests in order to specify the maximum acceptable response version. ~~The service SHOULD~~Services respond with the maximum supported version ~~it supports~~ that is less than or equal to the requested OData-MaxVersion.

The syntax of the OData-Version and OData-MaxVersion header fields ~~MUST be of the following form:~~

~~majorversionnumber "." minorversionnumber~~is specified in [OData-ABNF].

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

5.2 Model Versioning

~~The Data Model~~The Data Model exposed by an OData Service defines a contract between the OData service and its clients. Services ~~MAY~~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 and does not conflict with an existing dynamic property
- Adding a navigation property that is nullable or collection-valued and does not conflict with an existing dynamic navigation property
- Adding a new entity type to the model that does not derive from any entity types exposed by existing entity sets, or returned by existing functions or actions
- Adding a new complex type to the model that does not derive from a complex type used within entity types of existing entity sets, or returned by existing functions or actions
- Adding a new entity set ~~to an entity container~~
- Adding a new ~~named entity to an entity container~~ singleton
- Adding an action, a function, an action import, or function import
- Adding an action ~~or function~~ parameter that is nullable ~~or has a default value~~
- 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 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.

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~~may support additional 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 not understand and MUST fail any request that contains unsupported OData query options defined in the version of this specification supported by the service.

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~~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~~OData-Version header.

6.3 Action/Function Extensibility

~~Actions and Functions~~Actions and Functions extend the set of operations that can be performed on or with a service or resource. Actions ~~MAY~~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~~\$filter or ~~\$orderby~~\$orderby system query option.

Fully qualified action and function names ~~MUST~~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

~~Vocabularies provide the ability to annotate metadata as well as instance data, and define~~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.

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 ~~MUST understand and comply with~~ conform to the processing requirements for the headers defined by this specification for that version. ~~Compliance means either honoring the semantics of the header field or failing the request.~~

Individual services ~~MAY~~ 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 ~~[OData-JSON] or [OData-Atom]~~ at least one of `[OData-JSON]` or `[OData-Atom]`, and MAY support additional formats for both request and response bodies.

7 Formats

The client MAY request a particular response format through the `Accept` header, as specified in ~~[RFC2616]~~, or through the `$format` System Query Option: ~~[RFC2616]~~, or through the system query option `$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 ~~SHOULD reply~~ 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.

8 Header Fields

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

8.1 Common Headers

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

8.1.1 Header Content-Type

As specified in ~~[RFC2616]~~[RFC2616], the format of an individual request or response body MUST be specified in the Content-Type header of the request or response.

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

8.1.2 Header Content-Encoding

As specified in [RFC2616], 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].

~~8.1.28~~8.1.3 Header Content-Length

As specified in ~~[RFC2616]~~[RFC2616], 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.

~~8.1.38~~8.1.4 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 ~~lesser of the~~minimum of the ~~OData-MaxVersion~~OData-MaxVersion, if specified, and the maximum version of the protocol that the service understands.

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~~Versioning.

8.2 Request Headers

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

8.2.1 Header Accept

As specified in ~~[RFC2616]~~[\[RFC2616\]](#), the client MAY specify the set of accepted ~~formats~~[formats](#) through the use of [with](#) the Accept Header.

If ~~the~~[a](#) media type specified in the Accept ~~Header~~[header](#) includes a charset format parameter and the request also contains an ~~Accept-Charset~~[Accept-Charset](#) header, then the Accept-Charset header MUST be used.

If the media type specified in the Accept ~~Header~~[header](#) does not include a charset format parameter, then the ~~Content-Type header~~[Content-Type header](#) of the response MUST NOT contain a charset format parameter.

8.2.2 Header Accept-Charset

As specified in ~~[RFC2616]~~[\[RFC2616\]](#), the client MAY specify the set of accepted character sets ~~through the use of~~ [with](#) the Accept-Charset Header.

8.2.3 Header If-Match

As specified in ~~[RFC2616]~~[\[RFC2616\]](#), 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 entity set is annotated with the term Core.OptimisticConcurrencyControl (see ~~[OData-VocCore]~~[\[OData-VocCore\]](#)) and the client does not specify an If-Match request header in a ~~Data Modification Request~~[Data Modification Request](#) or ~~Action Request~~[Action Request](#), the service MUST respond with a 428 Precondition Required ~~for this case~~ 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 [HTTP-Conditional])~~. If the value does not match the current ETag value of the entity for a ~~Data Modification Request or Action Request~~[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~~[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~~[update](#) and not an ~~upsert~~[upsert](#).

8.2.4 Header If-None-Match

As specified in ~~[RFC2616]~~[\[RFC2616\]](#), 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 "*".

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 [HTTP-Conditional])~~. If the value ~~does match~~[matches](#) the current ETag value of the entity, then for a GET request, the service SHOULD respond with ~~304 Not Modified~~[304 Not Modified](#), and for a ~~Data Modification Request~~[Data Modification Request](#) or ~~Action Request~~[Action Request](#), the service MUST respond with 412 Precondition Failed and MUST ensure that no observable change occurs as a result of the request.

~~The client MAY include an~~[An](#) If-None-Match header with a value of "*" in a PUT or PATCH request ~~in order to ensure that the upsert request is handled~~[results in an upsert request being processed](#) as an ~~insert~~[insert](#) and not an ~~update~~[update](#).

8.2.5 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].

8.2.5.8.2.6 Header OData-MaxVersion

Clients SHOULD specify an OData-MaxVersion request header.

If specified, the service MUST generate a response with an ~~OData-Version~~ `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~~, see [Versioning](#).

8.2.6.8.2.7 Header Prefer

The `Prefer` header, as defined in [HTTP-PREFER][HTTP-Prefer], allows clients to request certain behavior from the service. The service MUST ignore preference values that are either not supported or not known 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~~ `Preference-Applied` Header.

8.2.6.18.2.7.1 Preference `odata.allow-entityreferences`

~~Clients MAY specify a preference of~~ The `odata.allow-entityreferences` ~~in a request to retrieve data from~~ preference indicates that the service ~~if specified, the service MAY 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 ~~the client~~

~~has not specified~~ `odata.allow-entityreferences` ~~has not been specified in the request. The syntax of the~~ `odata.allow-entityreferences` ~~preference is specified in [OData-ABNF].~~

In the case ~~that the service honors~~ `odata.allow-entityreferences` preference it MUST include a ~~Preference-Applied~~ `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.

8.2.7.2 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 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/notification/token/12345"
```

8.2.6.28.2.7.3 Preference `odata.continue-on-error`

Clients MAY specify a preference of `The odata.continue-on-error` preference on a batch request in order 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].

8.2.6.38.2.7.4 Preference `odata.include-annotations`

Clients MAY specify a preference of `The odata.include-annotations` preference in a request for data or metadata in order metadata is used to specify a the set of desired annotations the client requests to be returned 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 in a data or metadata response, and, with "*" representing all.

The full syntax of the `odata.include-annotations` preference is as follows: defined in [OData-ABNF].

```
annotationsPreference = 'odata.include-annotations' EQ DQUOTE annotationsList DQUOTE
annotationsList = annotationIdentifier *(COMMA annotationIdentifier)
annotationIdentifier = [excludeOperator]
                        ( STAR
                        / annotationNamespace [ "." termName ] )
annotationNamespace = namespace [ "." STAR ]
excludeOperator = "-"
```

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.

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.

For example, the following Example 3: a `Prefer` header requests requesting all annotations within a metadata document to be returned:

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

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

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

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

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

The following Example 6: a `Prefer` header requests 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 ~~MAY include a Preference-Applied~~ SHOULD include a `Preference-Applied` response header containing the `odata.include-annotations` preference to specify the annotations ~~that MAY have been actually~~ included, where applicable, in the response. This value ~~MAY~~ may differ from the annotations requested in the ~~Prefer~~ `Prefer` header of the request.

~~8.2.6.4~~ 8.2.7.5 Preference `odata.maxpagesize`

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

~~For example, 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~~ a partial set of the results with a ~~next link~~ 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 ~~entries~~ entities.

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

~~8.2.6.5~~ 8.2.7.6 Preference `odata.track-changes`

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

For ~~paged results~~ paged results, the preference MUST be specified on ~~each requested page in order to obtain a delta~~ the initial request. Services MUST ignore the `odata.track-changes` preference if applied to the next link on the final page of results.

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

~~In the case that the~~ The service ~~honors the `odata.track-changes` preference by including a delta link in the final page of a response it MAY include a Preference-Applied~~ includes a `Preference-Applied` response header in the first page of the response containing the `odata.track-changes` preference. ~~This may be useful in server-driven paging scenarios 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].

~~8.2.6.6~~ 8.2.7.7 Preference `return=representation` and `return=minimal`

As defined in ~~[HTTP-PREFER]~~, clients MAY specify a preference of The `return=representation` or `return=minimal` preferences are defined in [HTTP-Prefer].

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

A preference of `return=representation` or `return=minimal` ~~MAY be specified~~ is allowed on an individual ~~Data Modification Request~~ Data Modification Request or ~~Action Request~~ 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 ~~invokes~~ invoke the request but does not return content in the response. The service MAY ~~honor~~ apply this ~~request by returning 204 No Content.~~ In the case that the service honors the `return=minimal` preference by returning no content, 204 No Content in which case it MAY include a ~~Preference-Applied~~ 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 entity. The service MAY ~~honor~~ apply this ~~request~~ preference by returning the successfully modified resource in the body of the response, formatted according to the rules specified for the requested ~~format~~ format. ~~In the this case that the service honors the `return=representation` preference by returning content it~~ MAY include a ~~Preference-Applied~~ Preference-Applied response header containing the `return=representation` preference.

~~8.2.6.78.2.7.8~~ 8.2.7.8 Preference `respond-async`

The `respond-async` preference, as defined in ~~[HTTP-PREFER]~~ [HTTP-Prefer], 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~~ 202 Accepted response.

The `respond-async` preference MAY be used ~~in combination with~~ for batch requests, but the `wait` 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-Vocab].

~~Example:~~ A 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
```

~~8.2.6.88.2.7.9~~ 8.2.7.9 Preference `wait`

The `wait` preference, as defined in ~~[HTTP-PREFER]~~ [HTTP-Prefer], ~~can be~~ 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~~, a service MAY specify 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~~If-Match or ~~If-None-Match~~If-None-Match header of a subsequent ~~Data Modification Request~~Data Modification Request or ~~Action Request~~Action Request in order to apply ~~optimistic concurrency~~optimistic concurrency in updating, deleting, or invoking the action bound to, the entity.

~~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~~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 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~~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~~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~~create operation that returns ~~204-No-Content~~204 No Content MUST include an `OData-EntityId` response header. The value of the header is the ~~entity-id~~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~~Prefer header, a service MAY include a `Preference-Applied` header, as defined in [HTTP-Prefer], 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~~Prefer header.

8.3.5 Header Retry-After

A service ~~MUST~~MAY include a Retry-After header in ~~a 202-Accepted response; it MAY include it~~and in a 3xx-Redirect response.~~3xx Redirect responses~~

The Retry-After header specifies the ~~suggested~~ duration of time, in seconds, ~~after which~~that the client ~~SHOULD use~~is asked to wait before retrying the URL request or issuing a request to the resource returned as the value of the ~~Location header to check on the status of the operation.~~Location header.

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 ~~GET, PUT, or PATCH~~ request ~~MAY return~~ that does not create a resource ~~returns~~ 200 OK if ~~the operation~~ 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 Entity~~, ~~Create Media Entity~~, ~~Create Media Entity~~, ~~Create Link~~ ~~Create Link~~ or ~~Invoke Action~~ ~~Invoke Action~~ request that successfully creates a resource ~~MAY return~~ ~~returns~~ 201 Created. In this case, the response body MUST contain the resource created.

9.1.3 Response Code 202 Accepted

~~A service MAY reply to a Data Service Request with 202 Accepted, if the client has specified the respond-async-prefer header. A service MUST NOT reply to a Data Service Request with 202 Accepted if the request has not included the respond-async-preference. 202 Accepted indicates that the service utilizes an asynchronous processing model; the request has been accepted but has not yet completed. In this case, the response MUST contain a Location header pointing to a status monitor resource in addition to a Retry-After header, and the response body MUST be empty. The Location header URL points to a resource which represents the current state of the asynchronous processing, in the following called the AP resource. As long as the asynchronous processing is not finished, a GET request to the AP resource leads to a 202 Accepted response including a Location header and a Retry-After header (both can differ from the previous response). Always the latest AP resource MUST be used for a further request.~~

~~Once the asynchronous processing has successfully completed, the AP resource MUST return 200 OK with a Content-Type header with value application/http and a Content-Transfer-Encoding header with value binary as described in [HTTP-Message]. The response body MUST enclose a single HTTP response which is the response to the initial Data Service Request.~~

~~A DELETE request MAY be sent to the AP resource to terminate the asynchronous processing. A successful deletion will lead to a 200 OK or to a 204 No Content response. After a successful deletion the service MUST ensure that no observable change has occurred as a result of the canceled request.~~

~~If a GET or DELETE request to the AP resource fails, the service MUST respond with a HTTP 4xx or 5xx status code. The service MAY respond with a 410 GONE if the client waited too long to request the result of the asynchronous processing or if the asynchronous processing was terminated by a system administrator, a system process, or by a successful DELETE request to the AP resource. The service MAY also answer with an unspecific 404 Not Found in these cases.~~

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

~~As allowed in [HTTP-Semantics], a~~ A request returns 204 No Content if the requested resource has the null value, or if the service ~~MAY respond to a Data Modification Request with 204 No Content.~~ applies a return=minimal preference. In this case, the response body MUST be empty.

As defined in [HTTP-Semantics], 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 ~~Redirect~~Redirection

As per ~~[RFC2616]~~[RFC2616], a ~~service MAY respond to any request with a response code of 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~~Location header, as appropriate, with the URL from which the result can be obtained; it MAY include a ~~Retry-After header~~Retry-After header.

~~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 3xx.~~

9.1.6 Response Code 304 Not Modified

As per ~~[RFC2616]~~[RFC2616], a ~~service MAY respond to~~ 304 Not Modified is returned when the client performs a GET request containing an ~~If-Match~~If-Match or ~~If-None-Match~~If-None-Match header ~~with 304 Not Modified~~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.

9.2 Client Error Responses

~~Services SHOULD return 4xx Client~~ Error codes in response to the 4xx range indicate a client ~~error~~error, such as a malformed ~~requests, in addition to requests for non-existent resources such as entity collections, entities, or properties~~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~~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 service SHOULD respond with 404 Not Found.~~ The response body MAY ~~contain an error according to the requested format~~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, ~~the service SHOULD respond with 405 Method Not Allowed.~~ In this case the

response MUST include an Allow header containing a list of ~~the~~ valid request methods for the requested resource as specified in ~~[RFC2616]~~[RFC2616].

