
D7.5

# Final Standardization Report

## WP7 – Dissemination, Standardization and Exploitation

**SIFIS-HOME**

*Secure Interoperable Full-Stack Internet of Things for Smart Home*

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| **Dissemination Level** | | |
| **PU** | Public | **X** |
| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the consortium (including the Commission Services) | |
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*E-mail address: marco.tiloca@ri.se*


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**Authors:** Marco Tiloca (RISE), Göran Selander (Ericsson), Luca Barbato (Luminem)

**Approved by:** Andrea Saracino (CNR), Sean Robinson (F-Secure)

**Revision History**

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# Executive Summary

This document summarizes the roles, initiatives, and achievements of SIFIS-Home partners with respect to standardization activities, during the whole project execution.

The work includes:

- 23 documents across 4 Working Groups within the Internet Engineering Task Force (IETF), the premier international standardization body for developing open Internet standards; and
- various activities within the World Wide Web Consortium (W3C), the premier international standardization body for developing open standards for the long-term growth of the World Wide Web.

This document builds on, updates and obsoletes the previous deliverable D7.2 “Preliminary Standardization Report” from WP7, thus providing a self-contained, final description of the standardization activities carried out during the project.

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# 1 Introduction

Standardization is a major dissemination effort in the SIFIS-Home project, for which a specific Task T7.2 “Standardization” is dedicated in WP7 “Dissemination, Standardization and Exploitation”. This leverages the presence of particular partners within the SIFIS-Home consortium that have a strong participation and involvement in international standardization activities.

Both RISE and Ericsson have a long-term, successful track record in the premier international body Internet Engineering Task Force (IETF), where for several years they have led the standardization of IoT security protocols, across multiple Working Groups. The targeted Working Groups in the SIFIS-Home project are “Constrained RESTful Environments” (CoRE), “Authentication and Authorization for Constrained Environments” (ACE), “Lightweight Authenticated Key Exchange” (LAKE), and “Static Context Header Compression” (SCHC).

Such IETF contributions are strictly tied to SIFIS-Home activities that RISE and Ericsson carry out in WP3 “Network and System Security”. These include the design and development of solutions for secure (group) communication within T3.1 “Secure, Interoperable and Robust Communication”, as well as for access control and key management within T3.2 “Security Lifecycle Management”.

Furthermore, Luminem has been actively contributing within the premier international body World Wide Web Consortium (W3C), with an engagement targeting both the community as a whole, and in particular the Web-Of-Things (WoT) Working Group.

Such W3C contributions are strictly tied to SIFIS-Home activities that Luminem carries out in WP2 “Guidelines and Procedures for System and Software Security and Legal Compliance”, especially for what concerns expressing and circulating descriptions of “things” and their properties that can have security and privacy implications, while ensuring semantic interoperability of the used information models.

This document builds on, updates and obsoletes the previous deliverable D7.2 “Preliminary Standardization Report“ from WP7, thus providing a self-contained, final description of the standardization activities carried out during the project.

# 2 Overview of the Internet Engineering Task Force (IETF)

The Internet Engineering Task Force (IETF) is the premier body developing open Internet standards through an open process, involving researchers, network designers, operators and vendors. In particular, "*the mission of the IETF is to make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet.*"

Standardization activities in the IETF take place within Working Groups (WGs), which are in turn organized into Areas. Inputs are provided in the form of written technical specifications, namely Internet Drafts, which are initially proposed as individual submissions. These may later be "adopted" by a WG as officially endorsed documents, which will be incrementally revised and advanced in a collective way. Eventually, an approved document is published in the series "Request For Comments" (RFC).

Each year, the IETF hosts three meetings, each of which occurs over five days and mostly consists of WG sessions. Each IETF meeting is preceded by a "Hackathon" event devoted to progress and test implementations of Internet Drafts and RFCs. In between the three main IETF meetings, several WG interim meetings are also scheduled, typically online.

Annex B provides further details about how the IETF is organized and its internal process.

The following provides an overview of the four IETF WGs referred to in the rest of this document.

- The IETF WG "Constrained RESTful Environments" (CoRE) provides solutions for resource-oriented applications intended to run on constrained IP networks. Typically, these networks are characterized by limited packet sizes and possible high packet loss. In additon, they could be largely composed of devices that are intermittently available and have limited capabilities in terms of computing power, memory resources, and energy availability (e.g., battery-powered devices). More details can be found at: https://datatracker.ietf.org/wg/core/about/

- The IETF WG "Authentication and Authorization for Constrained Environments" (ACE) provides a solution for authentication and authorization that enables authorized access to resources hosted on a resource server in constrained environments. Resource access is based on REST operations, e.g., GET, PUT, POST, DELETE. The enforcement of access control policies is mediated by a non-constrained entity acting as an authorization server. More details can be found at: https://datatracker.ietf.org/wg/ace/about/

- The IETF WG "Lightweight Authenticated Key Exchange" (LAKE) provides a lightweight authentication key establishment protocol suitable for resource-constrained devices, the main use case being applications using the security protocol Object Security for Constrained RESTful Environments (OSCORE). More details can be found at: https://datatracker.ietf.org/wg/lake/about/

- The IETF WG "Static Context Header Compression" (SCHC) builds on the SCHC technology initially developed in the LPWAN Working Group for Low-Power Wide-Area (LPWA) networks, and extends it to be applicable also to upper-layer protocols and within non-LPA networks, e.g., when considering underlying

layers such as UDP tunnels, IP, PPP, and Ethernet. More details can be found at: https://datatracker.ietf.org/wg/schc/about/

# 3 Involvement of SIFIS-Home partners in the IETF

The SIFIS-Home partners RISE and Ericsson have a long-term and successful track record in IETF standardization of IoT security protocols. As detailed later in Section 3.1, the targeted Working Groups in the SIFIS-Home project have been CoRE, ACE, LAKE, and SCHC previously overviewed in Section 2.

Besides regularly participating as key contributors to such standardization activities, individuals from both RISE and Ericsson have taken additional responsibility roles. In particular:

- Francesca Palombini (Ericsson) is Area Director for the Area "Application and Real-Time" (ART).
- Marco Tiloca (RISE) is Chair of the WG CoRE. He is also a member of the Internet-of-Things Directorate and of the ART Area Review Team.

## *3.1. Ongoing Standardization Works*

The following list includes the IETF documents with RISE and/or Ericsson as co-author. For each of them, a brief description and the current status are provided.

For each document, two percentage values are indicated as rounded up to the nearest integer:

- "Project Perspective Contribution" (PPC), i.e., the portion of the 36-month project's lifetime during which the project individually contributed to the document.
- "Document Perspective Contribution" (DPC), i.e., the portion of the document's lifetime during which the project individually contributed to the document.

A red asterisk (*) denotes those documents such that the work on them started during the project execution.

