OPC 11021

Companion Spec Guidelines

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Guideline Revisions

Version	Date	Description
1.00	May 20	Initial Release
1.01	July 20	Clarifications only.
1.02	May 21	Improved guidelines for versioning, added guidelines for document series. Improved guidelines for voting and commenting during release process.
1.02.1	Dec 21	Clarifications.

CONTENTS

OPC FOUNDATION

UNIFIED ARCHITECTURE

FOREWORD

This document provides guidance for creating OPC UA companion specifications. It is a result of an analysis and design process to develop a standard interface to facilitate the development of applications by multiple vendors that shall inter-operate seamlessly together.

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1   Scope

OPC UA is a series of specifications providing multivendor, multiplatform, secure reliable information integration interoperability from the embedded world to the cloud.

OPC UA Companion Specifications are developed for various reasons:

1. To publish specific information models (e.g., for specific industries, specific devices, specific use cases)
2. To specify how to use OPC UA in specific environments. Examples are
   a. The mapping of OPC Services to IEC 61131-3 Function Blocks to be used as OPC UA Clients. See OPC 30001.
   b. The definition of a cloud-based library of OPC UA Information Models and or Address Spaces. See OPC 30400.
   c. Profiles that express requirements for specific use cases (for instance features like auditing or redundancy, specific transports or security policies)

The majority of Companion Specifications define specific information models are defined in the following paragraphs in more detail.

Companion Specifications for Information Models

Key parts of OPC UA are about information modelling and provide the foundation for other organizations to facilitate complex data modelling.

These capabilities are the fundamental components necessary for semantic interoperability.

New Information Models can be created based on the OPC UA Meta Model and eventually derived from OPC UA Base Information Models. Companion specifications of such Information Models together with behaviour descriptions and *Profiles* are often called "Industry standard models" because they typically address a dedicated industry problem. The synergy of the OPC UA infrastructure to exchange such industry information models enables interoperability at the semantic level.

A number of such industry standard models have already been created.

Ways to produce Companion Specifications

OPC Foundation differentiates three ways of producing companion specifications:

- **INTERNAL**:
  These are specifications created by OPC-internal working groups.

- **JOINT**:
  These are specifications that are created in a joint working group between the OPC Foundation and another organization. These joint specifications represent the majority. The released joint companion specifications can be found here: https://opcfoundation.org/developer-tools/specifications-opc-ua-information-models
  The JOINT working group program is defined here: https://opcfoundation.org/joint-working-groups/

- **EXTERNAL**:
  Companion specifications can also be created independently of the OPC Foundation. This document is targeted towards INTERNAL and JOINT companion specifications. The guidelines may be applied to EXTERNAL ones also. Hints are provided when services of the OPC Foundation are not available.

To support creating companion specifications, the OPC Foundation created a template. It is available for download here: https://opcfoundation.org/Guidelines-And-Templates/.

2   Essential points

2.1   Companion specification template as framework to create a specification

The companion specification template should be used to create the specification. It is a word document with a recommended structure, inline guidelines and examples for some of the most important information model elements.

A companion specification typically consists of

- the specification consisting of one or more parts (preferable as Word documents based on the companion specification template)

- When information models are specified, the proper NodeSet XML files and NodeIds CSV files as described in OPC 10000-6. The complete list of supporting files is defined in section 6.3.

- Certification documents described in section 9.

Section 3 provides guidelines for status and versioning.

2.2   Specification is complete – what now

When documents and supporting documents have been completed by the working group, the specification is considered a Release Candidate.

At the latest now the editor and/or chair needs to request a document number – see section 4.

Next, the review and release process described in section 6 will be conducted.

2.3   Publication – maintenance

Once released, the OPC Foundation publishes the companion specification for download on its website and visualizes the status according to the stages described in section 8.

OPC Foundation also publishes an online reference as described in section 6.2.5.

After publication, the responsible working group shall enter the maintenance cycle described in section 6.3.

2.4   Conformance testing and certification

The Companion Specification should include certification. The recommend process for this is described in the OPC Foundation presentation, which is available here.

In general, all companion specification should include:

- definition of profiles and conformance units (described in specification template)

- test case definition for all conformance units (a customized spreadsheet for this is available from the Compliance working group).

- Test Scripts for automated testing (again the OPC Foundation provides services to assist with this)

A longer description of this process can be found in section 9 of this document.

3   Document status and versioning

3.1   Document status

A document can be in status "Draft", "Release Candidate", and "Release".

Draft indicates that the document is still in progress; i.e., the working group still makes changes and / or is reviewing the contents.

