

Behavioural Atom Protocol Version 1.0

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Related work:

This specification is related to:

- *Classification of Everyday Living Version 1.0*. Edited by Joss Langford. Latest version: <http://docs.oasis-open.org/coel/COEL/v1.0/COEL-v1.0.html>.
- *Roles, Principles, and Ecosystem Version 1.0*. Edited by Matthew Reed. Latest version: <http://docs.oasis-open.org/coel/RPE/v1.0/RPE-v1.0.html>.
- *Minimal Management Interface Version 1.0*. Edited by David Snelling. Latest version: <http://docs.oasis-open.org/coel/MMI/v1.0/MMI-v1.0.html>.
- *Identity Authority Interface Version 1.0*. Edited by Paul Bruton. Latest version: <http://docs.oasis-open.org/coel/IDA/v1.0/IDA-v1.0.html>.
- *Public Query Interface Version 1.0*. Edited by David Snelling. Latest version: <http://docs.oasis-open.org/coel/PQI/v1.0/PQI-v1.0.html>.

Abstract:

This document defines a protocol for data exchanges that are capable of describing, querying and reporting a human activity event (Behavioural Atom) using the COEL model classification, as well as the context in which it took place (e.g. time, location).

Status:

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1 Introduction

Behavioural Atoms represent distinct human behavioural events. Their granularity has been designed so that they are small in terms of data volume but detailed enough to capture a single human behavior (e.g. eating egg based noodles or swimming laps of butterfly). The format of the Behavioural Atom allows many aspects of a human activity event to be coded – the type of event, the individual that the event relates to, the time it occurred, how it was recorded, location and context. The coding for the type of event references the hierarchical taxonomy defined in the Classification of Everyday Living [COEL_COEL-1.0].

This document describes the Behavioural Atom format and protocol for transmitting Atoms in this format to a Data Engine.

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

- | | |
|-----------------|--|
| [RFC2119] | Bradner, S., “Key words for use in RFCs to Indicate Requirement Levels”, BCP 14, RFC 2119, March 1997. http://www.ietf.org/rfc/rfc2119.txt . |
| [RFC2616] | R. Fielding et al, Hypertext Transfer Protocol – HTTP/1.1, http://www.ietf.org/rfc/rfc2616.txt . |
| [RFC3986] | T.Berners-Lee et al, Uniform Resource Identifiers (URI): Generic Syntax, August 1998, http://www.ietf.org/rfc/rfc3986.txt . |
| [RFC4627] | D. Crockford, The application/json Media Type for JavaScript Object Notation (JSON), July 2006, http://www.ietf.org/rfc/rfc4627.txt . |
| [RFC5246] | T. Dierks and E. Rescorla, The Transport Layer Security (TLS) Protocol Version 1.2, http://www.ietf.org/rfc/rfc5246.txt . |
| [COEL_RPE-1.0] | <i>Roles, Principles, and Ecosystem Version 1.0</i> . Latest version: http://docs.oasis-open.org/coel/RPE/v1.0/RPE-v1.0.docx |
| [COEL_IDA-1.0] | <i>Identity Authority Interface Version 1.0</i> . Latest version: http://docs.oasis-open.org/coel/IDA/v1.0/IDA-v1.0.docx |
| [COEL_COEL-1.0] | <i>Classification of Everyday Living Version 1.0</i> . Latest version: http://docs.oasis-open.org/coel/COEL/v1.0/COEL-v1.0.docx |
| [Weather] | <i>OpenWeatherMap, Weather Condition Codes</i> . Latest version: http://openweathermap.org/weather-conditions . |

1.3 Non-Normative References

- | | |
|----------------|--|
| [Data to Life] | Reed, M. & Langford, J. (2013). Data to Life. Coalition, London. ISBN 978-0957609402 |
|----------------|--|

2 HTTP Protocol

All interfaces are designed around the HTTP protocol stack [HTTP] and in particular rely on the REST based operational model. Each message includes one of the HTTP verbs, in particular GET or POST only, and further information depending on the operation being performed. This later information is included in the message body and encoded in JSON format [JSON].

In line with REST style protocol conventions, all accessible entities in the system SHALL be identifiable and reachable through dereferencing a URL unique to that entity. Entry to the system as a whole is via a well-known initial URI, known as the Data Engine Home URI.

2.1 Media Types for Messages

If the media type is present in the message, it SHALL be “application/json”. Atom server implementations SHALL accept message with this media type or none. However, they MAY reject malformed or oversized messages.

2.2 Operations

Only two operations are supported by the Behavioural Atom Protocol. The first is a GET operation directed at the Data Engine Home URI, which returns general information about the Data Engine and in particular the URI of the Atom POST operation URI.