### *In the LAKE Working Group (1 document)*

**Ephemeral Diffie-Hellman Over COSE (EDHOC)**
A very compact and lightweight authenticated Diffie-Hellman key exchange with ephemeral keys, providing mutual authentication, forward secrecy, and identity protection. EDHOC is intended for constrained scenarios, and a main use case is to establish a Security Context for the security protocol Object Security for Constrained RESTful Environments (OSCORE).
https://datatracker.ietf.org/doc/draft-ietf-lake-edhoc/

***Status**: Approved for publication as Proposed Standard*
***PPC**: 100 % ; **DPC**: 71 %*

### *In the CoRE Working Group (10 documents)*

**Group Communication for the Constrained Application Protocol (CoAP)**
Usage of the Constrained Application Protocol for group communication, using UDP/IP multicast as the underlying data transport.
https://datatracker.ietf.org/doc/draft-ietf-core-groupcomm-bis/
***Status**: Adopted as Working Group document*
***PPC**: 63 % ; **DPC**: 39 %*

**Group OSCORE – Secure Group Communication for CoAP**
A method for protecting group communication over CoAP, based on OSCORE.
https://datatracker.ietf.org/doc/draft-ietf-core-oscore-groupcomm/
***Status**: Adopted as Working Group document*
***PPC**: 38 % ; **DPC**: 16 %*

**Observe Notifications as CoAP Multicast Responses**
Method for a CoAP server to send (secure) observe notifications as response messages over IP multicast.
https://datatracker.ietf.org/doc/draft-ietf-core-observe-multicast-notifications/
***Status**: Adopted as Working Group document*
***PPC**: 75 % ; **DPC**: 50 %*

**Using EDHOC with CoAP and OSCORE**
Additional and optional features for the authenticated key establishment protocol EDHOC when run over the CoAP protocol. These especially include a method to efficiently combine the execution EDHOC with a following message exchange protected with OSCORE.
https://datatracker.ietf.org/doc/draft-ietf-core-oscore-edhoc/
***Status**: Publication requested as Proposed Standard*
***PPC**: 75 % ; **DPC**: 63 %*

**Key Update for OSCORE (KUDOS)** *
A lightweight method for two OSCORE peers to update their keying material and establish a new OSCORE Security Context.
https://datatracker.ietf.org/doc/draft-ietf-core-oscore-key-update/
***Status**: Adopted as Working Group document*
***PPC**: 63 % ; **DPC**: 63 %*

**Key Usage Limits for OSCORE** *
Definition of key usage limits for AEAD algorithms used by two OSCORE peers, and of the steps to take to address those limits and preserve security of OSCORE-protected communications.
https://datatracker.ietf.org/doc/draft-ietf-core-oscore-key-limits/
***Status**: Adopted as Working Group document*

***PPC**: 75 % ; **DPC**: 75 %*

**Discovery of OSCORE Groups with the CoRE Resource Directory**
Method for a CoAP endpoint to use the CoRE Resource Directory for discovering OSCORE groups and acquiring information to join them.
https://datatracker.ietf.org/doc/draft-tiloca-core-oscore-discovery/
***Status**: Individual submission*
***PPC**: 75 % ; **DPC**: 43 %*

**Proxy Operations for CoAP Group Communication**
A method to enable CoAP forward-proxies to operate in group communication scenarios. The proxy forwards a client's request to multiple servers, e.g., over IP multicast. Then, it receives the servers' responses and forwards them back to the client, in such a way that the client is able to distinguish each response's origin.
https://datatracker.ietf.org/doc/draft-tiloca-core-groupcomm-proxy/
***Status**: Individual submission*
***PPC**: 75 % ; **DPC**: 58 %*

**Cacheable OSCORE**
A method to enable CoAP forward proxies to cache response messages protected with Group OSCORE.
https://datatracker.ietf.org/doc/draft-amsuess-core-cachable-oscore/
***Status**: Individual submission*
***PPC**: 75 % ; **DPC**: 63 %*

**OSCORE-capable Proxies** *
A method for protecting CoAP messages with OSCORE also between an origin application endpoint and an intermediary, or between two intermediaries. This includes the possible double-protection of a message through "OSCORE-in-OSCORE", i.e., both end-to-end between origin application endpoints, as well as between an application endpoint and an intermediary.
https://datatracker.ietf.org/doc/html/draft-tiloca-core-oscore-capable-proxies
***Status**: Individual submission*
***PPC**: 63 % ; **DPC**: 84 %*

### *In the ACE Working Group (11 documents)*

**OSCORE profile of the Authentication and Authorization for Constrained Environments Framework**
A profile for the ACE framework, which utilizes OSCORE in order to achieve communication security, server authentication, and proof-of-possession.
https://datatracker.ietf.org/doc/draft-ietf-ace-oscore-profile/
***Status**: Published as RFC 9203 (Proposed Standard)*
***PPC**: 30.5 % ; **DPC**: 15 %*

**Notification of Revoked Access Tokens in the Authentication and Authorization for Constrained Environments (ACE) Framework**
A method for the ACE framework to allow an authorization server to notify registered devices (i.e., clients and

resource servers) about issued access tokens that have been revoked but are not expired yet.
https://datatracker.ietf.org/doc/draft-ietf-ace-revoked-token-notification/
***Status**: Publication requested as Proposed Standard*
***PPC**: 75 % ; **DPC**: 53 %*

**Key Provisioning for Group Communication using ACE**
Definition of message formats and procedures based on the ACE framework, to request and distribute group keying material, which is then used to protect communications among members of a group.
https://datatracker.ietf.org/doc/draft-ietf-ace-key-groupcomm/
***Status**: Publication requested as Proposed Standard*
***PPC**: 75 % ; **DPC**: 38 %*

**Key Management for OSCORE Groups in ACE**
A method to request and provision keying material in group communication scenarios where the group communication is based on CoAP and secured with Group OSCORE, building on the ACE framework for Authentication and Authorization.
https://datatracker.ietf.org/doc/draft-ietf-ace-key-groupcomm-oscore/
***Status**: Publication requested as Proposed Standard*
***PPC**: 75 % ; **DPC**: 36 %*

**Admin Interface for the OSCORE Group Manager**
A RESTful admin interface at the OSCORE Group Manager, that allows an Administrator entity to create and delete OSCORE groups, as well as to retrieve and update their configuration. The ACE framework for Authentication and Authorization is used to enforce authentication and authorization of the Administrator at the Group Manager.
https://datatracker.ietf.org/doc/draft-ietf-ace-oscore-gm-admin/
***Status**: Adopted as Working Group document*
***PPC**: 75 % ; **DPC**: 53 %*

**Using the Constrained RESTful Application Language (CoRAL) with the Admin Interface for the OSCORE Group Manager**
A specification of how to use CoRAL for interacting with the RESTful admin interface at the OSCORE Group Manager based on the ACE framework for Authentication and Authorization.
https://datatracker.ietf.org/doc/draft-ietf-ace-oscore-gm-admin-coral/
***Status**: Adopted as Working Group document*
***PPC**: 75 % ; **DPC**: 53 %*

**Publish-Subscribe Profile for Authentication and Authorization for Constrained Environments (ACE)**
A method to request and provision keying material in group communication scenarios where the group communication relies on publish-subscribe through a CoAP pub-sub Broker and is secured end-to-end between publisher and subscribers, building on the ACE framework for Authentication and Authorization.
https://datatracker.ietf.org/doc/draft-ietf-ace-pubsub-profile/
***Status**: Adopted as Working Group document*
***PPC**: 25 % ; **DPC**: 11 %*

**Ephemeral Diffie-Hellman Over COSE (EDHOC) and Object Security for Constrained Environments (OSCORE) Profile for Authentication and Authorization for Constrained Environments (ACE)** *

A profile for the ACE framework, which utilizes OSCORE in order to achieve communication security, following the execution of the authenticated key establishment protocol EDHOC.

https://datatracker.ietf.org/doc/draft-ietf-ace-edhoc-oscore-profile/

***Status**: Adopted as Working Group document*

***PPC**: 53 % ; **DPC**: 100 %*

**Group OSCORE Profile of the Authentication and Authorization for Constrained Environments Framework**

A profile for the ACE framework, which utilizes Group OSCORE possibly together with OSCORE, to provide communication security between a client and (a group of) resource server(s), while achieving server authentication, proof-of-possession and proof of client's group membership.