Release Candidate is reached when the working group has completed its internal review cycle and proposes the document to be released. Release Candidates of specifications will need to go through additional reviews. See chapter 6

After successful reviews and addressing accepted review comments the status changes to **Release** and the document will be published.

3.2   Document version

3.2.1   General guidelines

The version of OPC documents is a three-part number: major.minor.revision.

The **major** number will only be increased for incompatible versions. This also requires changing the OPC UA namespace URI. When increasing the major version, the minor version shall be set to 00, and the revision shall be set to 0.

The **minor** number has two digits and will be incremented when new functionality is added in a backwards-compatible manner.

The third number – **revision** - is used for minor updates like

- Editorial changes,
- Enhanced descriptions, resolving ambiguities,
- Corrections of errors.
- Minor new functionality added in a backward compatible way.

Draft or RC shall be added to the version as shown in the following examples:

- V1.03.2 Draft 9
- V2.05.1 RC 1

A revision table (as shown in OPC 11020 – Companion Specification Template) shall list and describe all corrections and enhancements.

Documents shall have the version as last part of the filename.

3.2.2   Guidelines for multi-part specifications like OPC 10000 (Unified Architecture)

The document versions for the parts in a document series are coordinated in that they receive the document series version at the time of release. If at the time of a series release a part does not need any updates, it is **not** re-published with the new series version. For example, the most recently published parts in a series may have the following document versions after series revision 4.

- Part 1 V1.05.0
- Part 2 V1.05.0
- Part 3 V1.05.3
- Part 4 V1.05.4
- Part 5 V1.05.4

If later a change is needed for only Part 2, then it would receive the next series revision of 5. So, the latest published set would have the following document versions:

- Part 1 V1.05.0
- Part 2 V1.05.5
- Part 3 V1.05.3
- Part 4 V1.05.4
- Part 5 V1.05.4

3.3 NodeSet versioning

When companion specifications come with a NodeSet, the date and version of the document are reflected in the ModelURI and in the NamespaceMetadata (Properties NamespaceVersion and NamespacePublicationDate).

For revisions (third number – see also 3.2), the URL for the NodeSet, defined in the specification, remains the same; i.e., the NodeSet is overwritten.

Whenever at least the minor number is increased, a new URL with this version is created. The NodeSet of the older version co-exists with the new one.

4   Document numbers

OPC document numbers are not issued for EXTERNAL companion specifications.

4.1   General

In 2019 OPC introduced a numbering system for documents created by OPC Foundation as well as joint working groups. Numbering will ensure globally unique identification even if the title is translated.

The schema is "`OPC nnnnn[-pp]`".

nnnnn is a 5-digit number where the first digit is between 1 and 9 (no leading 0).

Numbers beginning with 1 and 2 are reserved for OPC Foundation documents. Numbers starting with 3 or higher are used for documents of joint working groups.

`-pp` is an optional component for multi-part documents. The dash is followed by a 1..3 digit number which represents the part number.

Examples:

10000-3	OPC UA Specification, Part 3: Address Space Model
10000-4	OPC UA Specification, Part 4: Services
30081	OPC UA for Process Automation Devices (PA-DIM)
30100	OPC UA for SERCOS
30200	OPC UA for Commercial Kitchen Equipment
40010-1	OPC UA for Robotics, Part 1: Vertical Integration
40502	OPC UA for CNC Systems

4.2   Number assignment

The 5-digit number range is not further subdivided.

Numbers will be assigned sequential but with gaps leaving room for additional documents from the same working group.

The numbers are assigned and managed by OPC (Technical Director).

A number will latest be allocated when documents reach RC status.

5   Working group review process

5.1   File handling

The reviewer should download the file which was provided for review, or alternatively a file which already contains comments of another reviewer, and edit it locally. Then the reviewer should append his name or initials at the end of the filename and upload it to the box again. Please also notify the editor of the original file about the uploaded comments.

Table 1 shows an example of a review process with several rounds and several variations of filenames.