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.

9.3 Server Error Responses

As specified in ~~[RFC2616]~~, ~~services should use~~[RFC2616], error codes in the 5xx range ~~to~~ 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 ~~return an OData error describing~~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.

10 MetadataContext URL

The *metadatacontext* URL describes the content of the payload.

Request payloads generally do not require *metadatacontext* URLs as the type of the payload can generally be determined *byfrom* the request URL.

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

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

Category	Metadata URL template
	Sample resource URL
	Metadata URL for sample
	Comments

~~In each example:~~

- ~~{context-url} is the resource path to the \$metadata document,~~
~~{entity-set} is the name of an entity set or path to a contained navigation property~~
- ~~{entity-set-or-type-name} is the name of an entity set, path to a contained navigation property, or type name~~
~~{metadata-url} is the resource path to the \$metadata document~~
~~{namespace} is the name of a namespace~~
- ~~{property-list} is a parenthesized comma-separated list of properties on the resource,~~
- ~~+{type-name} is the qualified name of a complex type or entity type,~~
- ~~{/type-name} is an optional type-cast is a segment containing the qualified name of a derived type prefixed with a forward slash.~~

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

10.1 Service DocumentMetadata

Context URL ~~Formats~~template:

Set of Entities	{metadata-url}#{entity-set}
	http://host/service/Customers
	http://host/service/\$metadata#Customers
	If the entity set is in an entity container that has the IsDefaultEntityContainer attribute set to true, the entity set MAY be unqualified. If the entity set is in an entity container that has does not have an IsDefaultEntityContainer attribute with a value of true, the entity set MUST be namespace and container qualified.
Set of Projected	{metadata-url}#{entity-set}{/type-cast}({property-list})
	http://host/service/Customers?\$select=Address,Orders

Entities	http://host/service/\$metadata#Customers(Address,Orders)
	If a feed contains a subset of properties, a parenthetical comma separated list of properties is appended to the {entity-set} to specify the set of properties in the response. If all properties are included for a particular entity, a dot (.) MAY be used and is equivalent to omitting the {property-list}.
Set of Projected Related Entities	{metadata-url}#{entity-set}/{type-cast}({property-list})
	http://host/service/Employees/Sales.Manager?\$expand=DirectReports(\$select=FirstName,LastName,\$levels=4)
=4	http://host/service/\$metadata#Employees/Sales.Manager(.,DirectReports+(FirstName,LastName))
	If a nested collection contains a subset of properties, a parenthetical comma separated list of properties is appended to the collection property name to specify the set of properties in elements of the nested collection. Additionally, if the pattern is recursive for nested children the {property-name} includes the + suffix.
Set of Derived Entities	{metadata-url}#{entity-set}/{type-cast}
	http://host/service/Customers/Model.VipCustomer
	http://host/service/\$metadata#Customers/Model.VipCustomer
	If a feed consists exclusively of derived elements, a type cast segment is added to the metadata URL.
Element	{metadata-url}#{entity-set}/@Element
	http://host/service/Customers(1)
	http://host/service/\$metadata#Customers/@Element
	If a response is guaranteed to contain only a single entry from a feed, /@Element is appended to the metadata URL. This is also true for links payloads.
Projected Element	{metadata-url}#{entity-set}{property-list}/@Element
	http://host/service/Customers(1)?\$select=Name,Rating
	http://host/service/\$metadata#Customers(Name,Rating)/@Element
	If a single entry contains a subset of properties, a parenthetical comma separated list of properties is appended to the metadata URL prior to appending /@Element to specify the set of properties in the response.
Derived Element	{metadata-url}#{entity-set}/{type-cast}/@Element
	http://host/service/Customers(2)/Model.VipCustomer
	http://host/service/\$metadata#Customers/Model.VipCustomer/@Elem

Complex or Primitive Type Property	ent
	If a response is guaranteed to contain only a single element of a derived type, /<Type>/@Element is appended to the metadata URL.
	{metadata-url}#{namespace}.{type-name}
	http://host/service/Customers(1)/Name http://host/service/\$metadata#Edm.String If a response is a complex type or primitive type, the metadata URL contains the fully qualified type of the property.
Collection Type Property	{metadata-url}#Collection({namespace}.{type-name})
	http://host/service/Customers(1)/Hobbies
	http://host/service/\$metadata#Collection(Edm.String)
	If a response is a collection of complex types or primitive types, the metadata URL names the type of the property.
Null	{metadata-url}#Edm.Null
	http://host/service/Customers(1)/Description
	http://host/service/\$metadata#Edm.Null
	If a request or response is a null collection, complex or primitive type property, the metadata URL fragment is simply Edm.Null .
Operation Result	{metadata-url}#{entity-set-or-type-name}
	http://host/service/TopFiveCustomers
	http://host/service/\$metadata#Customers
	A response from an operation (service operation, action, function) has a metadata URL that identifies the type returned by the operation. The metadata URL will correspond to one of the former examples.
Service Doc	{metadata-url}
	http://host/service/
	http://host/service/\$metadata
	The metadata URL of the service document is the metadata URL of the service.
Entity Reference	{metadata-url}#{entity-set}/\$ref[/@Element]
	http://host/service/Customers(1)/Orders(1)/\$ref

Delta Response

~~[http://host/service/\\$metadata#Orders/\\$ref/@Element](http://host/service/$metadata#Orders/$ref/@Element)~~

~~If a response is guaranteed to contain only a single element from a navigation property with cardinality of many, /@Element is appended to the metadata URL.~~

~~[{metadata-url}#{entity-set}/@Delta](#)~~

~~[http://host/service/Customers?\\$deltaToken=1234](http://host/service/Customers?$deltaToken=1234)~~

~~[http://host/service/\\$metadata#Customers/@Delta](http://host/service/$metadata#Customers/@Delta)~~

~~The metadata URL is the same as the metadata URL to the root entity set, followed by /@Delta.~~

[{context-url}](#)

The context URL of the service document is the context 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}](#)

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

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

10.3 Entity

Context URL template:

[{context-url}#{entity-set}/\\$entity](#)

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
```

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
```

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, `/<Type>/$entity` is appended to the context URL after the type-cast segment.

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}{property-list}
```

If a result contains only a subset of properties, the parenthesized comma-separated list of the selected properties is appended to the `{entity-set}` after an optional type-cast segment. The shortcut `*` represents the list of all structural properties.

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}{property-list}/$entity
```

If a single entity contains a subset of properties, the parenthesized comma-separated list of the selected properties is appended to the {entity-set} after an optional type-cast segment and prior to appending /\$entity. 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
```

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)
```

10.9 Collection of Projected Expanded Entities

Context URL template:

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

If a navigation property is expanded, the parenthesized comma-separated list of properties contains the expanded navigation property. If the \$expand contains a nested \$select, the navigation property is suffixed with the parenthesized comma-separated list of properties selected from the related entities. Additionally, if the expansion is recursive for nested children, a plus sign (+) is infix between the navigation property name and the list of properties.

Example 20: resource URL and corresponding context URL

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

10.10 Projected Expanded Entity

Context URL template:

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

If a single entity is expanded and projected, the parenthesized comma-separated list of the selected properties is appended to the {entity-set} after an optional type-cast segment and prior to appending /\$entity.

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)
```

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 Collection of Complex or Primitive Types

Context URL template:

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

If a response is a collection of complex types or primitive types, the context URL names the type of the property.

Example 24: resource URL and corresponding context URL

```
http://host/service/Customers(1)/Hobbies  
http://host/service/$metadata#Collection(Edm.String)
```

10.14 Complex or Primitive Type

Context URL template:

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

If a response is a complex type or primitive type, the context URL contains the fully qualified type of the property.

Example 25: resource URL and corresponding context URL

```
http://host/service/Customers(1)/Name  
http://host/service/$metadata#Edm.String
```

10.15 Operation Result

Context URL templates:

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

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

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

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

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, otherwise it identifies the type returned by the operation. The context URL will correspond to one of the former examples.

Example 26: resource URL and corresponding context URL

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


10.16 Delta Response

Context URL template:

`{context-url}#{entity-set}/{type-name}{property-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 27: resource URL and corresponding context URL

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

10.17 Item in a Delta Response

Context URL templates:

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

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

`{context-url}#{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.

10.18 \$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.

10.19 \$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.

11 Data Service Requests

~~OData Services MAY support the following types of 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~~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~~service root).

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

11.1.2 Metadata Document Request

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

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

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

If a request for metadata does not specify a format preference (via ~~Accept header~~Accept header or ~~\$format~~\$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~~data model that describes the data and operations exposed by an OData service as an OData service with a fixed (meta) data model.

~~OData services MAY/SHOULD/MUST expose their data model as an OData Metadata Service.~~

~~The~~A metadata service MUST use the schema defined in ~~[OData-CSDL]~~[OData-CSDL]. The ~~Metadata Service Document~~root URL ~~MUST be of the metadata document URL~~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 Document~~metadata service root URL.

11.2 Requesting Data

OData services support requests for data ~~through the use of~~via HTTP GET requests.

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

~~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.~~

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

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.

11.2.11.1.1 Evaluating System Query Options

~~OData defines a number of system query options~~Properties that may be used are not available, for example due to further refine permissions, are not returned. In this case, the request. The result of the request~~Core.Permissions annotation, defined in [OData-VocCore] MUST be as if~~returned for the property with a value of Core.Permission'None'.

~~If no entity exists with the System query options were evaluated~~key values specified in the following order.request URL, the service responds with 404 Not Found.

~~Prior to applying any server-driven paging:~~

- ~~\$search~~
- ~~\$filter~~

- ~~\$count~~
- ~~\$orderby~~
- ~~\$skip~~
- ~~\$top~~

After applying any server driven paging:

- ~~\$expand~~
- ~~\$select~~
- ~~\$format~~

~~11.2.21.1.1 Requesting Individual Entities~~

~~To retrieve an individual entity, the client makes a GET request to an entity request URL.~~

~~The entity request URL MAY be returned in a response payload containing that instance (for example, as a self link in an [OData-Atom] payload).~~

~~Services MAY support conventions for constructing an entity request URL using the entity's Key Value(s), as described in [OData-URL].~~

11.2.3 Requesting Individual Properties

~~A service SHOULD support retrieving an individual property value.~~

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

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

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

~~For example:~~

~~http://services.odata.org/OData/OData.svc/Products(1)/Name~~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 28:

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

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

~~A service SHOULD support retrieving the~~To retrieve the raw value of a primitive type property.~~To retrieve this value,~~ the client sends a GET request to the property value URL. See the ~~[OData-URL]~~[OData-URL] document for details.

~~For example:~~

```
http://services.odata.org/OData/OData.svc/Products(1)/Name/$value
```

~~The raw value of an Edm.Binary property MUST be serialized as an unencoded byte stream.~~

~~The raw value of other properties SHOULD be represented using the text/plain media type. See [OData-ABNF] 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.

A \$value request for a property that is ~~NULL SHOULD result~~ null results in a ~~404 Not Found~~ 204 No Content response.

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/$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 30: 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 31:

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

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

Example 32:

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

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

Example 33: 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 34:

```
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 either by a parenthesized set of expand options (for filtering, sorting, selecting, paging, or expanding the related entities) or by a `/ $ref` path segment.

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

Example 35: for each customer entity within the Customers entity set the value of all associated Orders will be represented inline

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

Example 36: for each customer entity within the Customers entity set the references to the associated 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 37: for each customer entity within the Customers entity set, the value of those associated Orders whose Amount is greater than 100 will be represented inline

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

Example 38: for each order within the Orders entity set, the following will be represented inline:

- The `OrderLines` associated with the `Orders` identified by the resource path section of the URL and the products associated to each order line.
- The `Customer` associated with each order returned.

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

Example 39: for each customer entity in the Customers entity set, the value of all associated InHouseStaff will be represented inline if the entity is of type `VipCustomer` or a subtype of that. For entities that are not of type `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.

Example 40: 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)
```

11.2.411.2.5 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~~system query options provided as query options. The names of all ~~System Query Options~~system query options are prefixed with a dollar (\$) character.

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

11.2.4.111.2.5.1 The ~~\$filter~~ System Query Option \$filter

~~The~~The \$filter system query option restricts the set of entities~~items returned MAY be restricted through the use of the \$filter System Query Option.~~

For example:

```
http://services.odata.org/OData/OData.svcExample 41:  
return/Products?$filter=Price lt 10.00
```

~~Returns~~ all Products whose Price is less than \$10.00.

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

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

```
http://services.odata.org/OData/OData.svc/CateorigesExample 42:  
return?$filter=Products/$count lt 10
```

~~Returns~~ 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]~~[OData-ABNF].

11.2.4.1.111.2.5.1.1 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]~~[OData-URL].

Operator	Description	Example
Comparison Operators		
<u>eq</u>	<u>Equal</u>	<u>Address/City eq 'Redmond'</u>
<u>ne</u>	<u>Not equal</u>	<u>Address/City ne 'London'</u>
<u>gt</u>	<u>Greater than</u>	<u>Price gt 20</u>
<u>ge</u>	<u>Greater than or equal</u>	<u>Price ge 10</u>
<u>lt</u>	<u>Less than</u>	<u>Price lt 20</u>
<u>le</u>	<u>Less than or equal</u>	<u>Price le 100</u>
<u>has</u>	<u>Has flags</u>	<u>Style has Sales.Color'Yellow'</u>
Logical Operators		
eq	<u>Equal</u>	/Suppliers?\$filter=Address/City eq 'Redmond'

Operator	Description	Example
ne	Not equal	/Suppliers?\$filter=Address/City ne 'London'
gt	Greater than	/Products?\$filter=Price gt 20
ge	Greater than or equal	/Products?\$filter=Price ge 10
lt	Less than	/Products?\$filter=Price lt 20
le	Less than or equal	/Products?\$filter=Price le 100
and	Logical and	/Products?\$filter=Price le 200 and Price gt 3.5
or	Logical or	/Products?\$filter=Price le 3.5 or Price gt 200
not	Logical negation	/Products?\$filter=not endswith(Description, 'milk')
Arithmetic Operators		
add	Addition	/Products?\$filter=Price add 5 gt 10
sub	Subtraction	/Products?\$filter=Price sub 5 gt 10
mul	Multiplication	/Products?\$filter=Price mul 2 gt 2000
div	Division	/Products?\$filter=Price div 2 gt 4
mod	Modulo	/Products?\$filter=Price mod 2 eq 0
Grouping Operators		
()	Precedence grouping	/Products?\$filter=(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
----------	---------

Function	Example
String Functions	
bool substringofcontains	substringofcontains('Alfreds',CompanyName)
bool endswith	endswith(CompanyName,'Futterkiste')
bool startswith	startswith(CompanyName,'Alfr')
int length	length(CompanyName) eq 19
int indexof	indexof(CompanyName,'lfreds') eq 1
string substring	substring(CompanyName,1) eq 'lfreds Futterkiste'
string tolower	tolower(CompanyName) eq 'alfreds futterkiste'
string toupper	toupper(CompanyName) eq 'ALFREDS FUTTERKISTE'
string trim	trim(CompanyName) eq 'Alfreds Futterkiste'
string concat	concat(concat(City,', '), Country) eq 'Berlin, Germany'
Date Functions	
year DateTimeOffset now	year(BirthDate) eq 0 StartTime ge now()
month int day	day(StartTime)month(BirthDate) eq 812
int dayhour	hourday(StartTime) eq 18
hour int minute	minutehour(StartTime) eq 01
minute int month	month(BirthDate)minute(StartTime) eq 120
byte second	second(StartTime) eq 0
decimal fractionalseconds	second(StartTime) eq 0
date int year	date(StartTime) ne date(EndTime) year(BirthDate) eq 0
Date time date	date_time(StartTime) ne date(EndTime) le StartOfDay
totaloffsetminutes TimeOfDay time	time totaloffsetminutes (StartTime) le StartOfDay eq 60
int now totaloffsetminutes	totaloffsetminutes (StartTime) eq 60 ge now()
DateTimeOffset mindatetime	StartTime eq mindatetime()
DateTimeOffset maxdatetime	EndTime eq maxdatetime()
Math Functions	
double round	round(Freight) eq 32
decimal floor	floor(Freight) eq 32
double ceiling	ceiling(Freight) eq 33

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

11.2.4.1311.2.5.1.3 Parameter Aliases

~~Literal~~ Parameter aliases can be used in place of literal values ~~used in function parameters~~ in function parameters or within a ~~\$filter~~ \$filter or ~~\$orderby~~ \$orderby expression ~~MAY be substituted by a parameter alias~~. 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.

For example:

```
GET Example 43: returnshttp://host/service.svc/Employees?$filter=Region eq @p1&@p1='WA'
```

~~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.

11.2.4.211.2.5.2 The \$orderby System Query Option \$orderby

The \$orderby System Query option specifies the order in which entities 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 results. 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 ~~MAY~~ 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.

For example:

```
http://services.odata.org/OData/OData.svcExample 44:  
return/Products?$orderby=ReleaseDate asc, Rating desc
```

~~Returns~~ 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:

```
http://services.odata.org/OData/OData.svcExample 45:
return /Categories?$expand=Products($orderby=ReleaseDate asc, Rating desc)
```

Returns all Categories, and their Products ordered according to release date and in descending order of rating.

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

\$count may be used within a \$orderby expression to order the returned entities according to the count of related entities or elements within a collection-valued property:

```
http://services.odata.org/OData/OData.svcExample 46: return
/Categories?$orderby=Products/$count
```

Returns all Categories ordered by the number of Products within each category.

```
The $stop http://host/service/Categories?$orderby=Products/$count
```

11.2.4.3 11.2.5.3 System Query Option \$top

The \$top ~~System Query Option~~ system query option specifies a non-negative integer n that limits the number of ~~entities~~ items returned ~~within~~ from a collection. The service ~~MUST return~~ returns the number of available ~~entities~~ items up to, but not ~~exceeding, greater than~~ the specified value n.

For example:

```
http://services.odata.org/OData/OData.svcExample 47: /Products?$top=5
```

Would return only the first five ~~Products in~~ products of the Products entity set.

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

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

11.2.4.4 11.2.5.4 The \$skip ~~System Query Option~~ \$skip

The \$skip ~~System Query Option~~ system query option specifies ~~that the result MUST NOT include the first n entities, where n is a non-negative integer value specified by the \$skip query option~~ n that excludes the first n items of the queried collection from the result. The service returns items starting at position n+1.

For example:

```
http://services.odata.org/OData/OData.svcExample 48: /Products?$skip=5
```

Would return ~~Products~~ products starting with the 6th ~~Product in~~ product of the Products entity set.

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

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

For example:

```
http://services.odata.org/OData/OData.svcExample 49: /Products?$top=5&$skip=2
```

Would return the third through seventh ~~Products in~~ products of the Products entity set.

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

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

~~11.2.4.5~~11.2.5.5 The ~~\$count~~ System Query Option \$count

The ~~\$count~~ ~~System Query Option~~system query option with a value of true specifies that the total count of entities within a collection matching the request ~~MUST~~ be returned along with the result.

For example:

```
http://services.odata.org/OData/OData.svc/Example_50:/Products?$count=true
```

~~Would~~ return, along with the results, the total number of products in the ~~set~~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 51:

```
http://services.odata.org/OData/OData.svc/host/service/Categories?  
?$expand=Products($count=true)
```

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

The service ~~MUST return~~returns an HTTP Status code of ~~404~~400 Bad Request if a value other than true or false is specified.

The \$count system query option ignores any ~~\$top, \$skip, or \$expand~~\$top, \$skip, or \$expand query options, and returns the total count of results across all pages including only those results matching any specified ~~\$filter~~\$filter and \$search

How the count is encoded in the response body is dependent upon the selected format.

~~11.2.4.6~~11.2.5.6 The ~~\$search~~ System Query Option \$search

The \$search ~~System Query Option MAY be used to restrict~~system query option restricts the result to include only those entities *matching* the specified search expression.

For example:

```
http://services.odata.org/OData/OData.svc/Products?$search=bike
```

~~Returns all Products that match the search term "bike".~~ The definition of what it means to match is dependent upon the implementation.

Example 52: *return all Products that match the search term "bike"*

```
http://host/service/Products?$search=bike
```

The search expression ~~MAY~~can contain phrases, enclosed in double-quotes.

```
http://services.odata.org/OData/OData.svc/Products?$search="mountain bike"
```

~~Returns~~Example 53: *return all Products that match the phrase "mountain bike".*

```
The search expression MAY contain the  
http://host/service/Products?$search="mountain bike"
```

The upper case keyword NOT ~~in order to return~~restricts the set of entities to those that do not match the specified term.

```
http://services.odata.org/OData/OData.svc/Products?$search=NOT clothing
```

~~Returns~~Example 54: *return all Products that do not match "clothing".*

~~The~~ `http://host/service/Products?$search=NOT clothing`

Multiple terms within a search expression ~~MAY contain multiple terms,~~ are separated by a space (implicit AND) or the upper-case keyword AND, indicating that all such terms must be matched.

~~http://services.odata.org/OData/OData.svc/Products?\$search=mountain AND bike~~

~~Returns~~ Example 55: return all Products that match both "mountain" and "bike".

`http://host/service/Products?$search=mountain AND bike`

The search expression ~~MAY contain the~~ upper-case keyword OR ~~in order~~ is used to return entities that satisfy ~~any of the expressions~~ either the immediately preceding or subsequent expression.

~~http://services.odata.org/OData/OData.svc/Products?\$search=mountain OR bike~~

~~Returns~~ Example 56: return all Products that match either "mountain" or "bike".

~~The~~ `http://host/service/Products?$search=mountain OR bike`

Parentheses within the search expression ~~MAY contain parenthesis to~~ group together multiple expressions.

~~http://services.odata.org/OData/OData.svc/Products?\$search={mountain OR bike} AND NOT clothing~~

~~Returns~~ Example 57: return all Products that match either "mountain" or "bike" and do not match clothing.

`http://host/service/Products?$search=(mountain OR bike) AND NOT clothing`

The operations within a search expression MUST be evaluated in the following order: grouping operator, NOT operator, AND operator, OR operator

If both \$search and ~~\$filter~~ \$filter are specified in the same request, only those entities satisfying both criteria are returned.

The value of the \$search option is a Boolean expression as defined in ~~[OData-ABNF]~~ [OData-ABNF].

11.2.4.7 11.2.5.7 Server-Driven Paging

~~OData services MAY return~~ Responses that include only a partial set of the entities identified by the request URL. ~~In that case the response~~ MUST contain a link that allows retrieving the next partial set of entities. This link is called a *next-link*; its representation is format-specific. The final partial set of entities MUST NOT contain a next-link.

~~OData clients MUST treat the URL of the next link as opaque, and especially MUST NOT apply/append system query options to the URL of a next link, as these system query options MAY already have been used by the service when building the next link.~~

The client ~~MAY can~~ request a maximum page size through the ~~odata.maxpagesize~~ odata.maxpagesize preference. The service ~~MAY honor~~ may apply this requested page size or ~~MAY~~ implement a page size different than, or in the absence of, this preference.

OData clients MUST treat the URL of the next link as opaque, and MUST NOT append system query options to the URL of a next link. The Accept header MAY be used to specify the desired response format.

OData services ~~MAY~~ may use the reserved system query option \$skiptoken when building next-links. Its content is opaque, service-specific, and must only follow the rules for URL query parts.

OData clients MUST NOT use the system query option \$skiptoken when constructing requests.

11.2.6 Requesting Related Entities

To request related entities according to a particular relationship, the client issues a GET request to the source entity's request URL, followed by a forward slash and the name of the navigation property

representing the relationship. to the source entity's request URL, followed by a forward slash and the name of the navigation property representing the relationship.

If the navigation property does not exist on the entity indicated by the request URL, the service returns 404 Not Found.

If the relationship terminates on a collection, the response MUST be the format-specific representation of the collection of related entities. If no entities are related, the response is the format-specific representation of an empty collection.

11.2.51.1.1 If the relationship terminates on a single entity, the response MUST be the format-specific representation of the related single entity. Specifying Properties to Return

~~The \$select and \$expand system query options enable the client to specify the set of properties and navigation property included in a response.~~

11.2.5.1 The \$expand System Query Option

If no entity is related, the service returns 204 No Content

Example 58: return the supplier of the product with ID=1 in the Products entity set

~~The \$expand system query option indicates the related entities that MUST be represented inline.~~

~~The value of the \$expand query option MUST be a comma-separated list of navigation property names, optionally followed by a parenthetical 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].~~

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

~~Examples:~~

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

11.2.7 Requesting Entity References

To request entity references in place of the actual entities, the client issues a GET request with /\$ref appended to the resource path.

If the resource path does not identify an entity or a collection of entities, the service returns 404 Not Found.

If the resource path terminates on a collection, the response MUST be the format-specific representation of a collection of entity references pointing to the related entities. If no entities are related, the response is the format-specific representation of an empty collection.

If the resource path terminates on a single entity, the response MUST be the format-specific representation of an entity reference pointing to the related single entity. ~~sv6~~ If the resource path terminates on a single entity and no such entity exists, the service returns 404 Not Found.

Example 59: collection with an entity reference for each Order related to the Product with ID=0

```
http://host/service/Products(0)/Orders/$ref
```

11.2.8 Resolving an Entity-Id

To resolve an entity-id, e.g. obtained in an entity reference, into a representation of the identified entity, the client issues a GET request to the \$entity resource which located at the URL /\$entity relative to the service root. The entity-id MUST be specified using the system query option \$id.

Example 60: return the entity representation for a given entity-id

```
http://host/service/$entity?$id=http://host/service/Products(0)
```

A type segment following the `$entity` resource casts the resource to the specified type. If the identified entity is not of the specified type, or a type derived from the specified type, the service returns 404 Not Found.

The system query options `$select` and `$expand` can be specified in GET requests to the `$entity` resource.

Example 61: return the entity representation for a given entity-id and specify properties to return

```
http://host/service/$entity?$id=http://host/service/Customers?<del>$expand=Orders</del>('ALFKI')
<del>For each customer entity within</del>
&$select=CompanyName,ContactName<del>&$expand=Orders</del>
```

11.2.9 Requesting the CustomersNumber of Elements

To request only the number of elements of a collection of entities or elements of a collection-valued property, the client issues a GET request with `/$count` appended to the resource path of the collection.

On success, the response body MUST contain the count of entities matching the request after applying any `$filter` or `$search` system query options, formatted as a simple scalar integer value with media type `text/plain`. The returned count MUST NOT be affected by `$top`, `$skip`, `$orderby`, or `$expand`. Content negotiation using the `Accept` request header or the `$format` system query option is not allowed with the path segment `/$count`.

Example 62: return the number of products in the Products entity set the value

```
http://host/service/Products/$count
```

Example 63: return the number of all associated Orders MUST be represented inline.

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

~~Entity references to the associated Orders are inlined instead of the associated Orders themselves.~~

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

~~For each customer entity within the Customers entity set, the value of those associated Ordersproducts whose AmountPrice is greaterless than 100 MUST be represented inline.\$10.00~~

```
http://host/service<del>.svc</del>/Orders?<del>$expand=OrderLines($expand=Product)</del>,Customer<del>/Products</del>/$count?$filter=Price lt 10.00
```

~~For each Order within the Orders entity set, the following MUST be represented inline:~~

- ~~• The Order Lines associated/\$count segment can be used in combination with the Orders identified by the resource path section of the URL and the products associated to each Order line.~~
- ~~• The Customer associated with each Order returned.~~

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

~~For each Customer entity in the Customers entity set, the value of all associated InHouseStaff MUST be represented inline if the entity is of type VipCustomer or a subtype of that. For entities that are not of type VipCustomer, or any of its subtypes, that entity SHOULD be returned with no inline representation for the expanded navigation property.~~

11.2.5.1.1 The \$levels Expand Option

The \$levels-expand\$filter system query option can be used within \$expand 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.

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

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

~~The \$select~~ Example 64: return all customers with more than five interests

```
http://host/service/Customers?$filter=Interests/$count gt 5
```

11.2.5.211.2.10 System Query Option \$format

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 MUST return the specified content, and MAY choose to 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 name of the entity container in order to specify all operations within the container.

For example, the following request returns just the Rating and ReleaseDate for the matching Products:

```
http://services.odata.org/OData/OData.svc/Products?$The  
select=Rating,ReleaseDate
```

It is also possible to request all properties, including any dynamic properties, using a star request:

```
http://services.odata.org/OData/OData.svc/Products?$select=*
```

A star request SHOULD NOT introduce navigation properties, actions or functions not otherwise requested.

Properties of related entities MAY be specified by including the \$select query option within the \$expand:

```
http://services.odata.org/OData/OData.svc/Products?  
$expand=Category($select=Name)
```

If a \$select is present, it MUST include any expanded navigation properties in order for the related entities to be included in the result.