2.2.1 Data Engine Information Request

Every Data Engine SHALL publish its Data Engine Home URI. Performing a GET on this URI SHALL return general information about the Data Engine as JSON object. The fields returned SHALL include the “atomsURI”, the “queryURI”, and the “managementURI” encoded as strings.

Method	Request	Response Status	Response Content-Type	Response Body
GET	None	200 (OK)	application/json	JSON object
GET	Any	415 (Unsupported Media Type)	None	None
POST	Any	405 (Method Not Allowed)	None	None

The JSON object of the response MAY contain additional fields with information about the Data Engine. The fields returned MUST include the “atomsURI”, the “queryURI”, and the “managementURI”; these are the target URLs to be used for adding Atoms, querying Atoms and managing access to the data engine.

Example request message:

```
GET /home
```

Example response message:

```
HTTP/1.1 200 OK
```

```
{“atomsURI”: “https://www.dataengine.com/atoms”,  
  “queryURI”: “https://www.dataengine.com/query”,  
  “managementURI”: “https://www.dataengine.com/management”}
```

2.2.2 Atom POST

To add a Behavioural Atom to the Data Engine, a POST operation SHALL be sent to the Atom POST URI obtained by a preceding GET on the Data Engine Home URI. The POST SHALL include a non-empty body containing either a single JSON Atom Object or a JSON array containing one or more Atom Objects. The Content-Type of the message MUST be 'application/json'.

The response returns HTTP status code 202 (Accepted) and an empty message body if the message format is accepted. One of the following HTTP status codes MUST be returned if an error occurs:

- 400 (Bad Request) if the message does not contain valid JSON or mandatory fields are missing from one or more of the atoms.
- 404 (Not Found) MAY indicate that the Atom POST URI might have changed and the client SHOULD obtain the URI from the Data Engine Home URI.
- 405 (Method Not Allowed) if another operation (e.g. GET/PUT/DELETE) is used
- 415 (Unsupported Media Type) if the content type is not 'application/json'
- 500 (Internal Server Error) if an internal error occurred

If the message was not accepted the response message MAY contain a JSON object with a description of the error, i.e. a list of error messages.

If one or more of the Atoms in a request is missing mandatory elements then the response SHALL be 400 and none of the Atoms SHALL be accepted by the Data Engine. In this case, the sender MAY make a request to submit each atom individually in order that the well-formed ones can be accepted.

Method	Request Content-Type	Request Body	Response Status	Response Content-Type	Response Body
GET	Any	Any	405 (Method not allowed)	None	None
POST	application/json	Valid JSON Atom	202 (Accepted)	None	None
POST	application/json	Invalid JSON	400 (Bad Request)	application/json	None or JSON Object with a description of the error
POST	Any other		415 (Unsupported Media Type)	None	None

Example request message:

```
POST /atoms  
Content-Type: application/json  
Content-Length: nn  
  
{ ... }
```

Example response message:

```
HTTP/1.1 202 OK
```

Example request message with an incorrect content type:

```
POST /atoms
Content-Type: image/png
Content-Length: 2134

{ ... }
```

Example response message:

```
HTTP/1.1 415 Unsupported Media Type
```

2.3 Security

Atom POST SHALL use anonymous TLS only. The Data Engine cannot authenticate the sender, since the Data Engine has no relationship with the consumer. Note that the ConsumerID or DeviceID MUST have been registered by an Operator for the Atom to be accepted.

2.4 Exceptions

The Data Engine MUST specify (e.g. through contract terms, on a web site, or as additional data in the Information Request response) how it will manage the following exceptional circumstances when receiving data:

- Duplicate Atom posts (e.g. over-write, return error, duplicate created)
- Atoms with invalid or missing ConsumerIDs and DeviceIDs
- Atoms with unallocated ConsumerIDs and DeviceIDs
- Atoms with missing essential fields
- Incorrectly formed Atoms

3 Atom Object Definition (JSON)

An atom object SHALL have the following format. The top level JSON SHALL be an object with the elements described below:

3.1 Header

Name	Value	Description	REQUIRED
Version	Integer	Version of message format and COEL model	Yes

3.2 Context

Context of the event:

Name	Value	Description	REQUIRED
Social	Integer, 0-6	Indicates the social context of the activity	No
Weather	Integer, 0-999	Indicates the general weather conditions at the time of the activity	No
ContextTag	Integer	Context provides the ability to encode "Why" information	No
ContextValue	Integer	Value of Context annotation.	Yes if Context Tag present

The enumeration values for Social SHALL be:

- 0: Don't Know
- 1: Family
- 2: Colleagues
- 3: Guests
- 4: Partner
- 5: Myself
- 6: Friends

The enumeration values for Weather SHALL be those of the Open Weather Map weather condition code scheme **[Weather]**.

