

TM Forum Technical Report

TM Forum Intent Ontology (TIO)

TR292

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Executive Summary

This document is part of a series of specifications that introduce the TM Forum Intent Ontology (TIO). The TIO is a modular information and knowledge model designed to express and manage intent.

1. Introduction

An autonomous network or system is an embodiment of zero-touch principles. This means that human intervention in operational tasks shall be avoided and replaced by a machine making operational decisions and implementing suitable solutions automatically. This autonomous system needs to fulfil the requirements set by the operator and its customers to deliver value and support their business strategy by utilizing the investment in network infrastructure in the most optimal way possible.

In such a network or system, autonomy shall be preserved, although requirements can change at any time based on business decisions. Intent is in this respect the information object by which the autonomous network or system is told what its requirements are.

The architecture of autonomous networks according to TM Forum introduces Intent Management Functions (IMF aka. Intent managers). Each intent manager is responsible for operating an autonomous domain. This is the scope of operation of a distinct intent manager. This intent manager would receive the requirements its autonomous domain has to comply to. Furthermore, it would define requirements it needs other domains to fulfill. Intent is in both cases the specification of these requirements.

An intent owner is an intent manager that needs requirement to be met by other autonomous domains. It uses intent to express these requirements and communicate them to the intent manager of the targeted autonomous domain. The intent manager that receives intent to be fulfilled is referred to as "Intent Handler". The communication regarding intent between an intent owner and intent handler and the life-cycle management of the requirements expressed by intent is done through an intent enabled API, such as TMF921.

While intent is the expression of the requirements from intent owner to intent handler, intent reports are the communication from the intent handler back to the intent owner for reporting on the success and achievements regarding compliance. The sending of requirements from intent owner to intent handler and the reporting in return establishes a control loop between intent managers. Intent is in this respect the specification of the requirements the control loop needs to meet in the operated autonomous domain.

The TM Forum autonomous networks project proposes to use model federation for defining modular sets of vocabulary and semantics to be used in intent expressions. This means that individual intent is expressed by using the combined vocabulary of multiple distinct model modules. A version of the intent common model specified in TR290 is a mandatory component of every intent model federation. It introduces the minimum mandatory set of modeling artifacts, such as classes and properties that every intent manager needs to understand and support. This is domain independent minimum set of vocabulary. Every intent, no matter of the application domain or use case would be built using at least the artifacts of the intent common model.

However, the intent common model is not complete, as it does not provide the specific expressiveness needed in certain application domains. Additional vocabulary and semantics covering optional modeling concerns and domain specific expressiveness would be introduced by intent extension models. Those additional models can be proposed by any project, standards organization or work group with the mission to define the detailed operation of a particular domain. TM Forum has defined a set of intent extension models in the TR291x series of specification. However, any other organization or work group with specific needs regarding intent expression is encouraged to define further intent extension models and contribute to the federation of models. They can contribute their models to TM Forum, or publish them separately.

This decentralized and low governance approach to model federation makes the TM Forum intent useful within and across any number of application and industry domains.

The intent expression vocabulary introduced by the intent common model and intent extension models depends on common concepts, such as intent handling state machine, logical operators, sets of resources or function notation. These are introduced in the TR292x series of specifications.

The Resource Description Framework (RDF) and the RDF Schema (RDFS) are the base for intent modeling. One of the reasons for this selection is the categorical use of globally unique identifiers for all modeling artifacts. Based on this, RDF models make it easy to work with multiple namespaces and to distribute expressiveness over multiple several distinct models. Model federation relies on these characteristics of RDF based modeling.

Models for intent and intent reports are closely related. Intent models specified by TM Forum therefore specify the needed vocabulary for intent and intent reports together and consider them to be part of the same intent common model or intent extension model. This means an intent model defines not only the classes and properties to be used for expressing intent objects but also the corresponding classes and properties needed for expressing intent reports. This is the recommended best practice also for models defined by other entities than TM Forum. Keeping intent and intent reporting models together helps to preserve consistency and completeness. It must for example not happen that intent extension models introduce a new expectation class, but misses introducing also the respective expectation report class.