```
http://services.odata.org/OData/OData.svc/Categories?  
$select=CategoryName,Products&$expand=Products
```

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

```
http://services.odata.org/OData/OData.svc/Products?$select=DemoService,*
```

11.2.6 The \$format System Query Option

A request with a \$format system query option specifies ~~that the response MUST use~~ the media type specified by of the query option response.

~~If the~~ The \$format query option ~~is, if~~ present in a request, ~~it~~ MUST take precedence over the value(s) specified in the Accept request header.

The value of the \$format query option ~~MAY be any~~ is a valid internet media type, ~~which MAY include~~ optionally including parameters.

For example:

In addition, format-specific abbreviations may be used, see [OData-Atom] and [OData-JSON], but format parameters MUST NOT be appended to the format abbreviations.

Example 65: the request

```
http://services.odata.org/OData/OData.svc-host/service/Orders?  
$format=application/json;odata.metadata=full
```

is equivalent to a request with an *Accept* header using the same media type; it requests the set of Order entities represented using the JSON media type including full metadata, as specified in [OData-JSON].

In addition, format specific abbreviations may be used, see [OData-Atom] and [OData-JSON].

Media-type parameters MUST NOT be appended to the format abbreviations.

For example:

Example 66: the request

```
http://services.odata.org/OData/OData.svc-host/service/Orders?$format=json
```

is equivalent to a request with the *Accept* header set to *application/json*; it requests the set of Order entities represented using the JSON media type with minimal metadata, as specified in [OData-JSON].

11.2.7 Requesting Related Entities

To request related entities according to a particular relationship, the client issues a GET request.

The path of the request is the source entity's request URL, followed by a forward slash and the name of the navigation property representing the relationship.

If the navigation property does not exist on the entity indicated by the request URL, the service MUST return 404 Not Found.

If the relationship terminates on a collection, the response MUST be the format specific representation of the collection of related entities. If no entities are related, the response is the format specific representation of an empty collection.

If the relationship terminates on a single entity, the response MUST be the format specific representation of the related single entity. If no entity is related, the response MUST be 204 No Content.

For example:

```
http://services.odata.org/OData/OData.svc/Products(1)/Supplier
```

Returns the supplier of the product with ID=1 in the Products entity set.

11.2.81.1.1 Requesting Entity References

To request entity references in place of the actual entities, the client issues a GET request with */\$ref* appended to the resource path.

If the resource path does not resolve to an entity or collection of entities, the service MUST return 404 Not Found.

If the resource path terminates on a collection, the response MUST be the format specific representation of a collection of entity references pointing to the related entities. If no entities are related, the response is the format specific representation of an empty collection.

If the resource path terminates on a single entity, the response MUST be the format specific representation of an entity reference pointing to the related single entity. If no entity is related, the response MUST be 204 No Content.

For example:

```
http://services.odata.org/OData/OData.svc/Products(0)/Orders/$ref
```

Returns a collection containing an entity reference for each Order related to the Product with ID=0.

11.2.9 Requesting the Number of Elements of a Collection

To request only the number of elements of a collection of entities or elements of a collection-valued property, the client issues a GET request with `/$count` appended to the path of the request URL.

On success, the response body MUST contain the count of entities matching the request after applying any `$filter` or `$search` system query options, formatted as a simple scalar integer value.

The returned count option MUST NOT be affected by `$top`, `$skip`, `$orderby`, or `$expand` specified in batch requests as these always use the media type `multipart/mixed`.

For example:

```
http://services.odata.org/OData/OData.svc/Products/$count
```

Returns the count of Products in the Products entity set.

```
http://services.odata.org/OData/OData.svc/Customers('ALFKI')/Interests/$count
```

Returns the count of interests within the Interests collection of customer 'ALFKI'.

In metadata document requests the values `application/atom+xml`, `application/json`, their subtypes and parameterized variants as well as the format-specific abbreviations `atom` and `json` are reserved for future versions of this specification.

11.3 Requesting Changes

An OData service MAY support requesting changes (deltas) from a previous result.

Services MAY support requesting changes for arbitrary queries against the entity set or MAY require that any filters be applied solely to immutable (i.e., key) fields.

Services advertise their change-tracking capabilities by annotating entity sets with the `Capabilities.ChangeTracking` term defined in [OData-VocCap].

Clients request that the service support tracking changes to a result by specifying the `odata.track-changes` preference on a request. In response, the service MAY include `Preference-Applied` header in the response containing the `odata.track-changes` preference and includes a `delta-link` for requesting subsequent changes to the result on the last page of results.

11.3.1 Delta Links

Delta links are opaque, service-generated links that the client can use to retrieve subsequent changes to a result.

Delta links are based on a *defining query* that describes the set of results for which changes are being tracked; for example, the request that generated the results containing the delta link. The delta link MUST conceptually encode the following information: The delta link encodes the collection of entities for which changes are being tracked, along with a starting point from which to track changes.

- The collection of entities for which changes are being tracked, along with a starting point from which to track changes.

If the defining query contains a `$filter` or `$search`, the response MUST include only changes to `entries` matching the specified criteria. Added `entries` MUST be returned for entities that were added or changed and now match the specified criteria, and deleted `entries` MUST be returned for entities that are changed to no longer match the criteria. Clients MUST NOT append `$filter` or `$search` to a delta link.

The delta link MUST NOT encode any client `top` or `skip` value, and SHOULD NOT encode a request for an inline count.

If the defining query includes expanded relationships, the delta link MUST return changes, additions, or deletions to the expanded entities, as well as added or deleted `relationships` to expanded entities. Clients MUST NOT append `$expand` to a delta link.

Entities are considered changed if any of the structural properties have changed. Changes to related entities and to streams are not considered a change to the entity containing the stream or navigation property.

- If the defining query contains a ~~projection~~projection, the generated delta link SHOULD logically include the same projection, such that the delta query ~~SHOULD~~ only ~~return~~includes fields specified in the projection. ~~However, services MUST NOT~~Services MAY use the projection ~~in determining which entries to limit the entities returned to those that have changed; the entry within the selected fields, but the client~~ MUST be prepared to receive entities returned whether or not the field that changed was specified in the projection. ~~Client MUST NOT append \$select to a delta link.~~

The delta link MUST NOT encode the following query options:

- ~~Delta links represent changes to an entire conceptual set of results, not just an individual page, and MUST NOT encode any client top or skip value. The client may append \$top and \$skip to the delta link in order to page through the results of a query. In this case, the delta link for the next set of changes appears on the last page of results. There may be no changes in the final page if the specified value for \$skip is equal to or greater than the number of changes available.~~
- ~~Delta links SHOULD NOT encode a request for an inline count. The client MAY append the \$count system query option to the delta link in order to retrieve the number of added, changed, or deleted entities represented by the delta link. The count MUST NOT include added or deleted links.~~
- ~~Delta links MUST NOT encode a response format. The client MAY append \$format to the delta link in order to request a particular format for the response.~~
- ~~The results of a delta query are ordered by the service in such a way as to guarantee consistency when applied in the order provided. The client MUST NOT append the \$orderby query option to the delta link.~~

11.3.2 ~~Clients MAY append a /\$count~~Using Delta Links

The client requests changes by invoking the GET method on the delta link. The client MUST NOT attempt to append system query options to the delta link. The Accept header MAY be used to specify the desired response format.

The /\$count segment can be appended to the path of a delta link in order to get just the number of changes available. The count ~~MUST include~~includes all added, changed, or deleted ~~entries and MUST NOT include~~entities, as well as added or deleted links.

The results of a request against the delta link ~~request MAY be returned in more than one page~~may span multiple pages but MUST be ordered by the service. ~~If more than one page of changes is available, each page MUST contain a link for the next page of changes.~~

The final page of changes SHOULD contain a new delta link for subsequent changes. This delta link ~~MUST return across all changes subsequent~~pages in such a way as to guarantee consistency when applied in order to the last change of response which contained the previous delta link and MUST NOT be returned prior to the final page of results. ~~delta link.~~

Services SHOULD return only changed ~~entries~~entities, but MAY return additional entities matching the defining query for which the client will not see a change.

In order to continue tracking changes beyond the current set, the client specifies `odata.track-changes` on the initial request to the delta link but is not required to repeat it for subsequent pages. The new delta link appears at the end of the last page of changes and MUST return all changes subsequent to the last change of the previous delta link.

If no changes have occurred, the response is an empty collection that contains a delta link for subsequent changes if requested. This delta link MAY be identical to the delta link resulting in the empty collection of changes.

If the delta link is no longer valid, the service ~~SHOULD respond~~responds with ~~410 Gone~~410 Gone, and SHOULD include the URL for refetching the entire set in the ~~location~~Location header of the response.

11.4 Data Modification

An Updatable OData ~~service~~ MAY ~~services~~ support Create, Update, and Delete operations for some or all of the exposed entities ~~that it exposes~~. Additionally, ~~services MAY support one or more Actions which may~~ Actions supported by a service can affect the state of the system.

A successfully completed ~~Data Modification Request~~ Data Modification Request must not violate the integrity of the data.

The client may request whether content be returned from a Create, Update, or Delete request, or the invocation of an Action, by specifying the ~~Prefer header~~ return Prefer header.

11.4.1 Common Data Modification Semantics

~~Data Modification Requests~~ Data Modification Requests share the following semantics.

11.4.1.1 Use of ETags for Avoiding Update Conflicts

~~The client MAY include an ETag value in an if-match or if-none-match request header of a Data Modification Request or Action Request. If specified,~~ If an ETag value is specified in an If-Match or If-None-Match header of a Data Modification Request or Action Request, the operation MUST only be invoked if the if-match or if-none-match condition is satisfied.

The ETag value specified in the if-match or if-none-match request header may be obtained from an ~~ETag header~~ ETag header of a ~~request~~ response for an individual entity, or may be included for an individual ~~entry~~ entity in a format-specific manner.

11.4.1.2 Handling of DateTimeOffset Values

Services SHOULD preserve the offset of `Edm.DateTimeOffset` values, if ~~at all~~ possible. However, where the underlying storage does not support offset services ~~MAY~~ may be forced to normalize the value to some common time zone (i.e. UTC) in which case the result would be returned with that time zone offset. If the service normalizes values, it MUST fail evaluation of the query functions year, month, day, hour, and time for literal values that are not stated in the time zone of the normalized values.

11.4.1.3 Handling of Properties Not Advertised in Metadata

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. By using PATCH when ~~updating~~ updating entities, clients can ensure that such properties values are not lost if omitted from the update request.

11.4.1.4 Handling of Consistency Constraints

Services ~~MAY~~ may impose cross-entity consistency constraints. Certain referential constraints, such as requiring an entity to be created with related entities ~~MAY~~ can be satisfied through ~~creating~~ creating or ~~linking~~ linking related entities when creating the entity. Other constraints ~~MAY~~ might require multiple changes to be specified together in a single atomic ~~change set~~ change set.

11.4.2 Create an Entity

To create an entity in a collection, the client sends a POST request to that collection's URL. The POST body MUST contain a single valid entity representation.

An entity may also be created as the result of an ~~Upsert~~ Upsert operation.

If the target URL for the collection is a navigation link, the ~~corresponding new entity is automatically linked to the source entity of the navigation~~ property MUST contain the related entities (ContainsTarget="true") or have an associated navigation property binding to specify the target set of the related entity(ies)-link.

To create an *open entity* (an instance of an open type), additional property values beyond those specified in the metadata MAY be sent in the request body. The service MUST treat these as dynamic properties and add them to the created instance.

If the entity being created is not an open entity, additional property values beyond those specified in the metadata SHOULD NOT be sent in the request body. The service MUST fail if unable to persist all property values specified in the request.

Properties computed by the service (annotated with the term `Core.Computed`, see [OData-VocCore]) and properties that are tied to key properties of the principal entity by a referential constraint, MAY be omitted from the request.

Upon successful completion, the response MUST contain a ~~Location header~~ Location header that contains the edit URL or read URL of the created entity.

Upon successful completion the service MUST respond with either ~~201 Created~~ 201 Created, or ~~204 No Content~~ 204 No Content if the request included a ~~Prefer header~~ return Prefer header with a value of ~~return=minimal~~ return=minimal.

11.4.2.1 Link to Related Entities When Creating an Entity

~~A service SHOULD support linking new entities to existing entities upon creation.~~

To create a new entity with links to existing entities in a single request, the client includes the entity-ids of the related entities associated with the corresponding navigation properties in the request body.

The representation for binding information is format-specific.

~~For example, in JSON~~ Example 67: using the JSON format the client can create a new manager entity with links to two existing employees by applying the `odata.bind` annotation to the `DirectReports` navigation property:

```
{
  "odata.type": "Northwind.Manager",
  "EmployeeID": 1,
  "DirectReports@odata.bind": [
    "http://services.odata.org/OData/OData.svc/host/service/Employees(5)",
    "http://services.odata.org/OData/OData.svc/host/service/Employees(6)"
  ]
}
```

Example 68: using the Atom format the client can create a new manager entity with links ~~to existing~~ to two existing employees by including a navigation link element for each employee in the Atom entry representing the manager:

```
<entry>
  <id>http://services.odata.org/OData/OData.svc/Employees(1)</id>
  - <id> http://host/service /Employees(1)</id>
  <title type="text" />
  - <updated>2011-02-16T01:00:25Z</updated>
  - <author><name /></author>
  <link
    - rel="http://docs.oasis-open.org/odata/ns/related/DirectReports"
    href="http://services.odata.org/OData/OData.svc/host/service/Employees(5)"
    type="application/atom+xml;type=entry"
    title="DirectReportsDirect Reports" />
  />
  <link
    - rel="http://docs.oasis-open.org/odata/ns/related/DirectReports"
    href="http://services.odata.org/OData/OData.svc/host/service/Employees(6)"
    type="application/atom+xml;type=entry"
    title="DirectReportsDirect Reports" />
  />
```