https://datatracker.ietf.org/doc/draft-tiloca-ace-group-oscore-profile/

***Status**: Individual submission*

***PPC**: 75 % ; **DPC**: 53 %*

**Additional Authentication Credentials for the Datagram Transport Layer Security (DTLS) Profile for Authentication and Authorization for Constrained Environments (ACE)** *

An extension to the DTLS transport profile of the ACE framework for authentication and authorization, enabling the use of additional public authentication credentials, e.g., CWT Claims Sets (CCSs) as Raw Public Keys as well as public key certificates.

https://datatracker.ietf.org/doc/draft-tiloca-ace-authcred-dtls-profile/

***Status**: Individual submission*

***PPC**: 20 % ; **DPC**: 100 %*

**Alternative Workflow and OAuth Parameters for the Authentication and Authorization for Constrained Environments (ACE) Framework** *

An extension to the ACE framework for authentication and authorization, which enables an alternative workflow with the upload of access credentials delegated to the Authorization Server, and defines additional message parameters to extend the framework's functionalities and support new ones.

https://datatracker.ietf.org/doc/draft-tiloca-ace-workflow-and-params/

***Status**: Individual submission*

***PPC**: 20 % ; **DPC**: 100 %*

### *In the SCHC Working Group (1 document)*

**Clarifications and Updates on using Static Context Header Compression (SCHC) for the Constrained Application Protocol (CoAP)** *

A set of clarifications, updates and extensions to the standard RFC 8824 on using the Static Context Header Compression and fragmentation (SCHC) framework for CoAP messages, also when using the security protocol OSCORE to protect communications end-to-end. At the time of writing, it is planned for this document to be revised with the aim to eventually obsolete and replace RFC 8824.

https://datatracker.ietf.org/doc/draft-tiloca-schc-8824-update/

***Status**: Individual submission*

***PPC**: 19 % ; **DPC**: 60 %*

It is worth noting that the time for producing an IETF Proposed Standard from first submission to published RFC varies, but the whole process is typically a multi-year activity. This requires regular document editing contributions, implementation updates, and attendance at IETF meetings and Hackathon / interoperability testing events. Furthermore, it requires to follow and respond to document reviews on the topic of the Internet Draft, and to represent the WG in the resolution of the received comments.

Such a time span is needed even if the WG is already established and the current Charter of the WG (i.e., its description of work) is already covering the technical subject of the Internet Draft. If that is not the case, additional years should be accounted for, if at all possible, considering the requirement of rough consensus for starting a new WG on the topic in question.

Therefore, submitting a first version of an Internet Draft based on a project result as a one-off contribution to the IETF is bound to fail. For the same reason, it is highly improbable that submitting contributions to many different SDOs without a substantial commitment in each SDO will lead to any new standards that can have an impact. On the contrary, there is a need to focus.

Developing a novel technical solution and producing an RFC from scratch is thus in practice out of scope for a 3-year project. The project can either initiate work, maintain and progress ongoing work, and/or finalize standards based on previous work. The advantage of a 3-year project is that substantial commitments and advances can be made to specific SDOs, in order to enable significant contributions on the road to produce new standards.

## *3.2. Attendance to IETF events*

Throughout the project's lifetime, representatives from RISE and Ericsson have attended and actively participated in the following IETF meetings.

- IETF 109 (November 2020, Online)
- IETF 110 (March 2021, Online)
- IETF 111 (July 2021, Online)
- IETF 112 (November 2021, Online)
- IETF 113 (March 2022, Vienna, Austria)
- IETF 114 (July 2022, Philadelphia, USA)
- IETF 115 (November 2022, London, UK)
- IETF 116 (March 2023, Yokohama, Japan)
- IETF 117 (July 2023, San Francisco, USA)

In addition, representatives from RISE and Ericsson have attended and actively participated in several Working Group interim meetings, “Design team” meetings, and interoperability-test events.

Between March 2020 and February 2022, any such event had been conducted exclusively online, due to the COVID-19 pandemic.

# 4 Overview of the W3C

The World Wide Web Consortium (W3C) is an international community where Member organizations [W3C-MEMBERS], a full-time staff [W3C-STAFF], and the public work together to develop Web standards [W3C-STANDARDS]

The W3C has a mission similar to that of the IETF, although the W3C scope is more focused, and its structure is closer to more traditional standardization bodies.

The most significant difference is that a Membership is required in order to fully participate. The Community feedback is accounted for, but only Members and invited experts can directly contribute to the standardization documents. On the other hand, the main similarity is that the produced standards are publicly available and unrestricted as much as possible [W3C-LICENSE].

In the W3C, activities are carried out within Groups.

Every W3C Group describes its activities in its own, associated Charter Document. The output of a Group can be either a normative document (REC) or an informative (NOTE) document, which is reviewed and validated by the members of the W3C, possibly by some not directly involved in the specific Group in question. For every normative document, 2 implementations must be available in order to showcase its feasibility. If an item within a REC document is not covered by 2 implementations, such an item is marked as "At Risk" and is expunged if it still does not meet the implementation requirement by the ratification time.

Annex C provides further details about how the W3C is organized and its internal process.

[W3C-MEMBERS] https://www.w3.org/Consortium/Member/List

[W3C-STAFF] https://www.w3.org/People/

[W3C-STANDARDS] https://www.w3.org/standards/

[W3C-LICENSE] https://www.w3.org/Consortium/Patent-Policy-20200915/#sec-W3C-RF-license

## *4.1. Web of Things*

The W3C Group Web of Things (WoT) [W3C-WOT] is home to the standardization effort regarding IoT systems within the W3C. It aims on countering the fragmentation problem, by providing a means to describe and use already existing technologies (called brownfield) and a set of standards derived from the widely used Web Standards to let implementors produce new interoperable products (called greenfield).

Within WoT, there are three active groups:

- The Interest Group, which gathers feedback and develops use cases.
- The Working Group, which carries out the standardization activities. This is in turn split into multiple Task Forces that tackle specific facets of the IoT world, as summarized below.
- The Community Group, which collects further information and feedback from the non-member community, and advances the outreach of the developed standards and technologies.

In 2023, a new Charter Document has been drafted, and multiple improvements have been made over the original set of specifications ratified by the larger W3C community.

The following Task Forces are currently active within the WoT Working Group:

- WoT Architecture: This task force is responsible for the abstract architecture and interoperability profiles for the Web of Things. https://www.w3.org/WoT/activities/task-forces/tf-architecture/
- WoT Thing Description: This task force is responsible for defining the information model for WoT Thing metadata, its interpretation, and its common representation. https://www.w3.org/WoT/activities/task-forces/tf-td/
- WoT Discovery: This task force is responsible for defining a distribution mechanism for WoT Thing Descriptions that can be used to facilitate access to WoT Things. https://www.w3.org/WoT/activities/task-forces/tf-discovery/
- WoT Security: This task force is responsible for identifying and analyzing the security and privacy considerations of the WoT, as well as for providing recommendations to support appropriate security technologies and to mitigate security and privacy risks. https://www.w3.org/WoT/activities/task-forces/tf-security/
- WoT Scripting API: This task force is responsible for specifying an Application Programming Interface (API) representing the WoT Interface that allows scripts to discover, invoke interactions with Things, and expose interactions for locally defined Things. https://www.w3.org/WoT/activities/task-forces/tf-scripting/
- WoT Use Cases: This task force is responsible for collecting use cases for WoT and extracting requirements. https://www.w3.org/WoT/activities/task-forces/tf-usecases/
- WoT Marketing: This task force is responsible for reaching out and collaborating with the community to increase the adoption of the WoT standards. https://www.w3.org/WoT/activities/task-forces/tf-marketing/
- WoT Plugfest/Testing: This task force is responsible for organizing the Web of Things (WoT) Plugfests, and for organizing general testing procedures, data collection, and implementation report tooling for WoT deliverables. https://www.w3.org/WoT/activities/task-forces/tf-plugfest/

Further information on WoT is available at [W3C-WOT] https://www.w3.org/WoT/

# 5 Involvement of SIFIS-Home partners in W3C

As part of its activities in WP2, Luminem has developed from scratch a Rust implementation of the WoT Thing Description standard, and of a subset of the WoT Binding Protocols and Discovery.