There are no ContextTags defined in this version of the specification, but these MAY include references to previous Atoms to indicate causality or question / answer pairs to sequence interactions.

3.3 When

Time and duration of the event:

Name	Value	Description	REQUIRED
Time	Integer	Seconds since 1970/01/01 00:00Z (Unix timestamp in UTC)	Yes
UTCOffset	Integer	UTC Offset in seconds (e.g. UTC+1h = 3600,	No

		UTC-2h = -7200...) for the sender.	
Accuracy	Integer, 0-14	Indicates accuracy of the time field	No
Duration	Integer	Duration of the activity in seconds	No

The enumeration values for Accuracy SHALL be:

- 0: +/- 1 sec (exact)
- 1: +/- 1 min (default)
- 2: +/- 5 mins
- 3: +/- 15 mins
- 4: +/- 30 mins
- 5: +/- 1 hr
- 6: +/- 2 hrs
- 7: +/- 4 hrs
- 8: +/- 8 hrs
- 9: +/- 12 hrs
- 10: +/- 24 hrs (weekend)
- 11: +/- 72 hrs (week)
- 12: +/- 15 days (month)
- 13: +/- 91 days (season)
- 14: +/- 182 days (year)

This value refers to the accuracy reported and not necessarily the actual accuracy at which the measurement was obtained.

Atoms with duration of zero MAY be used and indicate an instantaneous event (or one where the duration is less than a second). A zero duration Atom MAY also be a marker for the end of a sequence of Atom such as in a running route, see section 3.6 Where.

3.4 What

Event as defined by the COEL model [COEL_COEL-1.0]:

Name	Value	Description	REQUIRED
Cluster	Integer, 1-32	COEL cluster.	Yes
Class	Integer, 1-99	COEL class, if available omit otherwise.	Only when 'Subclass' is also used.
SubClass	Integer, 1-99	COEL subclass, if available omit otherwise.	Only when 'Element' is also used.
Element	Integer, 1-99	COEL element, if available omit otherwise.	No

3.5 How

How the event was measured:

Name	Value	Description	REQUIRED
How	Integer, 0-11	An enumerated value describing how the information was provided	No

Certainty	Integer, 0-100	Percentage, certainty that this Atom is associated with the individual indicated in the Who field	No
Reliability	Integer, 0-100	Percentage, reliability of this atom as a whole. The default SHALL be 50, with 100 only being used for correction atoms.	No

The enumeration values for How SHALL be:

- 0: Don't Know
- 1: Observed
- 2: Objectively Measured: Public Infrastructure
- 3: Objectively Measured: Private Infrastructure
- 4: Objectively Measured: Fixed Computing Device
- 5: Objectively Measured: Portable Computer
- 6: Objectively Measured: Phones and Pocket Device
- 7: Objectively Measured: Wearables
- 8: Objectively Measured: Implants
- 9: Self-Reported
- 10: Remembered
- 11: Computationally derived from other Atoms

3.6 Where

Where the event occurred:

Name	Value	Description	REQUIRED
Exactness	Integer, 0-14	Format and precision of where fields	No
Latitude	Double	GPS location	No
Longitude	Double	GPS location	No
MCC	Integer	Mobile country code	No
MNC	Integer	Mobile network code	No
LCA	Integer	Local Area Code	No
CID	Integer	Cell ID	No
Place	Integer, 0-2	Profane location code	No
Postcode	String	Postcode	No

The enumeration values for Exactness SHALL be:

- 0: Mobile phone mast connected to the device.
- 1: Postcode or Zip code very long form.
- 2: Postcode or Zip code long form.
- 3: Postcode or Zip code short form
- 4: Place
- 5: GPS with accuracy between 0m and 1m.
- 6: GPS with accuracy between 1m and 5m.
- 7: GPS with accuracy between 5m and 10m.
- 8: GPS with accuracy between 10m and 15m.

- 9: GPS with accuracy between 15m and 20m.
- 10: GPS with accuracy between 20m and 25m.
- 11: GPS with accuracy between 25m and 30m.
- 12: GPS with accuracy between 30m and 50m.
- 13: GPS with accuracy between 50m and 100m.
- 14: GPS with accuracy between worse than 100m.

The enumeration values for Place SHALL be:

- 0: Home
- 1: Work
- 2: School

Where journeys are being recorded the location in this field SHALL be the starting location. The displacement of the journey can be recorded in an extension field and/or the final location MAY be recorded in a subsequent Atom.