```

- <category term="NorthwindModel.Manager"
scheme="http://odata.org/scheme"/>
- <content type="application/xml">
  <metadata:properties>
    <data:EmployeeID>1</data:EmployeeID>
  </metadata:properties>
- </content>
</entry>

```

Upon successful completion of the operation, the service ~~MUST create~~creates the requested entity and relate it to the requested existing entities.

If the target URL for the collection the entity is created in and binding information provided in the POST body contradicts the implicit binding information provided by the request URL, the request MUST fail and the service respond with 400 Bad Request.

Upon failure of the operation, the service MUST NOT create the new entity. In particular, the service MUST never create an entity in a partially-valid state (with the navigation property unset).

11.4.2.2 Create Related Entities When Creating an Entity

~~A service that supports creating entities SHOULD support creating related entities as part of the same request.~~

A request to create an entity ~~MAY specify~~that includes related entities ~~that should also be created. The related entities MUST be~~, represented using the appropriate inline representation ~~of the navigation property. The navigation property MUST contain the related entities (ContainsTarget="true") or have an associated navigation property binding, is referred to specify the target set of the related entity(ies) as a "deep insert".~~

~~Properties computed by the service, along with properties of related entities that are tied to key properties of the principal entity by a referential constraint, MAY be omitted from the request. If the inline representation contains a value for a computed property or dependent property, of a referential constraint, the service MUST ignore that value when creating the related entity.~~

On success, the service MUST create ~~each entity~~all entities and relate them. If the request included a return Prefer header with a value of return=representation and is applied by the service, the response MUST be expanded to at least the level that was present in the deep-insert request.

On failure, the service MUST NOT create any of the entities.

11.4.3 Update an Entity

Services SHOULD support PATCH as the preferred means of updating an entity. PATCH provides more resiliency between clients and services by directly modifying only those values specified by the client.

The semantics of PATCH, as defined in [\[RFC5789\]](#), are to merge the content in the request payload with the [entity's] current state, applying the update only to those components specified in the request body. Collection properties and primitive properties provided in the payload MUST replace the value of the corresponding property in the entity or complex type. Missing properties of the containing entity or complex property, including dynamic properties, MUST NOT be directly altered.

Services MAY additionally support PUT, but should be aware of the potential for data-loss in round-tripping properties that the client may not know about in advance, such as open or added properties, or properties not specified in metadata. Services that support PUT MUST replace all ~~property values~~ of structural properties with those specified in the request body. Missing structural properties MUST be set to their default values. Missing dynamic structural properties MUST be removed or set to ~~NULL~~null.

Key and other non-updatable properties ~~MAY can~~ be omitted from the request. If the request contains a value for a key or other non-updatable property, the service MUST ignore that value when applying the update.

The entity MUST NOT contain related entities as inline content. It MAY contain binding information for navigation properties. For single-valued navigation properties this replaces the relationship. For collection-valued navigation properties this adds to the relationship.

If the entity being updated is open, then additional values for properties beyond those specified in the metadata or returned in a previous request MAY be sent in the request body. The service MUST treat these as dynamic properties.

If the entity being updated is not open, then additional values for properties beyond those specified in the metadata or returned in a previous request SHOULD NOT be sent in the request body. The service ~~SHOULD consider such a~~MUST fail if unable to persist all property values specified in the request malformed.

On success, the response MUST be a valid ~~success response~~success response.

11.4.4 Upsert an Entity

An ~~Upsert~~upsert occurs when the client sends an ~~update request~~update request to a valid URL that identifies a single entity that does not exist. In this case the service MUST handle the request as a ~~create entity request~~create entity request or fail the request ~~all together~~altogether.

Upserts are not supported against ~~media entities~~media entities. Services MUST fail an update request to a URL that identifies an entity that does not exist.

To ensure that an update request is not treated as an insert, the client MAY specify an ~~If-Match header~~If-Match header in the update request. The service MUST NOT treat an update request containing an If-Match header as an insert.

A PUT or PATCH request MUST NOT be treated as an update if an ~~If-None-Match header~~If-None-Match header is specified with a value of "*".

11.4.5 Delete an Entity

~~To delete an existing entity, the client sends a~~A successful DELETE request to ~~that an~~an entity's edit URL. ~~deletes the entity.~~ The request body SHOULD be empty.

On successful completion of the delete, the response MUST be ~~204 No Content~~204 No Content and contain an empty body.

Services MUST implicitly remove relations to and from an entity when deleting it; clients need not delete the relations explicitly.

Services MAY implicitly delete or modify related entities if required by integrity constraints. ~~If~~ integrity constraints are declared in \$metadata using a ReferentialConstraint element, services MUST modify affected related entities according to the declared integrity constraints, e.g. by deleting dependent entities, or setting dependent properties to null or their default value.

11.4.6 Modifying Relationships ~~Between~~between Entities

Relationships between entities are represented by navigation properties as described in ~~Data Model~~Data Model. URL conventions for navigation properties are described in ~~{OData-URL}~~[OData-URL].

11.4.6.1 ~~Create~~Add a New Reference to an Existing Entity in a Collection-Valued Navigation Property

~~To relate an existing entity to another entity, send a~~A successful POST request to ~~the URL for the appropriate a~~a navigation property's references collection. ~~adds a relationship to an existing entity.~~ The request body MUST contain ~~an a~~a single entity reference that identifies the entity to be added. See the appropriate format document for details.

~~The body~~On successful completion, the response MUST be ~~formatted as~~204 No Content and contain an empty body.

11.4.6.2 Remove a ~~single entity~~ Reference to an Entity

A successful `DELETE` request to the URL that represents a reference to a related entity removes the relationship to that entity.

For collection-valued navigation properties, the entity reference of the entity to be removed **MUST** be specified using the `$id` query string option.

For single-valued navigation properties, the `$id` query string option **MUST NOT** be specified.

The `DELETE` request **MUST NOT** violate any integrity constraints in the data model.

On successful completion, the response **MUST** be `204 No Content` and contain an empty body.

11.4.6.3 Change the Reference in a Single-Valued Navigation Property

A successful `PUT` request to a single-valued navigation property's reference resource changes the related entity. The request body **MUST** contain a single entity reference that identifies the existing entity to be related. See the appropriate format document for details.

On successful completion, the response **MUST** be ~~204 No Content~~`204 No Content` and contain an empty body.

~~11.4.6.2 Remove a Reference to an Entity~~

~~To remove a link to a related entity, the client sends a `DELETE` request to the URL that represents the reference to the related entity.~~

~~The `DELETE` request **MUST** follow not violate any integrity constraints in the data model.~~

~~On successful completion, the response **MUST** be `204 No Content` and contain an empty body.~~

~~11.4.6.31.1.1 Change the Reference in a Single-Valued Navigation Property~~

~~To relate an existing entity to a different existing entity, the client sends a `PUT` request to the URL for the appropriate navigation property's references resource. The request body **MUST** contain an entity reference that identifies the existing entity to be related, in the same format as for creating a new link between existing entities.~~

~~On successful completion, the response **MUST** be `204 No Content` and contain an empty body.~~

~~If a navigation property is nullable, then a change **MAY** be performed by first removing the existing relationship and then adding the new one. Use the approach described for adding and removing links.~~

~~Alternatively, a relationship **MAY** be updated as part of an update to the source entity by including the required binding information for the new target entity. This binding information **MUST** be formatted as is format-specific, see [OData-JSON] and [OData-Atom] for a deferred navigation property in a response details.~~

11.4.7 Managing Media Entities

A *media entity* is an entity that represents an out-of-band stream, such as a photograph.

A media entity **MUST** have a source URL that can be used to read the media stream, and **MAY** have ~~an~~`a` media edit-media URL that can be used to write to the media stream.

Because a media entity has both a media stream and standard entity properties special handling is required.

11.4.7.1 Creating a Media Entity

~~To create a media entity, the client sends a `POST` request to the a media entity's entity set creates a new media entity.~~ The request body **MUST** contain the media value (for example, the photograph) whose media type **MUST** be specified in a ~~Content-Type~~`Content-Type` header.

~~On~~ Upon successful ~~creation of completion~~, the ~~media~~ response MUST contain a Location header that contains the edit URL of the created entity.

Upon successful completion the service ~~MUST respond~~ responds with ~~201 Created and a response body containing the newly created media entity.~~ either 201 Created, or 204 No Content if the request included a return Prefer header with a value of return=minimal.

11.4.7.2 Editing a Media Entity Stream

~~To change the data for~~ A successful PUT request to the media edit URL of a media entity ~~stream, the client sends a PUT request to the edit URL of the~~ changes the media stream of the entity.

If the entity includes an ETag value for the media stream, the client MUST include an ~~If-Match~~ If-Match header with the ETag value.

The request body MUST contain the new media value for the entity whose media type MUST be specified in a ~~Content-Type~~ Content-Type header.

If the request to edit a ~~Media Entity Stream~~ media stream returns a non-empty response body, the response body MUST contain the updated media entity.

11.4.7.3 Deleting a Media Entity

~~To delete a media entity, the client sends a~~ A successful DELETE request to the entity's edit URL deletes the media entity as described in ~~Delete An Entity~~ Delete An Entity.

Deleting a media entity also deletes the media associated with the entity.

11.4.8 Managing ~~Named~~ Stream Properties

An entity may have one or more ~~named stream properties~~. ~~Named stream~~ Stream properties are properties of type `Edm.Stream`.

The values for ~~named~~ stream properties do not appear in the entity payload. Instead, the values are read or written through URLs.

~~Named streams are not deletable or directly creatable by the client. The service owns their lifetime. The client can request to set the stream data to empty (0 bytes).~~

11.4.8.1 Editing ~~Named~~ Stream Values

~~To change the data for a named stream, the client sends a~~ A successful PUT request to the edit URL of a stream property changes the media stream associated with that property.

If the stream metadata includes an ETag value, the client SHOULD include an ~~If-Match~~ If-Match header with the ETag value.

The request body MUST contain the new media value for the stream whose media type MUST be specified in a ~~Content-Type header~~ Content-Type header. It may have a Content-Length of zero to set the stream data to empty.

Stream properties MAY specify a list of acceptable media types using an annotation with term `Core.AcceptableMediaTypes`, see [OData-VocCore].

11.4.9 Managing Values and Properties Directly

Values and properties can be explicitly addressed with URLs. This allows them to be individually modified. See ~~[OData-URL]~~ [OData-URL] for details on addressing.

11.4.9.1 Update a Primitive Property

~~To update a value, the client sends a~~ A successful PUT request to ~~an~~ the edit URL for a primitive property updates the value of the property. The message body MUST contain the new value, formatted as a single property according to the specified format.

The same rules apply whether this is a regular property or a dynamic property.

Upon successful completion of the update, the response MUST be a valid update ~~response~~response.

11.4.9.2 Set a Value to Null

~~There are two ways to set a primitive value to NULL. The client can Update a Primitive Property, specifying a null value. Alternatively, the client can send a DELETE request with an empty message body to the property URL.~~

~~The service SHOULD consider a~~A successful DELETE request to the edit URL for a primitive property sets the property to null. The request body is ignored and should be empty.

~~A DELETE request to a non-nullable value to be malformed~~MUST fail and the service respond with 400 Bad Request.

The same rules apply whether the target is the value of a regular property or the value of a dynamic property. A missing dynamic property is defined to be the same as a dynamic property with value ~~NULL~~null. All dynamic properties are nullable.

On success, the service MUST respond with 204 No Content and an empty body.

Updating a Primitive Property with a null value also sets the property to null.

11.4.9.3 Update a Complex Type

~~To update a complex type, the client SHOULD send a~~A successful PATCH request to the edit URL for a complex typed property updates that property's URL~~property.~~ The request body MUST contain a single valid representation for the target complex type.

The service MUST directly modify only those properties of the complex type specified in the payload of the PATCH request.

The service MAY additionally support clients sending a PUT request to a URL that specifies a complex type. In this case, the service MUST replace the entire complex property with the values specified in the request body and set all unspecified properties to their default value.

On success, the response MUST be a valid update ~~response~~response.

11.4.9.4 Update a Collection Property

~~To update a collection value, the client sends a~~A successful PUT request to the edit URL of a collection property updates that collection-property's URL. The message body MUST contain the desired new value, formatted as a collection property according to the specified format.

The service MUST replace the entire value with the value supplied in the request body.

Since collection members have no individual identity, PATCH is not supported for collection properties.

~~Services MUST treat collection properties as a unit.~~

On success, the response MUST be a valid update ~~response~~response.

11.5 Operations

~~Services MAY support custom~~Custom ~~operations.~~Operations (Actions~~Actions~~and Functions~~Functions~~) are represented as Action, ActionImport, Function, and FunctionImport elements in ~~[OData-CSDL]~~[OData-CSDL].

11.5.1 Common rules for all operations

~~All operations MUST follow the rules outlined in [OData-CSDL].~~

11.5.1.1 Declaring Operations in Metadata

Actions and Functions SHOULD be declared in `$metadata`. Actions are declared using an `Action` element while Functions are declared using a `Function` element. Both elements specify the name, parameters, and return types of the operation.

Actions and Functions MAY be bound to an entity container by declaring an `ActionImport` or `FunctionImport` in `$metadata`.

[OData-CSDL] specifies how actions, functions, action imports, and function imports are syntactically defined in CSDL.

For example this `Action` element describes an action that creates an order for a customer using the specified quantity and discount code. This action can be bound to any resource path that represents a Customer entity:

```
<Action Name="CreateOrder" IsBindable="true">
  <Parameter Name="customer" Type="SampleModel.Customer">
  <Parameter Name="quantity" Type="Edm.Int32">
  <Parameter Name="discountCode" Type="Edm.String">
</Action>
```

The following `Function` describes a function called `MostRecent` that returns the most recent `Order` within a collection of `Orders`:

```
<Function Name="MostRecent" EntitySetPath="orders"
  ReturnType="SampleModel.Order"
  IsBindable="true">
  <Parameter Name="orders" Type="Collection(SampleModel.Order)"/>
</Function>
```

11.5.1.1 Binding Operationsan Operation to a Resource

Actions and Functions MAY be bound to an entity type, primitive type, complex type, or a collection. The first parameter of a **bindable** operation is the *binding parameter*.

The namespace (`_` or alias) **qualified** name of **the** *bound* operation may be appended to any URL that identifies a resource whose type matches, or is derived from, the type of the binding parameter. The resource identified by that URL is used as the *binding parameter value*.

For example, the function

Example 69: the function `MostRecentOrder` can be bound to any URL that identifies a `SampleModel.Customer`

```
<Function Name="MostRecentOrder" ReturnType="SampleModel.Order"
  IsBindable="true" IsAlwaysBindable IsBound="true">
  <Parameter Name="customer" Type="SampleModel.Customer" />
</Function>
```

can be bound to any URL that identifies a `SampleModel.Customer`, for example:

```
GET http://server/Customers(6)/SampleModel.MostRecentOrder()
```

invokes *Example 70: invoking the `MostRecentOrder` function with the `'customer'` or value of the binding parameter value `customer` being the entity identified by `http://server/host/service/Customers(6)`.*

11.5.1.1.2 Entity Set Path Expression

For Functions or Actions that return an entity or collection of entities, the entity set associated with the returned entity or collection of entities MAY depend upon the entity set of one of the parameter values used to invoke the operation.

When such a dependency exists an *entity set path expression* is used. An entity set path expression MUST begin with the name of a parameter to the operation, and optionally includes a series of navigation

path segments (using type casts, as appropriate) to describe the entity set associated with the returned entity or collection of entities relative to the input parameter.