Furthermore, in 2022, Luminem was first invited to participate in the WoT activities as a community member, and then asked to participate as a full-fledged W3C Member in 2023.

## *5.1. Task force activities*

Members of the WoT Working Group are expected to participate in the weekly Task Force meetings and in the plenary Group meetings. These are devoted to discussing the ongoing developments, reviewing and approving proposals (e.g., raised as Pull Requests), and planning future activities.

The following table summarizes the activities from Luminem in addition to the regular participation.

| WoT Working Group Task Force | Carried out activities |
|---|---|
| Architecture | • Active review of the next Charter Document, providing feedback on the Thing Description direction.<br>• Participation in the Profile activities, pushing to ensure support for constrained consumers.<br>• Contribution to a second implementation of the Served Side Event HTTP Profile |
| Thing Description | • Participation in all the Task Force activities<br>• Fixed some smaller issues in version 1.1 of the standard [WOT-ACT1].<br>• Provided a presentation on the issues of the current version 1.1, and proposed some overhauls for the work on version 2.0 [WOT-ACT2].<br>• Provided own wot-td implementation, also comprising an implementation of the ComboSecurityScheme and other at-risk items |
| Discovery | • Participation in the Task Force activities, providing implementation feedback |
| Security | • Participation in the TF activities, providing feedback as requested by other members<br>• Requested to be involved in the Onboarding standardization that is slated to version 2.0 |
| Scripting API | • Provided feedback regarding the API design, since Rust makes some issues more evident with the current design. |
| Use Case | • Authored a use-case document [WOT-ACT3] based on the SIFIS-Home Risk/Hazard Labeling, upon request by the other members. |
| Marketing | • Provided feedback when requested to better organize the online presence of WoT. |
| Testing | • Provided the implementation report [WOT-ACT4] for wot-rust<br>• Run an interoperability activity with Krellian regarding wot-discovery and the SSE HTTP profile. |

[WOT-ACT1] https://github.com/w3c/wot-thing-description/pulls/lu-zero

[WOT-ACT2] https://github.com/w3c/wot/tree/main/PRESENTATIONS/2023-06-14-WoT-TD-PainPoints-Uniformity-and-Specs

[WOT-ACT3] https://github.com/w3c/wot-usecases/blob/main/USE-CASES/hazard-annotations.md

[WOT-ACT4] https://github.com/w3c/wot-testing/pulls?q=is%3Apr+author%3Alu-zero+is%3Aclosed

## *5.2. Outreach activities*

In 2022, Luminem presented:

- Its implementation wot-rust, at the RustLab 2022 in Florence [RUSTLAB-2022], introducing the Rust developers to both the concepts of SIFIS-Home and Web of Things.
- Its implementation wot-rust, at the WoT CG Meeting [WOT-CG-2022], explaining how the Thing Description extensibility is used to distribute the additional risk/hazard information developed in SIFIS-Home.

Furthermore, Luminem has presented two topics at the TPAC 2023 WoT [TPAC-2023], in the joint session involving the WoT Working Group, the JSON for Linking Data Community Group, and the RDF Dataset Canonicalization and Hash Working Group. The two topics are:

- Degraded consumption of Thing Description
- JSON-LD restrictions in the current Thing Descriptions

Finally, Luminem plans to contribute to the alternative serialization panel discussing the usage of YAML-LD and CBOR-LD, possibly showcasing how the serde-based wot-td can already support them within the well-known limitations regarding the subset of LD supported.

[RUSTLAB-2022] https://rustlab.it/past-editions/2022

[WOT-CG-2022] https://www.w3.org/2022/09/26-wot-cg-minutes.html

[TPAC-2023] https://www.w3.org/2023/09/TPAC/Overview.html

### *5.3. Implementation activities*

Luminem has developed and is maintaining a Rust implementation [WOT-RUST] of the WoT standards. Its development had the dual purpose of providing a testbed for the SIFIS-Home WP2 development practices, and a practical implementation of the WoT standards, validating both the practices and the standards at the same time.

It is structured as follows:

- **wot-td** [WOT-TD] covers the creation and consumption of Thing Descriptions
  - It implements WoT Thing Description 1.1
  - It implements the WoT Binding Templates for the HTTP, CoAP, and MQTT protocols
  - It supports a type-safe extension system to accommodate additional vocabularies
- **wot-serve** [WOT-SERVE] provides a library crate to streamline the implementation of WoT Servients.
  - It implements the following WoT Profiles:
    - **HTTP basic**
    - **HTTP SSE**
  - The namib-project [NAMIB] plans to contribute a CoAP profile during next year.
- **wot-discovery** [WOT-DISCOVERY] covers only the discovery subset of the WoT Discovery standard
  - mDNS/DNS-SD discovery for TCP Servients. [WOT-DISCOVERY]
- **demo-things** [DEMO-THINGS] showcases the integration of the SIFIS-Home risk/hazard

labels in simulated Things.

[WOT-RUST] https://github.com/wot-rust

[WOT-TD] https://github.com/sifis-home/wot-td

[WOT-SERVE] https://github.com/sifis-home/wot-serve

[NAMIB] https://github.com/namib-project

[WOT-DISCOVERY] https://github.com/wot-rust/wot-discovery

[DEMO-THINGS] https://github.com/sifis-home/demo-things

# 6 Conclusion

This document has summarized the roles, activities, and achievements of SIFIS-Home partners within the international standardization bodies Internet Engineering Task Force (IETF) and World Wide Web Consortium (W3C), during the whole project execution. This document builds on, updates and obsoletes the previous deliverable D7.2 “Preliminary Standardization Report” from WP7.

# 5 Annex A: Glossary

| Acronym | Definition |
|---|---|
| ACE | Authentication and Authorization for Constrained Environments |
| AEAD | Authenticated Encryption with Associated Data |
| API | Application Programming Interface |
| ART | Application and Real-Time |
| CBOR | Concise Binary Object Representation |
| CoAP | Constrained Application Protocol |
| CoRE | Constrained RESTful Environments |
| COSE | CBOR Object Signing and Encryption |
| EDHOC | Ephemeral Diffie-Hellman over COSE |
| IETF | Internet Engineering Task Force |
| IoT | Internet of Things |
| IP | Internet Protocol |
| LAKE | Lightweight Authenticated Key Exchange |
| OSCORE | Object Security for Constrained RESTful Environments |
| REST | REpresentational State Transfer |
| RFC | Request For Comments |
| SCHC | Static Context Header Compression |
| SIFIS-Home | Secure Interoperable Full Stack Internet of Things for Smart Home |
| UDP | User Datagram Protocol |
| W3C | World Wide Web Consortium |
| WG | Working Group |
| WoT | Web-Of-Things |

# 6 Annex B: Organization, operation and document lifecycle in the IETF

The Internet Engineering Task Force (IETF) is the leading standardization body for Internet technologies, developing freely available Internet standards through an open process, involving researchers, network designers, operators and vendors.