3.7 Who

Who the event relates to:

Name	Value	Description	REQUIRED
DeviceID	String	Pseudonymous Key of the device that MUST be registered with a Consumer ID	Yes if Consumer ID is not present
ConsumerID	String	Pseudonymous Key for the consumer, subject, user or patient.	Yes if Device ID is not present

The format of valid strings for ConsumerID and DeviceID are defined in [COEL_IDA-1.0].

3.8 Extension

Additional information about the event:

Name	Value	Description	REQUIRED
ExtIntTag	Integer	Extension tag for integer extension	No
ExtIntValue	Integer	Value of extension annotation	Yes, if ExtIntTag present
ExtFltTag	Integer	Extension tag for float extension	No
ExtFltValue	Float	Value of extension annotation	Yes if ExtFltTag present
ExtStrTag	Integer	Extension tag for string extension	No
ExtStrValue	String	Value of extension annotation	Yes if ExtStrTag present

Some proposed tags and values SHALL be (can be either integer or float depending on the precision available/needed):

1001	Resting heart rate	bpm
1002	Average heart rate	bpm
1003	Maximum heart rate	bpm
1004	Blood pressure Encoded (SSSDDD)	
1005	Weight	kg
1006	Respiratory rate	bpm
1007	Lung capacity	cl
1008	Temperature	C
1009	Oxygen saturation	%
1010	Calories ingested	kcal
1011	Calories burned	kcal
1012	Steps taken	count
1013	Distance	km
1014	Climb	m
1015	Body fat	%
1016	Metabolic equivalent	MET
1017	Water intake	cl

3.9 Examples

The following is an example Behavioural Atom for the activity: 'Housework', 'Dishes', 'Loading and unloading the dishwasher', 'Load the dishwasher'; the time is accurate to +/- 1 minute; it took place at a given postcode, it was reported by the user with a 100% certainty of the 'Who' field and a general 'Reliability' of 70%, the social context was with a partner.

```
{
  "Header":{"Version":4},
  "Who":{"ConsumerID":"5a702670-ff63-4d1d-ba9d-077dd345ab62"}
  "What":{"Cluster":4,"Class":4,"SubClass":1,"Element":4},
  "When":{"Accuracy":1,"Time":1423515660,"Duration":437},
  "Where":{"Postcode":"UB4 8FE"},
  "How":{"How":9,"Certainty":100,"Reliability":70},
  "Context":{"Social":4},
}
```

The following is an example Behavioural Atom for the activity: 'Travel', 'Non Powered', 'Travelling by bicycle', 'Racing bike'; the time is exact; it started at the given latitude and longitude, it was reported by the user, and an application specific extension indicated that 26.2 km had been travelled.

```
{
  "Header":{"Version":4},
  "Who":{"ConsumerID":"5a702670-ff63-4d1d-ba9d-077dd345ab62"}
  "What":{"Cluster":22,"Class":1,"SubClass":1,"Element":2},
  "When":{"Timezone":"-01:00","Accuracy":0,"Time":1433397180,"Duration":3903},
}
```

```
"Where":{"Exactness":6,"Latitude":51.53118159161092,"Longitude":-0.4319647327069491},  
"How":{"How":9},  
"Extension":{"ExtFiltTag":1003,"ExtFiltValue":26.2},  
}
```

4 Conformance

A Data Engine interface for receiving Behavioural Atoms conforms if it meets the conditions set out in Section 2 of this document AND the conformance criteria in **[COEL_RPE-1.0]**

A Behavioural Atom is correctly formatted if it conforms to the conditions set out in Section 3.

Appendix A. Acknowledgments

The following individuals have participated in the creation of this specification and are gratefully acknowledged:

Participants:

Paul Bruton, Individual Member
Joss Langford, Activinsights
Matthew Reed, Coelition
David Snelling, Fujitsu

Appendix B. Revision History

Revision	Date	Editor	Changes Made
1	22/9/2015	Joss Langford	First full version
2	25/9/2015	Joss Langford	Correction of basic mistakes and omissions.
3	13/10/2015	Paul Bruton	Conformance includes reference to RPE document.
4	19/10/2015	David Snelling	Dealt with SHALL, MAY, and MUST and added examples.
5	26/10/2015	David Snelling	Minor updates to examples.
6	31/10/2015	Joss Langford	Accept all changes, track changes off, check references and style consistency.
7	31/10/2015	Joss Langford	Change history corrected.
8	02/11/2015	David Snelling	Final date change
9	03/11/2015	Paul Bruton	Typographic change following review.
10	25/11/2015	Joss Langford	Fix issue COEL-51: contingent requirements added to use of COEL layers in 3.4.
11	25/11/2015	David Snelling	Set date for CD publication