```
Returning http://host/service/Customers(6)/SampleModel.MostRecentOrder()
```

11.5.11.5.2 Advertising Available Operations within a Payload

Services MAY return the available actions and/or functions bound to a particular entity as part of the entity representation within the payload. The representation of an action or function depends on the ~~format~~. An efficient format that assumes client knowledge of metadata **SHOULD NOT** include actions and functions in the payload that are available on all instances and whose target URL can be computed via metadata following standard conventions defined in [OData-URL].

For example, Example 71: given a GET request to `http://serverhost/service/Customers('ALFKI')`, the service might respond with a Customer that includes the `SampleEntities.MostRecentOrder` function bound to the entity:

```
{
  "odata.metadatacontext": ...,
  "#SampleEntities.MostRecent": {
    "title": "Most Recent Order",
    "target": "Customers('ALFKI')/SampleEntities.MostRecentOrder"
  },
  "CustomerID": "ALFKI",
  "CompanyName": "Alfreds Futterkiste",
  ...
}
```

~~An efficient format that assumes client knowledge of metadata SHOULD NOT include actions and functions in the payload that are available on all instances and whose target URL can be computed via metadata following standard conventions defined in [OData-URL].~~

11.5.211.5.3 Functions

Functions are operations exposed by an OData service that **MUST** return data and **MUST** have no observable side effects.

11.5.2.11.5.3.1 Invoking a Function

To invoke a function bound to a resource, the client issues a GET request to a function URL. A function URL may be ~~obtained~~ obtained from a previously returned entity ~~instance~~ representation or constructed by appending the namespace- (or alias-) qualified function name to a URL that identifies a resource whose type is the same as, or ~~derives~~ derived from, the type of the binding parameter of the function. The value for the binding parameter is the value of the resource identified by the URL prior to appending the function name, and additional parameter values are specified using ~~either inline parameter or parameter name syntax~~. inline parameter syntax. If the function URL is obtained from a previously returned entity representation, parameter aliases that are identical to the parameter name preceded by an at (@) sign **MUST** be used. Clients **MUST** check if the obtained URL already contains a query part and appropriately precede the parameters either with an ampersand (&) or a question mark (?).

Functions ~~may~~ can be used within ~~\$filter~~ \$filter or ~~\$orderby~~ \$orderby system query options. Such functions ~~may~~ can be bound to a resource, as described above, or called directly by specifying the namespace- (or alias-) qualified function name. Parameter values for functions within ~~\$filter~~ \$filter or ~~\$orderby~~ \$orderby **MUST be** are specified according to the ~~inline parameter syntax~~ inline parameter syntax.

To invoke a function through a function import the client issues a GET a request to a URL identifying the function import and passing parameter values using ~~either inline parameter or parameter name syntax~~ inline parameter syntax. The canonical URL for a function import is the service root, followed by the name of the function import. ~~If the function import is defined in the default entity container, its~~

~~unqualified name MAY be used, otherwise its namespace (or alias) and container-qualified name MUST be used.~~

Additional path segments and system query options may be appended to URLs that identify composable functions (or function imports) as appropriate for the type returned by the function or function import.

Services MAY support invoking a function or function import using a PUT, POST, PATCH or DELETE requests where the target of the operation is the result of the function.

Parameter values passed to functions MUST be specified either as a URL literal (for ~~Primitive Types~~primitive types) or as a JSON formatted OData object (for ~~Complex Types~~complex types or ~~Collections~~collections of ~~Primitive Types~~primitive types or ~~Complex Types~~complex types).

If a collection-valued function has no result for a given parameter value combination, the response is the format-specific representation of an empty collection. If a single-valued function with a nullable return-type has no result, the service returns 204 No Content.

If a single-valued function with a non-nullable return type has no result, the service returns 4xx. For functions that return a single entity 404 Not Found is the appropriate response code.

If a request URL contains further path segments after the function URL (including parameters), processing is stopped when the function result requires a 4xx response, and continues otherwise.

Function imports MUST NOT be used inside either the ~~\$filter~~\$filter or ~~\$orderby~~\$orderby system query options.

~~11.5.2.1~~11.5.3.1.1 Inline Parameter Syntax

Parameter values ~~MAY be~~are specified inline by appending a comma-separated list of parameter values, enclosed by parenthesis, ~~i.e. (and),~~ to the function name.

Each parameter value ~~MUST be~~is represented as a name/value pair in the format Name=Value, where Name is the name of the parameter to the function and Value is the parameter value.

~~For example this request:~~

```
GET http://server/EmployeesByManager (ManagerID=3)
```

~~Invokes~~Example 72: invoke a `Sales.EmployeesByManager` function which takes a single `ManagerID` parameter via the function import `EmployeesByManager`. ~~this request~~

~~And this request:~~

```
GET http://server/Customers?$filter=Sales.SalesRegion(City=$it/City) eq "Western"  
Returnshttp://host/service/EmployeesByManager (ManagerID=3)
```

Example 73: return all `Customers` whose `City` property returns "Western" when passed to the `Sales.SalesRegion` function.

```
Parameter values MAY be specified by substituting a parameter aliashttp://host/service/Customers?  
$filter=Sales.SalesRegion(City=$it/City) eq "Western"
```

A parameter alias can be used in place of an inline parameter to a function call ~~and specifying a~~. The value for the alias is specified as a separate query option using the name of the parameter alias.

~~For example:~~

```
GET http://server/Sales.EmployeesByManager (ManagerID=@p1)?@p1=3
```

~~Invokes~~Example 74: invoke a `Sales.EmployeesByManager` function, passing 3 for the `ManagerID` parameter.

11.5.2.1.2 Parameter Name Syntax

Parameter values for the last Function call in a Request URL Path MAY be specified by appending name/value pairs, representing each parameter Name and Value for that Function, as query strings to the Query part of the Request URL.

This enables clients to invoke functions without parsing the advertised Target Url.

For example:

```
GET http://serverhost/service/Sales.EmployeesByManager? (ManagerID=@p1) ?@p1=3
```

11.5.2.2 11.5.3.2 Function overload resolution

Function overloads are supported in OData, meaning a service MAY expose multiple functions with the same name that take The same function name may be used multiple times within a schema, each with a different set of parameters. The combination of the function name and the unordered list of parameter types and names MUST identify a particular function overload.

All non-bindable overloads MUST have the same return type. Also, all bindable overloads with a given binding parameter type MUST have the same return type.

Clients SHOULD use typed null values (e.g. null 'Date') when passing null parameter values in order to disambiguate requests.

If the function is bindable and the binding parameter type is part of an inheritance hierarchy, the function overload is selected based on the type of the URL segment preceding the function name, which MAY. A type segment can be used to select a type-cast function defined on a particular type in the hierarchy, see [OData-URL][OData-URL].

11.5.3 11.5.4 Actions

Actions are operations exposed by an OData service that MAY have side effects when invoked. Actions MAY return data but MUST NOT be further composed.

11.5.3.1 11.5.4.1 Invoking an Action

To invoke an action bound to a resource, the client issues a POST request to an action URL. An action URL may be obtained from a previously returned entity instance representation or constructed by appending the namespace (or alias) qualified action name, optionally followed by open and close parenthesis "()", to a URL that identifies a resource whose type is the same as, or derives from, the type of the binding parameter of the action. The value for the binding parameter is the value of the resource identified by the URL prior to appending the action name, and any non-binding parameter values are passed in the request body according to the particular format.

To invoke an action through an action import, the client issues a POST request to a URL identifying the action import. The canonical URL for an action import is the service root, followed by the name of the action import, optionally followed by open and close parenthesis "()". If the action import is defined in the default entity container, its unqualified name MAY be used, otherwise its namespace (or alias) and container qualified name MUST be used. When invoking an action through an action import all non-default parameter values MUST be passed in the request body according to the particular format.

Any nullable parameter values not specified in the request MUST be assumed to behave the default null value specified for the parameter, or null if no default is specified.

If the action returns results the client SHOULD use content type negotiation to request the results in the desired format, otherwise the default content type will be used.

If To request processing of the client only wants an action to be processed when only if the binding parameter value, an entity or collection of entities, is unmodified, the client SHOULD include the If-Match header with the latest known ETag value for the entity or collection of entities. The ETag value for a collection as a whole is transported in the ETag header of a collection response.

On success, the response ~~SHOULD be 200~~ is 201 *Created* for actions ~~with a~~ that create entities, 200 *OK* for actions that return ~~type results~~ or 204 *No Content* for action without a return type. The client can request whether any results from the action be returned using the ~~Prefer header~~, return Prefer header.

~~Example: The following JSON request invokes 75: invoke~~ the *SampleEntities.CreateOrder* action using */Customers('ALFKI')* as the customer (or binding parameter). The values 2 for the *quantity* parameter and *BLACKFRIDAY* for the *discountCode* parameter are passed in the body of the request:

```
POST http://serverhost/service/Customers('ALFKI')/SampleEntities.CreateOrder
{
  "quantity": 2,
  "discountCode": "BLACKFRIDAY"
}
```

~~11.5.3~~11.5.4.2 Action Overload Resolution

~~Actions support overloading by binding parameter, meaning a service MAY expose multiple actions with the same action name that take~~ may be used multiple times within a schema provided there is at most one non-bindable overload, and each bindable overload specifies a different binding parameter type.

If the action is bindable and the binding parameter type is part of an inheritance hierarchy, the action overload is selected based on the type of the URL segment preceding the action name, ~~which MAY~~. A type segment can be used to select an action defined on a particular type ~~cast~~ in the hierarchy, see ~~[OData-URL]~~[OData-URL].

11.6 Asynchronous Requests

A *Prefer* header with a *respond-async* preference allows clients to request that the service process a Data Service 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. A service MUST NOT reply to a Data Service Request with 202 *Accepted* if the request has not included the *respond-async* preference.

Responses that return 202 *Accepted* MUST have an empty response body and MUST include a *Location* header pointing to a *status monitor resource* that represents the current state of the asynchronous processing in addition to an optional *Retry-After* header indicating the time, in seconds, the client should wait before querying the service for status.

A GET request to the status monitor resource again returns 202 *Accepted* response if the asynchronous processing has not finished. This response MUST again include a *Location* header and MAY include a *Retry-After* header to be used for a subsequent request. The *Location* header and optional *Retry-After* header may or may not contain the same values as returned by the previous request.

A GET request to the status monitor resource returns 200 *OK* once the asynchronous processing has completed. This response MUST include a *Content-Type* header with value *application/http* and a *Content-Transfer-Encoding* header with value *binary* as described in [HTTP-Message]. The response body MUST enclose a single HTTP response which is the response to the initial Data Service Request.

A DELETE request sent to the status monitor resource requests that the asynchronous processing be canceled. A 200 *OK* or to a 204 *No Content* response indicates that the asynchronous processing has been successfully canceled. A client can request that the DELETE should be executed asynchronously. A 202 *Accepted* response indicates that the cancellation is being processed asynchronously; the client can use the returned *Location* header (which MUST be different from the status monitor resource of the initial request) to query for the status of the cancellation. If a delete request is not supported by the service, the service returns 405 *Method Not Allowed*.

After a successful `DELETE` request against the status monitor resource, any subsequent `GET` requests for the same status monitor resource returns `404 Not Found`.

If an asynchronous request is cancelled for reasons other than the consumers issuing a `DELETE` request against the status monitor resource, a `GET` request to the status monitor resource returns `200 OK` with a response body containing a single HTTP response with a status code in the `5xx Server Error` range indicating that the operation was cancelled.

The service **MUST** ensure that no observable change has occurred as a result of a canceled request.

If the client waits too long to request the result of the asynchronous processing, the service responds with a `410 Gone` or `404 Not Found`.

The status monitor resource URL **MUST** differ from any other resource URL.

11.6.11.7 Batch Requests

Batch requests allow grouping multiple operations into a single HTTP request payload. A batch request **MUST be** represented as a Multipart MIME v1.0 message [RFC2046][RFC2046], a standard format allowing the representation of multiple parts, each of which may have a different content type (as described in [OData-Atom][OData-Atom] and [OData-JSON][OData-JSON]), within a single request.

11.6.11.7.1 Batch Request Headers

Batch requests **MUST be** submitted as a single HTTP `POST` request to the batch endpoint of a service, which **MUST be** located at the URL `/batch` relative to the `Service-Root-URL` service root.

The batch request **MUST** contain a `Content-Type` header specifying a content type of `multipart/mixed` and a boundary specification as defined in [RFC2046][RFC2046] is defined in the Batch Request Body section below.

Batch requests **SHOULD** contain the applicable `OData-Version` header.

Example 76:

```
POST /service/$batch HTTP/1.1
Host: odata.org
OData-Version: 1.0
OData-MaxVersion: 3.0
Content-TypeContent-Type: multipart/mixed; boundary=batch_36522ad7-fc75-4b56-8c71-56071383e77b
<Batch Request Body>
```

As shown in the example above, batch requests **SHOULD** contain applicable `OData-Version` headers.

11.6.211.7.2 Batch Request Body

The body of a batch request is ~~be~~ made up of a series of individual requests and ~~change-sets~~ change sets, each represented as a distinct MIME part (i.e. separated by the boundary defined in the `Content-Type` header).

The service **MUST** process the requests within a batch request sequentially, ~~and MUST stop processing the request~~. Processing stops on the first error unless the ~~odata.continue-on-error~~ `odata.continue-on-error` preference is specified.

An individual request in the context of a batch request is a ~~Data request~~ Data request, ~~Data Modification~~ Data Modification request, ~~Action invocation~~ Action invocation request, or ~~Function invocation~~ Function invocation request. A MIME part representing an individual request **MUST** include a `Content-Type` header with value `application/http` and a `Content-Transfer-Encoding` header with value `binary`.

Preambles and Epilogues in the MIME payload, as defined in ~~[RFC2046]~~**[RFC2046]**, are valid but are assigned no meaning and thus MUST be ignored by processors of batch requests.

The Request-URI of HTTP requests serialized within MIME part bodies **MAY**can use one of the following three formats:

- Absolute URI with schema, host, port, and absolute resource path, ~~for example,~~

Example 77:

```
GET https://myserver.mydomain.org:1234/path/service/root/path/People(1) HTTP/1.1
```

- Absolute resource path and separate Host header, ~~for example,~~

Example 78:

```
GET /path/service/root/path/People(1) HTTP/1.1
Host: myserver.mydomain.org:1234
```

- Resource path relative to the batch request URI, ~~for example,~~

Example 79:

```
GET People(1) HTTP/1.1
```

Services MUST support all three formats.

Each MIME part body that represents a single request MUST NOT include:

- authentication or authorization related HTTP headers
- Expect, From, Max-Forwards, Range, or TE headers

Processors of batch requests MAY choose to disallow additional HTTP constructs in HTTP requests serialized within MIME part bodies. For example, a processor **MAY**may choose to disallow chunked encoding to be used by such HTTP requests.

~~The example below shows a sample~~Example 80: a batch request that contains the following operations in the order listed:

1. A query request
2. ~~Change-Set~~Change Set that contains the following requests:
 - ~~1.~~• Insert entity (with Content-ID = 1)
 - ~~2.~~• Update request (with Content-ID = 2)
3. A second query request

Note: For brevity, in the example, request bodies are excluded in favor of English descriptions inside <> brackets and OData-Version headers are omitted.

POST /service/\$batch HTTP/1.1

Host: host

OData-Version: 4.0

Content-Type: multipart/mixed;boundary=batch_36522ad7-fc75-4b56-8c71-56071383e77b

```
POST /service/$batch HTTP/1.1
Host: host
OData-Version: 4.0
Content-Type: multipart/mixed;boundary=batch_36522ad7-fc75-4b56-8c71-56071383e77b

--batch_36522ad7-fc75-4b56-8c71-56071383e77b
```

```

Content-Type: application/http
Content-Transfer-Encoding:binary

GET /service/Customers('ALFKI')
Host: host

--batch_36522ad7-fc75-4b56-8c71-56071383e77b
Content-Type: multipart/mixed;-boundary=changeset_77162fcd-b8da-41ac-a9f8-
9357efbbd6219357efbbd
Content-Length: ###

--changeset_77162fcd-b8da-41ac-a9f8-9357efbbd6219357efbbd
Content-Type: application/http
Content-Transfer-Encoding: binary

Content-ID: 1

POST /service/Customers HTTP/1.1
Host: host
Content-Type: application/atom+xml;type=entry
Content-Length: ###

<AtomPub representation of a new Customer>

--changeset_77162fcd-b8da-41ac-a9f8-9357efbbd6219357efbbd
Content-Type: application/http
Content-Transfer-Encoding:binary
Content-ID: 2

PATCH /service/Customers('ALFKI') HTTP/1.1
Host: host
Content-Type: application/json
If-Match: xxxxxx
Content-Length: ###

<JSON representation of Customer ALFKI>

--changeset_77162fcd-b8da-41ac-a9f8-9357efbbd6219357efbbd--

--batch_36522ad7-fc75-4b56-8c71-56071383e77b
Content-Type: application/http
Content-Transfer-Encoding: binary

GET /service/Products HTTP/1.1
Host: host

--batch_36522ad7-fc75-4b56-8c71-56071383e77b--
Note: For brevity, in the example, request bodies are excluded in favor of
English descriptions inside <> brackets and OData Version headers are omitted.

```

11.6.311.7.3 Change Sets

A **change set** is an atomic unit of work consisting of an unordered group of one or more **Data Modification** requests or **Action invocation** requests. Change sets MUST NOT contain any GET requests or other change sets. The contents of a MIME part representing a

change set MUST itself be a multipart MIME document (see ~~[RFC2046]~~[\[RFC2046\]](#)) with one part for each operation that makes up the change set. Each part representing an operation in the change set MUST include the same headers (Content-Type and Content-Transfer-Encoding) and associated values as previously described for query operations. In addition each request within a change set MUST specify a Content-ID header with a value unique within the batch request.

~~11.6.3.1~~[11.7.3.1](#) Referencing Requests in a Change Set

New entities created by an ~~insert~~[insert](#) request within a change set ~~MAY~~[can](#) be referenced by subsequent requests within the same change set by referring to the value of the Content-ID header prefixed with a \$ character. When used in this way, \$<Content-ID> acts as an alias for the URI that identifies the new entity.

~~The example below shows a sample~~[Example 81: a batch request that contains the following operations in the order listed:](#)

A change set that contains the following requests:

- ~~1.~~[1.](#) Insert a new entity (with Content-ID = 1)
- ~~2.~~[2.](#) Insert a second new entity (references request with Content-ID = 1)

```
POST /service/$batch HTTP/1.1
Host: host
OData-Version: 4.0
Content-Type: multipart/mixed;-boundary=batch_36522ad7-fc75-4b56-8c71-56071383e77b

--batch_36522ad7-fc75-4b56-8c71-56071383e77b
Content-Type: multipart/mixed;-boundary=changeset_77162fcd-b8da-41ac-a9f8-9357efbbd6219357efbbd
Content-Length: ###

--changeset_77162fcd-b8da-41ac-a9f8-9357efbbd6219357efbbd
Content-Type: application/http
Content-Transfer-Encoding: binary
Content-ID: 1

POST /service/Customers HTTP/1.1
Host: host
Content-Type: application/atom+xml;type=entry
Content-Length: ###

<AtomPub representation of a new Customer>

--changeset_77162fcd-b8da-41ac-a9f8-9357efbbd6219357efbbd
Content-Type: application/http
Content-Transfer-Encoding: binary

POST $1/Orders HTTP/1.1
Host: host
Content-Type: application/atom+xml;type=entry
Content-Length: ###

<AtomPub representation of a new Order>

--changeset_77162fcd-b8da-41ac-a9f8-9357efbbd6219357efbbd--

--batch_36522ad7-fc75-4b56-8c71-56071383e77b--
```

11.6.411.7.4 Responding to a Batch Request

Requests within a batch ~~MUST be~~are evaluated according to the same semantics used when the request appears outside the context of a batch.

The order of change sets and individual requests in a Batch request is significant~~as a~~. A service MUST process the components of the Batch in the order received. The order of requests within a change set is not significant~~as~~; a service ~~MAY~~may process the requests within a change set in any order.

All operations in a change set represent a single change unit so a service MUST successfully process and apply all the requests in the change set or else apply none of them. It is up to the service implementation to define rollback semantics to undo any requests within a change set that may have been applied before another request in that same change set failed and thereby ~~have~~apply this all-or-nothing requirement. The service MAY execute the ~~operations in~~requests within a change set in any order and MAY return the responses to the individual requests in any order. The service MUST include the Content-ID header in each response with the same value that the client specified in the corresponding request, so clients can correlate requests and responses.

If the set of request headers of a Batch request are valid (the Content-Type is set to multipart/mixed, etc.) the service MUST return a ~~200-OK~~200 OK HTTP response code to indicate that the request was accepted for processing, but the processing is yet to be completed. The requests within the body of the batch may subsequently fail or be malformed; however, this enables batch implementations to stream the results.

If the service receives a Batch request with an invalid set of headers it MUST return a ~~4xx-response code~~4xx response code and perform no further processing of the request.

A response to a batch request MUST contain a Content-Type header with value multipart/mixed.

Structurally, a batch response body MUST match one-to-one with the corresponding batch request body, such that the same multipart MIME message structure defined for requests is used for responses. There are ~~two~~three exceptions to this rule:

- When a request within a change set fails, the change set response is not represented using the multipart/mixed media type. Instead, a single response, using the application/http media type and a Content-Transfer-Encoding header with a value of binary, is returned that applies to all requests in the change set and MUST be formatted according to the Error Handling defined for the particular response format. ~~The other exception occurs when an error occurs processing a request and the odata.continue-on-error preference is not specified and therefore processing of the batch is terminated.~~
- When an error occurs processing a request and the odata.continue-on-error preference is not specified, processing of the batch is terminated and the error response is the last part of the multi-part response.
- Asynchronously processed batch requests can return interim results and end with a 202 Accepted as the last part of the multi-part response.

A response to a query operation in a batch MUST be formatted exactly as it would have appeared outside of a batch as described in ~~Requesting Data~~Requesting Data or ~~Invoking a Function~~Invoking a Function, as appropriate.

For example, Example 82: referencing the batch request example 80 above, assume all the requests except the final query request succeed. In this case the response would be ~~as shown in the following example.~~

```
HTTP/1.1 200 Ok
OData-Version: 4.0
Content-Length: ####
Content-Type: multipart/mixed;-boundary=b_243234_25424_ef_892u748
```

```

--b_243234_25424_ef_892u748
Content-Type: application/http
Content-Transfer-Encoding: binary

HTTP/1.1 200 Ok
Content-Type: application/atom+xml;type=entry
Content-Length: ###

<AtomPub representation of the Customer entity with EntityKey ALFKI>

--b_243234_25424_ef_892u748
Content-Type: multipart/mixed;-boundary=cs_12u7hdkin252452345eknd_383673037
Content-Length: ###

--cs_12u7hdkin252452345eknd_383673037
Content-Type: application/http
Content-Transfer-Encoding: binary
Content-ID: 1

HTTP/1.1 201 Created
Content-Type: application/atom+xml;type=entry
Location: http://host/service.svc/Customer('POIUY')
Content-Length: ###

<AtomPub representation of a new Customer entity>
Content-ID: 2

--cs_12u7hdkin252452345eknd_383673037
Content-Type: application/http
Content-Transfer-Encoding: binary

HTTP/1.1 204 No Content
Host: host

<AtomPub representation of a new Customer entity>
Content-ID: 2

--cs_12u7hdkin252452345eknd_383673037--

Content-Type: application/http
Content-Transfer-Encoding: binary

HTTP/1.1 204 No Content
Host: host

--cs_12u7hdkin252452345eknd_383673037--

--b_243234_25424_ef_892u748
Content-Type: application/http
Content-Transfer-Encoding: binary

HTTP/1.1 404 Not Found
Content-Type: application/xml
Content-Length: ###

<Error message>

--b_243234_25424_ef_892u748--

```

11.6.511.7.5 Asynchronous Batch Requests

Batch requests may be executed asynchronously by including the `respond-async` preference in the `Prefer` header. The service MUST ignore the `respond-async` preference for individual responses within a batch.

After successful execution of the batch request the response to the batch request would be returned in the body of a response to an interrogation request against the ~~monitor URL~~ status monitor resource URL (see section 11.6 “Asynchronous Requests”).

A service MAY return interim results to an asynchronously executing batch. ~~While the server has more requests in the batch to process it does this by including a 202 Accepted response with a 202 Accepted is added at the end as the last part of the list of responses to indicate the server is continuing to process the batch request.~~ multi-part response. The client can use the monitor URL returned in this ~~202 Accepted~~ 202 Accepted response to continue processing the batch response.

~~For example, Since a change set is executed atomically, 202 Accepted MUST NOT be returned within a change set.~~

Example 83: referencing the ~~same batch request~~ example 80 above again, assume that when interrogating the monitor URL for the first time only the first request in the batch finished processing and all the remaining requests except the final query request succeed. In this case the responses would be ~~as shown in the following example.~~

```
HTTP/1.1 200 Ok
OData-Version: 4.0
Content-Length: ####
Content-Type: multipart/mixed;-boundary=b_243234_25424_ef_892u748

--b_243234_25424_ef_892u748
Content-Type: application/http
Content-Transfer-Encoding: binary

HTTP/1.1 200 Ok
Content-Type: application/atom+xml;type=entry
Content-Length: ###

<AtomPub representation of the Customer entity with EntityKey ALFKI>

--b_243234_25424_ef_892u748
Content-Type: application/http
Content-Transfer-Encoding: binary

HTTP/1.1 202 Accepted
Location: http://service-root/async-monitor
Retry-After: ###

--b_243234_25424_ef_892u748--
```

Client makes a second request using the returned monitor URL-

```
HTTP/1.1 200 Ok
OData-Version: 4.0
Content-Length: ####
Content-Type: multipart/mixed;-boundary=b_243234_25424_ef_892u748

--b_243234_25424_ef_892u748
Content-Type: multipart/mixed;-boundary=cs_12u7hdkin252452345eknd_383673037
Content-Length: ###
```

```

--cs_12u7hdkin252452345eknd_383673037
Content-Type: application/http
Content-Transfer-Encoding: binary
Content-ID: 1

HTTP/1.1 201 Created
Content-Type: application/atom+xml;type=entry
Location: http://host/service.svc/Customer('POIUY')
Content-Length: ###

<AtomPub representation of a new Customer entity>
Content-ID: 2

--cs_12u7hdkin252452345eknd_383673037
Content-Type: application/http
Content-Transfer-Encoding: binary

HTTP/1.1 204 No Content
Host: host

--cs_12u7hdkin252452345eknd_383673037--

--b_243234_25424_ef_892u748
Content-Type: application/http
Content-Transfer-Encoding: binary