The IETF is a voluntary organization. That is, both individuals with leadership and management roles as well as the contributors to Internet standards participate with no remuneration, although they are typically supported by their employers or sponsors.

As per the IETF mission statement RFC 3935, "the mission of the IETF is to make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet."

Such technical documents, also referred to as "specifications", as well as the process to create those, attempt to ensure that the technology in question: can perform its needed functions; will support the scale of deployment and usage; is secure in itself and can be operated securely; and is manageable in an effective, efficient and extensible way.

The rest of this section overviews how the IETF body is organized (see Section 6.1), how contributions occur and are handled (see Section 6.2), as well as the lifecycle of a technical specification from its first submission as Internet Draft until its publication as RFC (see Section .3).

Further high-level information about the IETF, and especially targeting newcomers, is available at https://www.ietf.org/about/participate/tao/

## *6.1 How the IETF is organized*

The IETF is organized into seven thematic Areas, namely "General", "Application/Real Time", "Transport", "Internet", "Routing", "Operations & Management", and "Security".

Each Area is associated with one to three Area Directors (ADs). The ADs together form a board of its own, namely the Internet Engineering Steering Group (IESG). The AD of the "General" area also serves as IESG Chair and IETF Chair. Each AD serves a term of two years, and can possibly serve an additional term.

Under this framework, standardization activities in the IETF take place within Working Groups (WGs). Each WG belongs to one Area, and is supervised by a responsible AD from that Area. In turn, a WG is led by two or three WG Chairs.

As further explained in Section 6.2 and Section 6.3, the production of an Internet standard occurs through activities within a WG, which may "adopt" a standard proposal as its own document to collectively work on.
The Working Groups, much like the specifications (see Section 6.2), are formed bottom-up, based on a proposal to meet a perceived need in the community. In particular, a potential new WG is usually proposed by some IETF participants at dedicated "Birds of a Feather" sessions, when a description of work ("Charter") and activity schedule for the WG are negotiated. If approved by the IESG, the new WG is created, and lives on over the years while possibly updating its Charter, until it eventually closes when its work is considered concluded.

Each year, the IETF hosts three meetings by rotating between Asia, the Americas and Europe, in the months of March, July and November. Each meeting occurs over five days, consists especially of WG sessions, and is possible to attend both onsite and online.

Each WG session lasts up to 2 hours (rarely more), and is intended to assess the status and advancement of active documents, discuss prominent unresolved issues for progressing documents, as well as present new works and assess interest in them.

During the weekend immediately preceding an IETF meeting, a 2-day "Hackathon" event is also held at the same venue, as mostly intended to advance and test software implementations of (in-progress) technical specifications.

Furthermore, in between the three IETF meetings, several WGs can schedule their own, dedicated interim meetings. These are typically held online, can occur on-demand or according to a regular pattern (e.g., every 2 or 4 weeks), and are usually focused on discussing outstanding open points on a small number of documents and on presenting new work.

It is worth noting that WG sessions at IETF meetings as well as WG interim meetings are recorded, and then archived on the IETF YouTube channel. This is part of a broader set of rules regulating IETF processes, which is also known as "Note Well" and covers, among other things, handling of IPR and the community code of conduct. Further information about the IETF "Note Well" is available at https://www.ietf.org/about/note-well/

## *6.2 How contributions to the IETF occur*

Unlike several other Standards Development Organizations, the IETF operates according to quite peculiar guidelines and attitudes.

Within the area of Internet technologies, new ideas as well as specific directions to address open points are raised

according to a bottom-up approach. That is, self-selected individual participants without a formal governing role make a proposal to a relevant Working Group, or to the community as a whole.

The assessment of such new ideas and specific directions is ultimately market-based, does not rely on formal voting, and is not weighed by any sort of influence quota. Instead, assessing the proposals from a participant relies on building and gauging "rough consensus" (see RFC 7282). This is achieved when all raised issues are addressed although not necessarily accommodated, i.e., dissenting opinions are heard but are not ultimately controlling.

Final decisions on rough consensus are taken and recorded on public mailing lists, and rely on individuals with a management role (e.g., the Chairs of a WG) to act as an ultimate arbiter.

### 6.2.1 IETF documents

Concretely, an input towards an Internet standard is provided in the form of a written technical specification, namely an Internet Draft, which is initially proposed as an individual submission from its co-authors.

As further explained in Section 6.3, an Internet Draft may at some point be "adopted" by a WG as an officially endorsed document, which will be incrementally revised and advanced in a collective way within the WG. The adoption of an Internet Draft as a WG document is indeed a first measure of success, since a WG as an officially acknowledged part of the community has committed to develop the document until it is ready to become a standard.

Eventually, in its version approved by the IESG and editorially revised, the document is published in the series "Request For Comments" (RFC). In particular, three main document types can be produced.

- **Standards Track** - This type of RFC comprises the actual standard specifications. These are released as "Proposed Standard" at the time of their first publication, and might yield a later "Internet Standard" update document, in case of wide deployment and use over the years.
- **Experimental** - This type of RFC is used to document solutions for which it is still unclear if there will be consistent interest in implementations, or whether they will work to the expected extent once deployed. That is, the content of an Experimental RFC should be object of experiments first, before considering at some point to produce a revision as Standards Track.
- **Informational** - This type of RFC is used to document general, supportive information to the Internet community.

Finally, an RFC may additionally "Update" or "Obsolete" previously published RFCs.

### 6.2.2 Ways to contribute for individuals

Unlike other standard organizations, the participation in the IETF is open and intended to individuals, with no formal membership or roster enforced. Minimally, one practically requires to have an account on the IETF Datatracker system as well as to subscribe to relevant mailing lists, neither of which is subject to a paywall or other particular requirements.

As a participant, one can engage with different levels of commitment. What is generally good to do includes identifying topics and WGs of interest, reading related relevant specifications, as well as regularly attending IETF meetings and WG interim meetings. Building on that, the three following levels of engagement are typical.

- **Passive/lightweight engagement** - The participant keeps themselves up to date with current activities and developments, reads specifications as they are revised, and follows discussions during meetings and

on mailing lists.

- **Active engagement** - The participant provides comments/input to existing specifications during meetings and on mailing lists, provides reviews to existing specifications on mailing lists, and declares interest and support for an existing specification to proceed.

- **Very active engagement** - The participant is an author of Internet Drafts, and/or provides software implementations of existing specifications. The latter may in turn result in participating to interoperability tests among different implementers, whose outcomes can provide valuable feedback for further improving specifications.

An IETF participant interested to contribute with a new Internet Draft is likely and rightly going to ask themselves the following questions.

- **What to write in the new Internet Draft?** Especially Standards Track and Experimental documents are written for implementers, and the right style is learned by reading other mature specifications and is improved by practice. Yet, one needs to focus on content that is an actual, enforceable idea to propose to the community.

- **Should a new Internet Draft be submitted at all?** It is generally a good and meaningful thing to do if all the following conditions hold: the intended content is a good idea in principle; it is perceived that people are or would be interested in that idea and in making a software implementation; most important, people feel an unsatisfied need that the new idea would satisfy. In order to gauge interest from the community, one has to "socialize" their proposal, preferably in an informal way (e.g., during hallway discussions at meetings).