Scope

The TM Forum Intent Ontology is a system of models designed for expressing intent as part of intent driven systems and control loops. This document provides an overview over all specifications included in the TM Forum Intent Ontology.

Revision Information

This revision v3.6.0 of the quantity ontology model is part of the TM Forum Intent Ontology (TIO) v3.6.0.

The revision v3.6.0 of this document replaces v.3.5.0 with the following changes:

- Minor editorial corrections.

2. Principles of intent modelling

Intent management functions use the Intent Management API TMF921 to exchange intent and intent reports. The TM Forum Intent Ontology (TIO) defines the information model used on the intent API to express intent and intent reports.

The intent common model is mandatory. Every intent management function needs to implement support for the intent common model.

Intent Extension models are optional. Every additional model that extends the vocabulary for intent and intent reports.

2.1. Model Federation Principles

The TM Forum Intent Ontology (TIO) refers to the entire ontology used by an intent management function for expressing intent and intent reports. It therefore consists of an intent common model TR290, the intent management base ontology TR292 and all used intent extension models if they are derived from and based on the intent common model and intent management base ontology. It can consist of multiple distinct ontology graphs defined over multiple distinct specifications. They can be defined by TM Forum, but also other organizations.

The principles of the Resource Description Framework (RDF) are applicable with respect to distributing parts of the overall ontology into multiple sub-graphs. In particular, IRI/URI are used unique identification of partial intent models as well as the intent modeling artifacts that constitute the available vocabulary for intent expression.

TM Forum has already defined a set of intent extension models addressing additional typical intent expression concerns, such as the conditional validity of requirements within an intent. Other TM Forum defined intent extension models contain vocabulary specific supporting optional API procedures related to intent negotiation.

It is not required that further intent extension models are designed by or under supervision of TM Forum. No central governance or coordination is required. Any entity, such as independent standard developing organizations (SDO), academic projects, communication service providers (CSP) or system vendors can contribute additional models. They can develop, maintain and publish these models according to their own requirements and processes. It is however recommended to base the extensions on the models provided by the core TIO, for example by defining specializations of exiting classes and properties. This anchors the extensions in the semantic context of the TIO.

In the TMF 921 intent API the overall federated ontology is used for expressing the exact content of the intent and intent report payload. Therefore, the intent management functions, which communicate over the Intent API must only use the intersection of their ontology graphs with each other. The coordination of this is a concern of intent manager capability management. It refers to a mechanism by which intent management functions publish the set of ontology models they use and support. Other intent managers can therefore limit the intent and intent report expression to the jointly supported ontology.

2.2. Version information

This document introduces the version 3.6.0 of the TM Forum intent ontology. This version has expanded the expressiveness of the model considerably compared to earlier versions.

The versioning of the TIO uses three numbers separated by a decimal point "<major>.<minor>.<admin>".

The first number refers to the major release of the TIO. The major release refers to a consistent level of features and concepts. Major releases are not necessarily compatible to older versions.

The second number refers to the minor release within the major release series. Minor releases are compatible with each other with respect to modeling concepts. However, vocabulary in distinct models might be added or removed within a minor release series.

The third number refers to administrative releases. They are used for introducing clarifications and error corrections and does not introduce new concepts, features or vocabulary.

A new major or minor release of the TIO steps the version numbers of all TM Forum released specifications to the TIO release number. This means also the version numbers of documents that were not changed or only had administrative corrections are changed to the TIO release number. This means that all TIO specifications and documents with the same major and minor version number are compatible and consistent with each other.

3. Specifications within the TM Forum Intent Ontology Release 3

The release version 3 of the TM Forum intent ontology

3.1. Overview and general documents

TR292 TM Forum Intent Ontology (TIO) Release 3 - v3.6.0

This document provides an overview of the specification in the TR292x series.

TR292R TM Forum Intent Ontology (TIO) Release 3 v3.6.0 - References

This document contains a collection of references shared by all distinct documents of the TR292x series.

3.2. Intent Management Base Ontology

TR292A Intent Management Elements v3.6.0

This document introduces the model of general concepts in intent management, such as types of intent models, as well as intent management functions and their roles.