Table 1 – Example for file names during review phase

| Person	Action	Filename
Editor	Creates a new document	WordDoc 1.00 Draft 01.docx
Reviewer A	Adds comments	WordDoc 1.00 Draft 01_RA.docx
Reviewer B	Adds comments	WordDoc 1.00 Draft 01_RB.docx
Reviewer A	Adds more comments (to the 'original' file, not to the file which Reviewer A uploaded recently)	WordDoc 1.00 Draft 0.01_RA1.docx
Editor	Resolves all comments together with the reviewers who provided the comments	WordDoc 1.00 Draft 02.docx
Editor	Adds some new content to the document, puts it back to the file sharing system and requests for a new review	WordDoc 1.00 Draft 03.docx
Reviewer A	Adds comments	WordDoc 1.00 Draft 03_RevA.docx
Editor	Resolves all comments and prepares the document for final review round	WordDoc 1.00 Draft 04.docx
Editor	No more comments, document can go into official review and release process.	WordDoc RC 1.00.docx

5.2   Comments in MS Word

Comments are preferred over direct edits on the document. Please add the comments using the comment function provided by MS Word. If the reviewer wants to change text directly, the change tracking function should be active, and (except for editorial changes) a comment should be added with explanations.

6   Official review and release process

The official OPC review process is not available for EXTERNAL companion specifications.

The following release process applies to all OPC UA specifications as well as specifications that the OPC Foundation has jointly developed with another organization under the OPC IPR Policy.

The process is illustrated by the following figure.
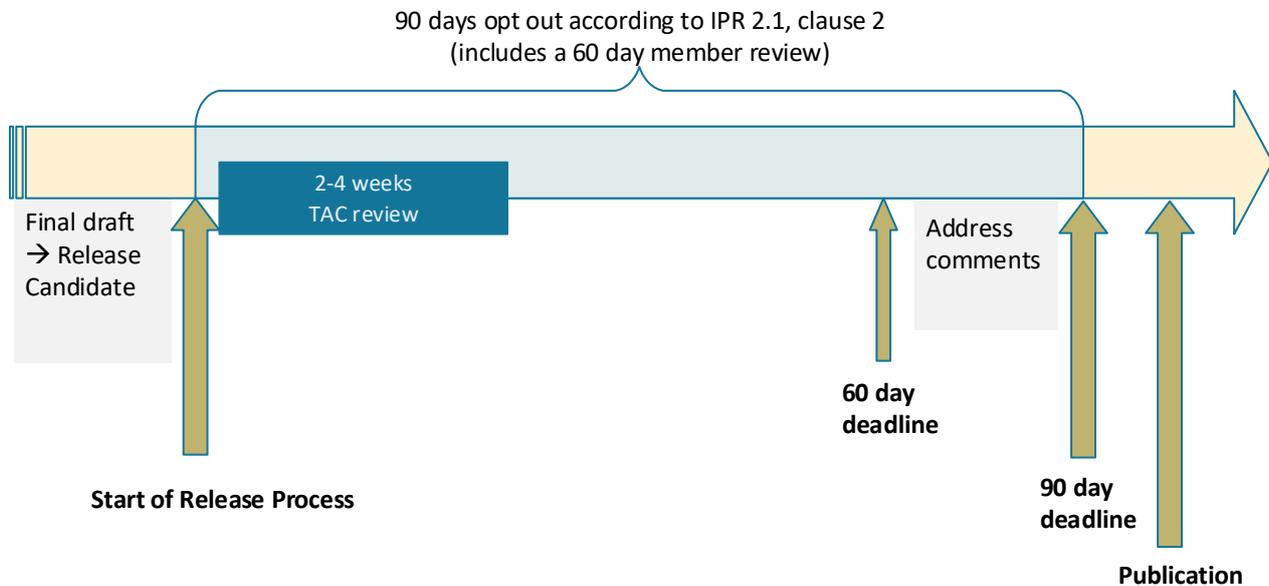
The process applies to all new specifications and to new versions – except for revisions with bug fixes and editorial changes only.

6.1   Preparing for release process

When the document is complete, the working group changes the state from Draft to Release Candidate (RC).

The RC together with all supporting documents (e.g., UANodeSet XML file) is handed over to the OPC Technical Director (TD). The TD checks that the document conforms to the specification template and has all required sections completed. When an information model is specified, the working group shall have performed the validation step as follows

Validation checks that a document (docx format) is consistent with the related NodeSet. It is performed with a tool that the OPC Foundation provides https://apps.opcfoundation.org/NodeSetValidator/. This tool requires that all tables in the document follow the format in the companion specification template.

The mandatory UANodeSet XML file is referenced in the document and contains all nodes and references defined in the document. These nodes are mainly type definition nodes. It is recommended that the working group provides an additional UANodeSet XML file with example instance trees representing typical scenarios covered by the document. This helps reviewers to understand the specification and is also needed for prototyping. These example instances shall be in a separate example namespace.

It is highly recommended to also provide a proof-of-concept implementation. See also "stages of completion" in 8.

6.2   Release process

6.2.1   Start

When the TD approves the formal correctness (e.g., all supporting documents are provided, document includes required template sections) it makes the RC available for download by OPC Foundation members (except Logo members).