- **To which WG should the new Internet Draft be brought up?** Often, already in its first version as individual submission, it is fairly clear that a new Internet Draft would pertain to a particular WG. Other times, the right venue might be neither obvious nor easy to determine, not even after informal discussions used to assess people's interest. In such a case, proponents can present a pitch of their idea to the DISPATCH or SECDISPATCH groups, thus receiving guidance on whether work on the topic is appropriate and needed, and, if so, in which WG it fits best or if a new WG should preferably be created.

## *6.3 Lifecycle of IETF documents*

This section discusses the lifecycle of an IETF document, also shown in Figure 1.

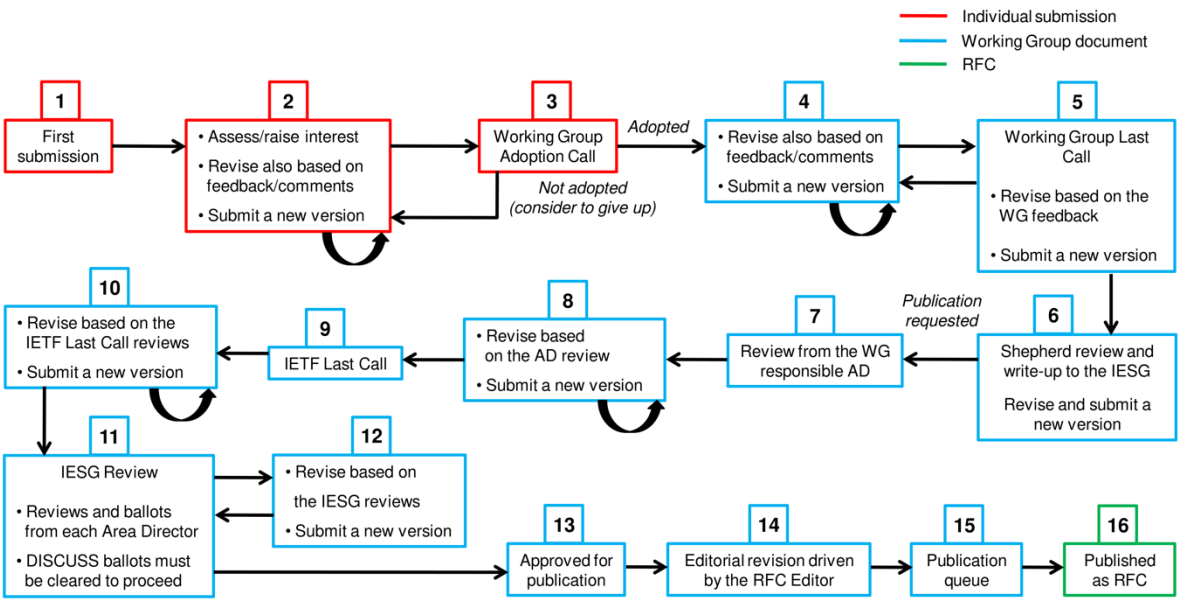


**Figure 1 - Lifecycle of an IETF document.**

1. **First Submission** - The official lifecycle of a document starts with its authors submitting it as version -00 of an Internet Draft, as an individual submission. Although this is just a first version, with no expectation of thoroughness and completeness, the Internet Draft has to minimally comply with the editorial template, and to practically convey the proposed idea, together with its underlying motivation and an early description of the means to enforce it.

2. **Discussion, revision and resubmission** - The authors ask for agenda time for the Internet Draft at an IETF meeting or at a WG interim meeting (see Section 6.1). This is usually preceded by a heads-up on the relevant mailing lists, where a discussion on the current content of the Internet Draft can have an early start.

   When the document is in its early versions, the goal of this step is especially to assess interest in the proposed work altogether; more generally, the goal is also to get feedback on the latest content in order to improve and progress the document.

   Based on the feedback and comments received from the discussion, the authors work on revising the Internet Draft and produce the next version.

   Once the Internet Draft has been revised, the authors submit a new version. If the authors believe that this latest version is fairly stable to be officially taken by the WG, the process moves to step 3. Otherwise, which is typically the case for several versions of the document as an individual submission, step 2 is repeated.

3. **WG Adoption Call** - When the latest version of the Internet Draft is fairly stable and provides a preliminary proposal of the intended specification, the authors request whether the involved WG is interested in "adopting" the Internet Draft as a WG document.

   If the WG Chairs determine that this is an appropriate step at that point in time and altogether, they issue a WG Adoption Call on the Internet Draft.

The WG Adoption Call takes place on the WG mailing list and typically lasts two weeks, during which the WG participants have the possibility to express their support, opposition and opinion about adopting the Internet Draft, or to simply ignore it if not interested or neutral in that respect.

At the end of the WG Adoption Call, it is ultimately a call of judgment of the WG Chairs to determine whether there is rough consensus (see Section 6.2) on adopting the Internet Draft and whether there is enough interest and energy in the WG to effectively work on it.

- If the decision is to not adopt the Internet Draft as a WG document, the authors may want to move back to step 2, and plan to request a new WG Adoption Call in the future, assuming that people are interested in the proposed idea altogether and having addressed the received feedback and comments. If appropriate or suggested to, the authors may instead consider stopping pursuing that work in the specific WG in question, and rather approach a different WG where to start over with presenting the proposed idea.
- If the Internet Draft is adopted as a WG document, the authors resubmit its latest version in its WG document incarnation, for which the document tag begins with "draft-ietf-" and the version number restarts from -00. This explicitly stresses two things.

  First, from here on, the document does not belong to its authors anymore, but to the WG. That is, the authors are hereafter expected to continue contributing to the document together with the WG, and to progress the document writing in order to reflect the decisions that the WG collectively takes in developing the specification.

  Second, a just adopted WG document is not completed at all, but it is effectively a good starting point for collectively working on it in the WG towards a standard specification. Yet, as discussed in Section 6.2.1, this is indeed a first measure of success, since a WG as an officially acknowledged part of the IETF has committed to develop the Internet Draft until it is ready to become a standard.

  Then, the process moves to step 4.

4. **Discussion, revision and resubmission** - This step is similar to step 2. The main difference is that, since the Internet Draft is now a WG document, the authors work on revising the Internet Draft as a result of collective discussions and decisions in the WG.

   In this spirit, the authors are still the main, hands-on responsible and still engage in presenting the progress of the Internet Draft and the outstanding issues to the WG, to discuss and determine the best course of action. Concerning a WG document, this takes priority over individually submitted Internet Drafts, especially when scheduling presentation slots at IETF meetings and WG interim meetings.

   Based on the received feedback and comments from the WG participants, the authors work on revising the Internet Draft and producing the next version accordingly.

   Once the Internet Draft has been revised, the authors submit a new version. If the authors believe that this latest version is stable and complete, the process moves to step 5. Otherwise, as is typically the case for several versions of the Internet Draft as a WG document, step 4 is repeated.

5. **Working Group Last Call** - When the authors of the Internet Draft believe that they have completed the work on the document and that there are no issues left to address, the authors request that the document undergoes a Working Group Last Call.

If the WG Chairs determine that this is premature (e.g., there are indeed issues to address), the process moves back to step 4. Otherwise, if the WG Chairs determine that this is an appropriate step to take, they issue a WG Last Call on the Internet Draft.

The WG Last Call takes place on the WG mailing list and typically lasts two or three weeks, during which the WG participants have the possibility to perform in-depth reviews of the Internet Draft and provide final comments.

At the end of the WG Last Call, the authors revise the document in order to address the comments and reviews received during the WG Last Call, especially by addressing any possible new issues. This results in the submission of one or more new versions of the Internet Draft.