TR292B Intent Management State Machines v3.6.0

This document introduces the generic state machine and events of intent handling.

TR292C Function Definition Ontology v3.6.0

This document introduces function notation as part of intent expression.

TR292D Quantity Ontology v3.6.0

This document introduces the quantity class and datatype for expressing quantities and combination of numeric value and unit.

TR292E Logical Operators v3.6.0

This document introduces logical operators to be used to make logical statement for expressing, for example, conditions.

TR292F Set Operators v3.6.0

This document introduces vocabulary for defining sets of objects and operators to use sets in logical statements.

TR292G Metrics and Observations v3.6.0

This document introduces classes and properties for modeling metrics and express observed values.

TR292H Mathematical Functions Definition and Collection v3.6.0

This document introduces mathematical functions including a collection of pre-defined function types.

TR292I Security Ontology v3.6.0

This document introduces concepts regarding security. It allows describing security requirements through intent.

TR299 Intent Specification v3.6.0

This document introduces the model for expressing intent specification. An intent specification is a set of rules regarding a well-formed intent and allowed intent content.

The appendix A of each document contains an alphabetically sorted vocabulary reference.

3.3. Intent Common Model

TR290 Intent Common Model v3.6.0

This document contains an introduction to the intent common model and its parts as specified in the TR290x series.

TR290A Intent Common Model Part 1: Intent Expression v3.6.0

This document specifies the structure of intent and common vocabulary for intent expression.

TR290B Intent Common Model Part 2: Intent Reporting v3.6.0

This document specifies the structure of intent reports and common vocabulary for intent report expression.

TR290V Intent Common Model - Vocabulary Reference v3.6.0

This document is the alphabetically sorted vocabulary reference of the intent common model. It contains the vocabulary of TR290A and TR290B combined.

3.4. Intent Extension Models defined by TM Forum

TR291 Intent Extension Models v3.6.0

This document contains an overview of intent extension models defined in the TR291 series of specifications

TR291A Intent Validity - Intent Extension Model v3.6.0

This document specifies validity context.

TR291B Intent Probing - Intent Extension Model v3.6.0

This document specifies how intent probing is reflected in intent reports

TR291C Proposal of Best Intent - Intent Extension Model v3.6.0

This document specifies how to request a best proposal within an intent and how the proposal is communicated with intent reports.

TR291G Preference of handling outcomes - Intent Extension Model v3.6.0

This document specifies how to request a judgement of potential handling outcomes from the intent owner using intent reports and how the preference of the owner is communicated through intent updates.

TR291H Intent Guarantee - Intent Extension Model v3.6.0

This document specifies how to request and provide guarantees regarding intent based requirements.

TR291I Utility - Intent Extension Model v3.6.0

This document specifies how to express utility information in intent for describing the business value of requirements.

The appendix A of each document contains an alphabetically sorted vocabulary reference.

Not all previously defined intent extension models are already updated according to release 3 of the TM Forum Internet Ontology. They will be added successively in coming releases.

4. Administrative Appendix

4.1. Document History

4.1.1. Version History

Version Number	Date Modified	Modified by:	Description of changes
1.0.0	31-Mar-2022	Alan Pope	Final edits prior to publication
1.1.0	01-Jun-2022	Alan Pope	Final edits prior to publication
3.0.0	07-Feb-2023	Alan Pope	Final edits prior to publication
3.1.0	11-Apr-2023	Alan Pope	Final edits prior to publication
3.2.0	15-Aug-2023	Alan Pope	Final edits prior to publication
3.4.0	29-Feb-2024	Alan Pope	Final edits prior to publication
3.5.0	03-May-2024	Alan Pope	Final edits prior to publication
3.6.0	04-Jul-2024	Alan Pope	Final edits prior to publication