HTTP/1.1 404 Not Found
Content-Type: application/xml
Content-Length: ###

<Error message>

--b_243234_25424_ef_892u748-

```

Since a change set is executed atomically, 202 Accepted MUST NOT be returned within a change set.
~~202 Accepted~~

12 Security Considerations

This section is provided as a service to the application developers, information providers, and users of OData version 4.0 giving some references to starting points for securing OData services as specified. OData is a REST-full multi-format service that depends on other services and thus inherits both sides of the coin, security enhancements and concerns alike from the latter.

For HTTP relevant security implications please cf. the relevant sections of **[RFC2616]** (15 Security Considerations) and for the HTTP `PATCH` method **[RFC5789]** (5. Security Considerations) as starting points.

12.1 Authentication

OData Services requiring authentication SHOULD consider supporting basic authentication as specified in **[RFC2617]** over HTTPS for the highest level of interoperability with generic clients. They MAY support other authentication methods.

12.13 Conformance

OData is designed as a set of conventions that can be layered on top of existing standards to provide common representations for common functionality. Not all services will support all of the conventions defined in the protocol; services choose those conventions defined in OData as the representation to expose that functionality appropriate for their scenarios.

To aid in client/server interoperability, this specification defines multiple levels of conformance for an ~~OData Service, as well as the minimal requirements~~ OData Service, as well as the minimal requirements for an OData Client to be interoperable across OData services.

~~12.1~~13.1 OData Service Conformance Levels

OData defines three levels of conformance for an OData Service.

Note: The conformance levels are design to correspond to different service scenarios. For example, a service that publishes data compliant with one or more of the OData defined formats may comply with the ~~OData Minimal Conformance Level~~ OData Minimal Conformance Level without supporting any additional functionality. A service that offers more control over the data that the client retrieves may comply with the ~~OData Intermediate Conformance Level. Services that conform to the OData Advanced Conformance Level~~ OData Intermediate Conformance Level. Services that conform to the OData Advanced Conformance Level can expect to interoperate with the most functionality against the broadest range of generic clients. Services can advertise their level of conformance by the OData Conformance Level Annotation.

Note: Services are encouraged to support as much additional functionality beyond their level of conformance as is appropriate for their intended scenario.

~~12.1.1~~13.1.1 OData Minimal Conformance Level

In order to conform to the OData Minimal conformance level, a service:

- 1. MUST publish a service document at the service root (section 11.1.1)
- 2. MUST return data according to at least one of the OData defined formats (section 7)
- 3. MUST support ~~server-driven paging~~ server-driven paging when returning partial results (section 11.2.5.7)
- 4. MUST return the appropriate ~~OData-Version~~ OData-Version header (section 8.1.4)
- 5. MUST ~~honor~~ conform to the semantics the following headers, or fail the request
 - ~~Accept~~
 - ~~OData-MaxVersion~~
 - 5.1.Accept (section 8.2.1)
 - 5.2.OData-MaxVersion (section 8.2.6)
- 6. MUST follow OData guidelines for ~~extensibility~~ extensibility (section 6 and all subsections)
- 7. MUST successfully parse the request according to ~~{OData-ABNF}~~ [OData-ABNF] for any supported system query string options and either follow the specification or return ~~501-Not-Implemented~~ 501 Not Implemented (section 9.3.1) for any unsupported functionality (section 11.2.1)
- 8. MUST expose only data types defined in ~~[OData-CSDL]~~ [OData-CSDL]
- 9. MUST NOT require clients to understand any metadata or instance annotations, (section 6.4), custom headers, (section 0), or custom content (section 6.2) in the payload in order to correctly consume the service
- 10. MUST NOT violate any OData update semantics (section 11.4 and all subsections)
 - ~~SHOULD support \$expand specifically to enable clients to define the extent of the graph to retrieve~~
- 11. MUST NOT violate any other OData-defined semantics
12. SHOULD support \$expand (section 11.2.4.2)

13. MAY publish metadata at \$metadata according to [OData-CSDL] (section 11.1.2)

In addition, to be considered an *Updatable OData Service*, the service:

- 14. MUST include edit links (explicitly or implicitly) for all updatable or deletable resources according to [OData-Atom] and [OData-JSON]
- 15. MUST support POST of new entities to insertable entity sets (section 11.4.2 and 11.4.2.1)
- 16. MUST support POST of new related entities to updatable navigation properties (section 11.4.6.1)
- 17. MUST support POST to \$ref to add an existing entity to an updatable related collection (section 11.4.6.1)
- 18. MUST support PUT to \$ref to set an existing single updatable related entity (section 11.4.6.3)
- 19. MUST support PATCH to all edit links for updatable resources (section 11.4.3)
- 20. MUST support DELETE to all edit links for ~~deletable~~deletable resources (section 11.4.5)
- 21. MUST support DELETE to \$ref to remove an entity from an updatable navigation property (section 11.4.6.2)
- 22. MUST support ~~if-match~~if-match header in update/delete of any resources returned with an ETag (section 11.4.1.1)
- 23. MUST return a Location header ~~from POST~~ with the edit-link or ~~self-read~~link of ~~the~~a created resource (section 11.4.2)
- 24. MUST include the OData-EntityId header in response to any POST/PATCH that returns 204 No Content (Section 8.3.3)
- 25. MUST support ~~Upserts~~Upserts (section 11.4.4)
- 26. SHOULD support PUT and PATCH to an individual primitive (section 11.4.9.1) or complex (section 11.4.9.3) property (respectively)
- 27. SHOULD support DELETE to set an individual property to null (section 11.4.9.2)
- 28. SHOULD support deep inserts (section 11.4.2.2)

~~12.1.2~~13.1.2 OData Intermediate Conformance Level

In order to conform to the OData Intermediate Conformance ~~level~~Level, a service:

- MUST conform to the OData Minimal level
- SHOULD publish metadata at /\$metadata according to ~~[OData-CSDL]~~
- SHOULD support the OData-JSON format
- 1. MUST conform to the OData Minimal Conformance Level
- 2. MUST successfully parse the ~~[OData-ABNF]~~[OData-ABNF] and either follow the specification or return 501 Not Implemented for any unsupported functionality (section 9.3.1)
- 3. MUST support \$select (section 11.2.4.1)
- 4. MUST support casting to a derived type according to [OData-URL] if derived types are present in the model
- 5. MUST support \$top (section 11.2.5.3)
- 6. MUST support /\$value on media entities (section 4.10. in [OData-URL]) and individual properties (section 11.2.3.1)
- 7. MUST support \$filter (section 11.2.5.1)
 - 7.1. MUST support eq, ne filter operations on ~~filterable~~properties of entities in the requested entity set (section 11.2.5.1.1)
 - 7.2. MUST support aliases in \$filter expressions (section 11.2.5.1.3)
 - 7.3. SHOULD support additional filter operations (section 11.2.5.1.1) and MUST ~~fail-on-return~~ 501 Not Implemented for any unsupported filter operations (section 9.3.1)
 - 7.4. SHOULD support the canonical functions (section 11.2.5.1.2) and MUST ~~fail-on-return~~ 501 Not Implemented for any unsupported canonical functions (section 9.3.1)
 - SHOULD support \$search
 - SHOULD support \$skip
 - SHOULD support /\$count

- ~~SHOULD support \$expand for expandable navigation properties~~
- 7.5. SHOULD support \$filter on expanded ~~properties~~ entities (section 11.2.4.2.1)
- 8. SHOULD publish metadata at \$metadata according to [OData-CSDL] (section 11.1.2)
- 9. SHOULD support the [OData-JSON] format
- 10. SHOULD consider supporting basic authentication as specified in [RFC2617] over HTTPS for the highest level of interoperability with generic clients
- 11. SHOULD support the \$search system query option (section 11.2.5.6)
- 12. SHOULD support the \$skip system query option (section 11.2.5.4)
- 13. SHOULD support the \$count system query option (section 11.2.5.5)
- 14. SHOULD support \$expand (section 11.2.4.2)
- 15. SHOULD support the ~~canonical functions~~ lambda operators any and all on navigation- and collection-valued properties (section 5.1.1.5 in [OData-URL])
- 16. SHOULD support the /\$count segment on navigation- and collection properties ~~within a \$filter expression~~ (section 11.2.9)
- 17. SHOULD support \$orderby asc and desc on individual properties (section 11.2.5.2)

12.1.3 11.3 OData Advanced Conformance Level

In order to conform to the OData Advanced Conformance ~~level~~ Level, a service:

- 1. MUST conform to at least the ~~OData Intermediate Conformance Level~~ OData Intermediate Conformance Level
- 2. MUST publish metadata at ~~/\$\$~~ \$metadata according to [OData-CSDL] (section 11.1.2)
- 3. MUST support the ~~OData-JSON~~ [OData-JSON] format
- 4. MUST support the /\$count segment on navigation and collection properties ~~within a \$filter expression~~ (section 11.2.9)
- 5. MUST support the ~~canonical functions~~ lambda operators any and all on navigation- and collection-valued properties (section 5.1.1.5 in [OData-URL])
 - ~~MUST support the \$skip~~
 - ~~MUST support /\$count on collection-valued resource paths~~
- 6. ~~MUST support the \$count~~ system query option (section 11.2.5.4)
- 7. MUST support the \$count system query option (section 11.2.5.5)
- 8. MUST support \$orderby asc and desc on individual properties (section 11.2.5.2)
- 9. MUST support \$expand ~~for expandable navigation properties~~ (section 11.2.4.2)
 - 9.1. MUST support returning references for expanded properties (section 11.2.4.2)
 - 9.2. MUST support \$filter on ~~filterable properties of~~ expanded entities (section 11.2.4.2.1)
 - 9.3. MUST support cast segment in expand with derived types (section 11.2.4.2.1)
 - 9.4. SHOULD support \$orderby asc and desc on individual properties (section 11.2.4.2.1)
 - 9.5. SHOULD support the \$count system query option for expanded properties (section 11.2.4.2.1)
 - 9.6. SHOULD support \$top and \$skip on expanded properties (section 11.2.4.2.1)
 - 9.7. SHOULD support \$search on expanded properties (section 11.2.4.2.1)
 - 9.8. SHOULD support \$levels for recursive expand (section 11.2.4.2.1.1)
- 10. MUST support the \$search system query option (section 11.2.5.6)
 - ~~MUST support \$search~~
- 11. ~~MUST support the \$batch~~ system query option (section 11.7 and all subsections)
- 12. MUST support the resource path conventions defined in [OData-URL] [OData-URL]
- 13. SHOULD support Asynchronous operations (section 8.2.7.8)
- 14. SHOULD support Delta change tracking (section 8.2.7.6)
- 15. SHOULD support cross-join queries ~~rooted at the entity container~~ defined in [OData-URL]
- 16. SHOULD support a conforming OData service interface over metadata (section 11.1.3)

13.1.4 OData Conformance Level Annotation

Services can advertise their level of conformance by annotating their entity container with the `Capabilities.ConformanceLevel` annotation defined in [\[OData-VocCap\]](#).

12.213.2 Interoperable OData Clients

Interoperable OData Clients can expect to work with OData Services that comply with at least the ~~ⓘData Minimal conformance level~~[OData Minimal Conformance Level](#) and implement the ~~[OData-JSON]~~[\[OData-JSON\]](#) format. Clients that additionally support ~~[OData-Atom]~~[\[OData-Atom\]](#) can expect to interoperate with a broader range of OData Services.

To be generally interoperable, OData Clients

- 1. MUST specify the ~~ⓘdata~~[OData](#)-MaxVersion header in ~~request~~[requests](#) ([section 8.2.5](#))
- 2. MUST specify `OData-Version` ([section 8.1.4](#)) and `Content-Type` ([section 8.1.1](#)) in any request with a payload
- 3. MUST be a conforming consumer of OData as defined in ~~[OData-JSON]~~[\[OData-JSON\]](#)
- 4. MUST follow redirects ([section 9.1.5](#))
- 5. MUST correctly handle next links ([section 11.2.5.7](#))
 - ~~MUST be a conformant client of metadata as defined in [OData-CSDL]~~
- 6. MUST support instances returning properties and navigation properties not specified in metadata ([section 11.2](#))
 - ~~MUST support entity instances with external metadata~~
 - ~~MUST support properties with externally defined data types~~
7. MUST generate PATCH requests for updates, if the client supports updates ([section 11.4.3](#))
8. SHOULD support basic authentication as specified in [\[RFC2617\]](#) over HTTPS
- 9. MAY request entity references in place of entities previously returned in the response ([section 11.2.7](#))
- 10. MAY support deleted ~~entries~~[entities](#), link ~~entries~~[entities](#), deleted link ~~entries~~[entities](#) in a delta response ([section 11.3](#))
- 11. MAY support asynchronous responses ([section 9.1.3](#))
- 12. MAY support `odata.metadata=minimal` in a JSON response ([see \[OData-JSON\]](#))
- 13. MAY support `odata.streaming` [in a JSON response \(see \[OData-JSON\]\)](#)

~~To support updates, OData Clients:~~

- ~~MUST generate PATCH requests for updates~~

Appendix A. Acknowledgments

The following individuals were members of the OASIS OData Technical Committee during the creation of this specification and their contributions are gratefully acknowledged:

- ~~Howard Abrams (CA Technologies)~~
- ~~Ken Baclawski (Northeastern University)~~
- ~~Jay Balunas (Red Hat)~~
- ~~Mark Biamonte (Progress Software)~~
- ~~Matthew Borges (SAP AG)~~
- ~~Edmond Bourne (BlackBerry)~~
- ~~Joseph Boyle (Planetnetwork, Inc.)~~
- ~~Peter Brown (Individual)~~
- ~~Antonio Campanile (Bank of America)~~
- ~~Pablo Castro (Microsoft)~~
- ~~Axel Conrad (BlackBerry)~~
- ~~Robin Cover (OASIS)~~
- ~~Erik de Voogd (SDL)~~
- ~~Diane Downie (Citrix Systems)~~
- ~~Stefan Drees (Individual)~~
- ~~Patrick Durusau (Individual)~~
- ~~Andrew Eisenberg (IBM)~~
- ~~Chet Ensign (OASIS)~~
- ~~Davina Erasmus (SDL)~~
- ~~Colleen Evans (Microsoft)~~
- ~~Senaka Fernando (WSO2)~~
- ~~Brent Gross (IBM)~~
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- ~~Anila Kumar GVN (CA Technologies)~~
- ~~Ralf Handl (SAP AG)~~
- ~~Barbara Hartel (SAP AG)~~
- ~~Hubert Heijkers (IBM)~~
- ~~Jens Hüsken (SAP AG)~~
- ~~Evan Ireland (SAP AG)~~
- ~~Gershon Janssen (Individual)~~
- ~~Ram Jeyaraman (Microsoft)~~
- ~~Ted Jones (Red Hat)~~
- ~~Diane Jordan (IBM)~~
- ~~Stephan Klevenz (SAP AG)~~
- ~~Gerald Krause (SAP AG)~~
- ~~Nuno Linhares (SDL)~~
- ~~Paul Lipton (CA Technologies)~~
- ~~Susan Malaika (IBM)~~
- ~~Ramanjaneyulu Malisetti (CA Technologies)~~
- ~~Neil McEvoy (iFOSSF—International Free and Open Source Solutions Foundation)~~
- ~~Stan Mitranic (CA Technologies)~~
- ~~Dale Moberg (Axway Software)~~
- ~~Graham Moore (BrightstarDB Ltd.)~~
- ~~Farrukh Najmi (Individual)~~
- ~~Shishir Pardikar (Citrix Systems)~~
- ~~Sanjay Patil (SAP AG)~~
- ~~Nuccio Piscopo (iFOSSF—International Free and Open Source Solutions Foundation)~~

- ~~Michael Pizzo (Microsoft)~~
- ~~Robert Richards (Mashery)~~
- ~~Sumedha Rubasinghe (WSO2)~~
- ~~James Snell (IBM)~~
- ~~Jeffrey Turpin (Axway Software)~~
- ~~John Willson (Individual)~~
- ~~John Wilmes (Individual)~~
- ~~Christopher Woodruff (Perficient, Inc.)~~
- ~~Martin Zurmuehl (SAP AG)~~

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Appendix B. Revision History

Revision	Date	Editor	Changes Made
Working Draft 01	2012-08-22	Michael Pizzo	Translated Contribution to OASIS format/template
Committee Specification Draft 01	2013-04-26	Michael Pizzo, Ralf Handl, Martin Zurmuehl	<p>Added Delta support, Asynchronous processing, Upsert</p> <p>Aligned and expanded Prefer header preferences</p> <p>Simplified data model</p> <p>Defined rules and semantics around distributed metadata</p> <p>Fleshed out descriptions and examples and addressed numerous editorial and technical issues processed through the TC</p> <p>Added Conformance section</p>
<u>Committee Specification Draft 02</u>	<u>2013-07-01</u>	<u>Michael Pizzo, Ralf Handl, Martin Zurmuehl</u>	<p><u>Cleaned up action and function overloads and binding, removed old-style function parameter syntax</u></p> <p><u>Improved asynchronous processing and added callback notifications</u></p> <p><u>Improved context URL (formerly: metadata URL)</u></p> <p><u>Improved handling of empty results</u></p> <p><u>Improved description of rules for processing PUT and POST requests, especially deep inserts</u></p> <p><u>Harmonized \$count and \$inlinecount</u></p>