When the Working Group Chairs determine that the latest version of the Internet Draft satisfactorily addresses all the comments raised during the WG Last Call and that no issues are left, then the process moves to step 6.

6. **Shepherd assignment and request for publication** - The WG Chairs assign a Shepherd to the Internet Draft. This role is assigned to an individual that is not a co-author of the Internet Draft, but is believed to be knowledgeable about it in order to supervise the process hereafter. Often, although not necessarily, the role is taken by one of the WG Chairs.

   From here on, the Shepherd acts as the main connection between, on one hand the Responsible AD and the IESG throughout their evaluation of the Internet Draft, and, on the other hand, the authors of the Internet Draft and the WG.

   At this particular step, the Shepherd performs a further, final review of the Internet Draft, and compiles a Write-Up mostly intended to the IESG, as summarizing key points about different aspects of the Internet Draft. In particular, the Shepherd performs a final check with the authors and the WG about any IPR relevant to the Internet Draft having been properly disclosed.

   Then, the authors further revise the Internet Draft by addressing the review from the Shepherd, and accordingly submit a new version.

   When both this latest version of the Internet Draft and the Shepherd Write-Up are available, the WG Chairs request publication of the Internet Draft to the IESG. Then, the process moves to step 7.

   The Shepherd may update their write-up in the future, in order to highlight particularly relevant events or changes concerning the Internet Draft as they occur in the following steps.

7. **AD Review** - The Responsible AD assigned to the WG reviews the Internet Draft, and provides their comments and review on the mailing list of the WG. Then, the process moves to step 8.

8. **Discussion, revision and resubmission** - The authors revise the Internet Draft in order to address the comments and review received from the Responsible AD. This results in the submission of one or more new versions of the Internet Draft.

   If the Responsible AD is not satisfied with the final revision of the Internet Draft produced by the authors, the process moves back to step 7. Otherwise, the process moves to step 9.

9. **IETF Last Call** - The Responsible AD starts an IETF Last Call on the Internet Draft.

   The IETF Last Call takes place on the IETF Last Call mailing list, and typically lasts two weeks, during which the IETF participants at large have the possibility to provide final comments about the Internet Draft.

   During the IETF Last Call, the other ADs also request additional reviews from their own Areas' Directorates or Review Teams, such as the Security Directorate, the IoT directorate, etc. These reviews are also provided to the IETF Last Call mailing list.

   At the end of the IETF Last Call, the process moves to step 10.

10. **Discussion, revision and resubmission** - Possibly aided by the WG and the Shepherd, the authors revise the Internet Draft in order to address the comments and reviews received during the IETF Last Call, especially by addressing any possible new issues. This results in the submission of one or more new versions of the Internet Draft.

    When the Responsible AD determines that the latest version of the Internet Draft satisfactorily addresses the comments raised during the IETF Last Call, then the process moves to step 11.

11. **IESG Review** - The Responsible AD officially brings the Internet Draft to the attention of the IESG, by requesting a ballot from each other AD. Possible ballots are "Yes" (strong support), "No objection" (typically accompanied by non-blocking comments to address), and "Discuss" (also accompanied by blocking comments about major points to address).

    During bi-weekly formal meetings, the IESG can collectively examine the status of an Internet Draft under IESG Review, if the Responsible AD requests so.

    The Responsible AD casts a "Yes" ballot, and requests other ADs to perform their own review of the Internet Draft in support for their cast ballot. When doing so, an AD considers the latest available version of the Internet Draft and leverages the review performed during the IETF Last Call from the Directorate or Review Team in their Area.

    If the latest ballot shows that the majority of ADs has cast "Yes" or "No objection", there are no "Discuss" ballots and all the ADs are satisfied with the latest version of the Internet Draft, then the process moves to step 13. Otherwise, the process moves to step 12.

12. **Discussion, revision and resubmission** - Possibly aided by the WG, the Shepherd and the Responsible AD, the authors revise the Internet Draft in order to address the comments and reviews received from the IESG, especially by addressing any possible new issues. This results in the submission of one or more new versions of the Internet Draft.

    When the Responsible AD determines that the latest version of the Internet Draft satisfactorily addresses (a consistent amount of) the comments raised from the IESG Review, then the process moves back to step 11.

13. **Approved for publication** - During one of its bi-weekly formal meetings and in the light of the currently positive ballots, the IESG approves the Internet Draft for publication. This also includes the final

determination of the document's track, i.e., Standards Track, Experimental or Informational (see Section 6.2.1). Then, the process moves to step 14. At this point the standard is in principle ready, which could be considered a success criterion.

14. **Editorial revision and processing** - The authors of the Internet Draft start interacting with the RFC Editor. This provides an in-depth editorial review of the Internet Draft, often together with requests for technical clarifications.

    Throughout this step, the authors revise the Internet Draft in order to address the comments and reviews received from the RFC Editor. This results in the submission of one or more new versions of the Internet Draft.

    At the same time, according to what is requested by the Internet Draft, the Internet Assigned Numbers Authority (IANA) organization proceeds with the addition of symbols and numbers to existing IANA registries, or with the creation of new registries.

    Once the editorial processing is concluded, the process moves to step 15.

15. **Publication queue** - The Internet Draft is assigned an RFC number and is put in the publication queue.

    In order for publication to happen, a specific requirement has to be fulfilled. That is, all the IETF documents that the Internet Draft refers to as its normative references have to be published as RFC, before the present Internet Draft can also be published.

    This might also result in the formation of a document "cluster" in the publication queue, as composed of Internet Drafts waiting for other IETF documents' and/or each other's publication before they can be published themselves.

    When such a requirement is fulfilled, the process moves to step 16.

16. **Publication** - The Internet Draft is published as an IETF RFC and made available at https://www.rfc-editor.org/

    Once published, the RFC cannot be changed. Possible errors detected after publication can be reported by filing an erratum, which will be reviewed by the responsible AD and, if approved, displayed as additional information associated with the RFC.

    Filing an erratum is a means to fix content of the RFC that is unclear or incorrect at publication time, with respect to the decisions of the originating WG and the IETF consensus reflected in the RFC. That is, filing an erratum is not a means to update a specification, which would require a new Internet Draft going through the same IETF process.

# 7 Annex C: How W3C is organized

The World Wide Web Consortium (W3C) is an international community where Member organizations [W3C-MEMBERS], a full-time staff [W3C-STAFF], and the public work together to develop Web standards [W3C-STANDARDS].

The W3C has a similar mission to the IETF even if its scope is more focused and its structure is closer to more traditional standardization bodies. The most significant difference is the request for Membership in order to participate fully. The Community feedback is accounted for but only Members and invited experts can directly contribute to the standardization documents. While the main affinity is that the produced standards are publicly available and as unrestricted as possible [W3C-LICENSE].

The full W3C process is detailed in the Process Document [W3C-PROCESS].

[W3C-MEMBERS] https://www.w3.org/Consortium/Member/List

[W3C-STAFF] https://www.w3.org/People/

[W3C-STANDARDS] https://www.w3.org/standards/

[W3C-LICENSE] https://www.w3.org/Consortium/Patent-Policy-20200915/#sec-W3C-RF-license

[W3C-PROCESS] https://www.w3.org/2021/Process-20211102/

## *7.1 Internal structure*

The W3C resembles a representative democracy in its structure:

- The Advisory Committee is composed of one representative per Member Organization.
    - It reviews the plans and proposal for the Consortium.
    - It elects the Advisory Board and the majority of the Technical Architecture Group.
    - It votes and may initiate an Appeal against a decision [W3C-APPEAL].
- The Advisory Board is mainly consultive on issues of strategy, management, legal matters, process, and conflict resolution.
- The Technical Architecture Group (TAG) has stewardship purposes and focuses on:
    - documenting and building consensus around principles of Web architecture and to interpret and clarify these principles when necessary;
    - resolving issues involving general Web architecture brought to the TAG;
    - helping coordinate cross-technology architecture developments inside and outside W3C.