4.1.2. Release History

Release Status	Date Modified	Modified by:	Description of changes
Pre-production	31-Mar-2022	Alan Pope	Initial Release
Pre-production	02-May-2022	Adrienne Walcott	Updated to Member Evaluated Status
Pre-production	01-Jun-2022	Alan Pope	Updated to v1.1.0
Pre-production	07-Feb-2023	Alan Pope	Updated to v3.0.0
Pre-production	17-Mar-2023	Adrienne Walcott	Updated to Member Evaluated Status
Pre-production	11-Apr-2023	Alan Pope	Updated to v3.1.0
Production	19-Jun-2023	Adrienne Walcott	Updated to reflect TM Forum Approved status
Pre-production	15 Aug-2023	Alan Pope	Updated to v3.2.0
Production	06-Oct-2023	Adrienne Walcott	Updated to reflect TM Forum Approved status
Pre-production	29-Feb-2024	Alan Pope	Updated to v3.4.0
Production	26-Apr-2024	Adrienne Walcott	Updated to reflect TM Forum Approved status

Release Status	Date Modified	Modified by:	Description of changes
Pre-production	03-May-2024	Alan Pope	Updated to v3.5.0
Production	28-Jun-2024	Adrienne Walcott	Updated to reflect TM Forum Approved status
Pre-production	04-Jul-2024	Alan Pope	Updated to v3.6.0
Production	30-Aug-2024	Adrienne Walcott	Updated to reflect TM Forum Approved status

4.2. Acknowledgments

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5. TRTRxxx Intent SpecificationTR292A Intent Management Elements v3.4.0 - Appendix A Vocabulary

5.1. Appendix A: Vocabulary Reference

This chapter contains a reference definition of all model vocabulary. It is sorted alphabetically.

5.1.1. BaseOntologyModel

The class `imo:BaseOntologyModel` is a subclass of `imo:TIOmodel`. Its instances are models within the TM Forum Intent Ontology. Intent common models and intent extension models rely on the fundamental vocabulary and semantics defined by a base ontology model.

Instance of: `rdfs:Class`

Subclass of: `imo:TIOmodel`

5.1.2. associatedValueCombination

The property `imo:associatedValueCombination` specifies the combination function to be applied if multiple contributors to the associated value of an instance a class are used.

Instance of: `rdf:PropertyDomain: rdfs:ClassRange: fun:Function`

5.1.3. associatedValueType

The property `imo:associatedValueType` specifies the type of the associated value of instances of a class. If this property is used in the definition of a class, instances of this class have associated values.

Instance of: `rdf:PropertyDomain: rdfs:Class`

5.1.4. IntentCommonModel

The class `imo:IntentCommonModel` is a subclass of `imo:TIOmodel`. Its instances are intent common models within the TM Forum Intent Ontology.

Instance of: `rdfs:Class`

Subclass of: `imo:TIOmodel`

5.1.5. IntentExtensionModel

The class `imo:IntentExtensionModel` is a subclass of `imo:TIOmodel`. Its instances are an intent extension model within the TM Forum Intent Ontology.

Instance of: `rdfs:Class`

Subclass of: `imo:TIOmodel`

5.1.6. IntentManager

The class `imo:IntentManager` expresses that its instance is an Intent Management Function.

Instance of: `rdfs:Class`

5.1.7. LCMrole

The class `imo:LCMrole` expresses that its instance has a role in intent life-cycle management. Its subclasses specify which role that is.

Instance of: `rdfs:Class`

5.1.8. Handler

The class `imo:Handler` expresses that its instance has the role of intent handler in intent life-cycle management.

Instance of: `rdfs:Class` Subclass of: `imo:LCMrole`

5.1.9. handler

The property `imo:handler` expresses that the resource of type `imo:IntentManager` in its object has the role of an intent handler for the subject. The subject is typically an intent or associated intent report.

Instance of: `rdf:Property`

Range: `imo:IntentManager`

5.1.10. owner

The property `imo:owner` expresses that the resource of type `imo:IntentManager` in its object has the role of an intent owner for the subject. The subject is typically an intent or associated intent report.

Instance of: `rdf:Property`

Range: `imo:IntentManager`

5.1.11. Owner

The class `imo:Owner` expresses that its instance has the role of intent owner in intent life-cycle management.

Instance of: `rdfs:Class` Subclass of: `imo:LCMrole`

5.1.12. TIOmodel

The class `imo:TIOmodel` expresses that its instance is an ontology model within the TM Forum Intent Ontology

Instance of: `rdfs:Class`