With the exception of the Director and the Team that are not elected:

- The Director is the lead technical architect at W3C, acts as tiebreaker and consensus arbiter.
- The Team is the group of paid and unpaid staff, in charge of enforcing rules and facilitating the process.

The standardization activity happens in smaller, focused, groups

- Interest Groups, whose primary goal is to bring together people who wish to evaluate potential Web technologies and policies [W3C-IG].
- Working Groups, where the development activity happens [W3C-WG]. A WG produces deliverables and

reviews deliverables of other WGs. Their activities are detailed in their Charter document [W3C-CHARTER].

The group has a designed Chair with a role similar to the Director but restricted in the scope of the single Group.

[W3C-APPEAL] https://www.w3.org/2021/Process-20211102/#ACAppeal

[W3C-IG] https://www.w3.org/2021/Process-20211102/#GroupsIG

[W3C-WG] https://www.w3.org/2021/Process-20211102/#GroupsWG

[W3C-CHARTER] https://www.w3.org/2021/Process-20211102/#charter

## *7.2 Consensus and voting procedures*

As in the IETF, the organization focuses on gathering a wide consensus. The Director on the global scale and the Chair on the Group-level are tasked to gauge the level of consensus.

Upon every decision there are 3 scenarios:

- *Consensus*: A substantial number of individuals in the set supports the decision and nobody in the set registers a Formal Objection. Individuals in the set *may* abstain. Abstention is either an explicit expression of no opinion or silence by an individual in the set.
- *Unanimity*: The particular case of consensus where all individuals in the set support the decision (i.e., no individual in the set abstains).
- *Dissent*: At least one individual in the set registers a Formal Objection.

The dissent is suggested to be managed by striving to find a path of least friction, trying to minimize the dissent and to make sure it is weighted by Member Organization in order to avoid distortions in the process.

Only once the dissent is deemed unsolvable a vote may be taken to break the impasse. The voting procedure is devised by Charter and varies from group to group.

## *7.3 Chartered groups lifecycle*

The Advisory Committee is notified when a charter for a new Working Group or Interest Group is in development and representatives may provide feedback in this regard. A Working Group or Interest Group may start at any time given enough interested Members.

Once a Charter document is prepared a Call for Review is issued and the Advisory Committee has to review the document. If approved, a Call for Participation is issued. Every significant change to the charter must go through the same process.

The charter document contains a timeline for the group. It can be extended or closed before time depending on the situation (e.g., the group delivers ahead of time or further time is required to expand).

## *7.4 Outputs*

The Working Groups main output is Technical Reports. Three kinds of reports are formally detailed:

- Recommendations: Working Groups develop technical reports on the W3C Recommendation Track in order to produce normative specifications or guidelines as standards for the Web. The Recommendation Track process incorporates requirements for wide review, adequate implementation experience, and consensus-building, and is subject to the W3C Patent Policy [PATENT-POLICY], under which participants commit to Royalty-Free IPR licenses for implementations.
- Notes: Groups can also publish documents as W3C Notes and W3C Statements, typically either to document information other than technical specifications, such as use cases motivating a specification and best practices for its use.
- Registries: Working Groups can also publish registries in order to document collections of values or other data. These are typically published in a separate registry report, although they can also be directly embedded in Recommendation Track documents as a registry section. Defining a registry requires wide review and consensus, but once set up, changes to registry entries are lightweight and can even be done without a Working Group.

All the published Technical Reports are available at the w3 website, see https://www.w3.org/TR/

## *7.5 Publishing a report*

Technical reports have styling and content rules. Every document published as part of the technical report development process must clearly indicate its maturity level, and must include information about the status of the document.

Such a status information:

- *must* be unique each time a specification is published,
- *must* state which Working Group developed the specification,
- *must* state how to send comments or file bugs, and where these are recorded,
- *must* include expectations about next steps,
- *should* explain how the technology relates to existing international standards and related work inside or outside W3C, and
- *should* explain or link to an explanation of significant changes from the previous version.

Some of the requirements above can benefit of automated validation, which makes the review process more streamlined, see https://www.w3.org/pubrules/

In addition, every type of report has a different lifecycle.

**Recommendation lifecycle**

The Recommendation are normative, have a stricter process (see Figure 2) and they undergo different reviews with an increasingly wider audience as the document matures

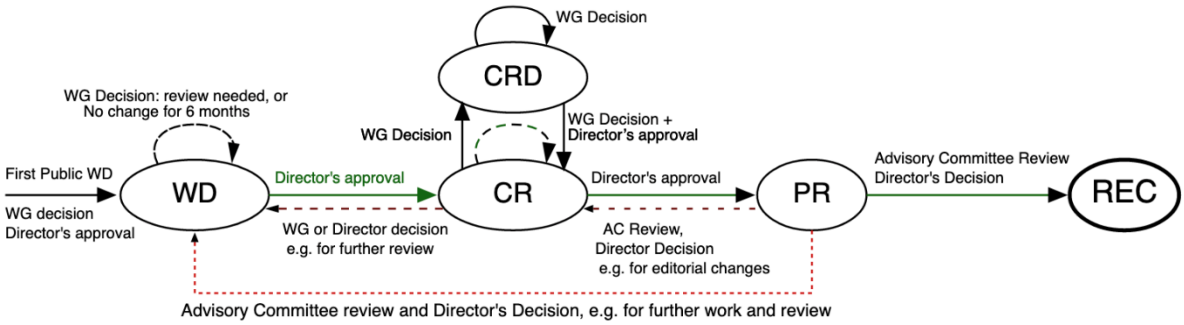


**Figure 2 - Lifecycle of a W3C document.**

Once the first Public Working Draft is out, all the process happens in the open as much as possible. The overall process tries to balance the veto power of the Director with the ability of the Advisory Committee to override his decisions.

A Working Draft is required to have at least two independent implementations to ensure the specification is clear enough in order to be considered a W3C Recommendation. In W3C jargon it is called implementation experience.

**Note lifecycle**

Notes are non-normative documents aimed at providing additional rationale, best practices and retrospectives. They are commonly published by Interest Groups, the Advisory Board and the Technical Architecture Group.

Their evolution does not have the same strict requirements as the Recommendations.

**Registry lifecycle**

Registries have the purpose of providing a consistent lookup point for data. In the case of IETF specifications, this task is partially offloaded to IANA.

A registry has three associated components:

- the registry definition, defining how the registry tables are structured and maintained
- one or more registry tables, holding the data set represented by the registry (the *registry data*)
- one or more referencing specifications, which make use of the registry

The registry lifecycle closely follows the Recommendation lifecycle, with few constraints relaxed (e.g., Patent Policy checks). The process of updating a registry table does not require the full review process that happens for updating a Recommendation.

## *7.6 Timing*

Like for the IETF, the lifecycle of a Recommendation spans multiple years, and its cadence has a similar variability. The Charters on the other hand are evaluated, and extended when needed, over a shorter time span.

At the time of writing this document, the latest Charter for Web of Things is estimated to start in September 2023, see https://github.com/w3c/wot/blob/main/planning/schedule.md