The members are informed by email and with a News item stating a deadline for comments.

- The designated representatives of OPC Foundation members are informed that a 90-day review begins where they can opt out claims according to IPR 2.1, clause 2.
- All member company employees that are registered at the OPC Website are informed that a 60-day review begins where they can submit reasoned comments.

The deadline begins with the Email notification.

6.2.2   Review and approval by Technical Advisory Council (TAC)

Early in the release process, the TAC members are asked to review as well and to vote for release. This is a majority vote. In case of a negative vote, the release process is stopped and the document is put back to draft state.

If more than one NO vote exists, the TCB will be notified and decide on further steps.

6.2.3   Handling of comments

After the 60-day period, the comments will be reviewed by chairman and editor. Editorial comments (typos, clarifications) can be handled right away.

Technical / content related comments require a working group review.

A reply must be provided to all content-related comments (FIXED, WON't FIX) to the Technical Director. A WON't FIX has to include an explanation. The updated release candidate together with the replies will be forwarded to the reviewers for re-examination.

If a reviewer objects, a web meeting will be arranged between working group and the objecting reviewers. If no mutual consent is achieved, the TCB will be notified and decide on further steps.,

6.2.4   Publication

After all comments have been addressed (verified by the reporting reviewers) and after the 90 day opt out period, the OPC Foundation releases the specification. The document and accompanying files (e.g., UANodeSet XML) are made available for download by members and non-members.

The document will be published as PDF with bookmarks for headings.

6.2.5   Online reference

In addition to the publication for download, the OPC Foundation also adds the companion specification to the online reference.

The OPC UA Online Reference is a searchable collection of released specifications and information models.

Information models are made available by publishing an index of types defined in the model as human readable tables. When possible, the definition of a type is linked to the appropriate section in the specification. These tables are generated automatically from the published NodeSet.

Specifications are also made available. These pages are automatically generated from Microsoft Word documents. The documents are generated from the latest released version with errata

applied. Note that the online reference is a work in progress and not all published errata will be in the online documents.

The online reference is available under **https://reference.opcfoundation.org/**.

6.3   OPC UA NodeSets and other supporting files

For each information model specification, the following normative files need to be published:

- *.NodeSet2.xml - The formal definition of the Nodes defined by the specification;
- *.NodeIds.csv - A CSV file containing the NodeIds assigned to Nodes defined by the specification;

The following non-normative files are highly recommended when DataTypes are defined in the NodeSet:

- *.Types.xsd - The XML schema for the DataTypes defined by the specification;
- *.Types.bsd - The OPC Binary schema for the DataTypes defined by the specification (obsolete);

In addition, the following non-normative support files may be published:

- *.Classes.cs - C# classes for Nodes used with the .NETStandard stack;
- *.DataTypes.cs - C# classes for DataTypes used with the .NETStandard stack;
- *.Constants.cs - C# constant declarations used with the .NETStandard stack;
- *.PredefinedNodes.uanodes - A non-normative binary representation of the UANodeSet for use with .NETStandard stack;

The files for each companion specification are stored on Github (https://github.com/OPCF-Members/UA-NodeSet) in a subdirectory with the short name of the specification. The files for the core specification are in the Schema subdirectory.

If you have not yet access to this repository check here: https://opcf-members.github.io/Help/.

This repository is used as part of the review process. This means files checked into this repository may contain errors. If an error or problem is found it should be reported as a mantis issue against the appropriate specification.

When the review process is complete the files are processed to create the online reference. As part of this process, OPC tools will add documentation links and copyright headers (non-material changes).

Finally, the files are published to the OPC Foundation website as defined in the specification. **If someone is looking for the officially released version of the UANodeSets they must follow the links in the specification.**

For more details see the Readme in https://github.com/OPCF-Members/UA-NodeSet.

7   Maintenance

The OPC Mantis tool is not available for EXTERNAL companion specifications.

7.1   Problem reporting

Released specifications enter a maintenance cycle. Companies that implement a released specification often find inconsistencies, ambiguous definitions or even errors. Handling of such findings requires a problem reporting tool.

OPC Foundation uses "Mantis" (https://apps.opcfoundation.org/mantis/) for tracking issues within its own specifications but makes it available for companion specifications as well. The working group chair can request a Mantis project. In maintenance cycle, working group should meet regularly to review and handle problem reports.

7.2   Process for bug fixes

Important clarifications and bug fixes have to be documented and published. This should be done with a new revision (a so-called maintenance revision) of the specification as described in clause 3.2.

For information model specifications a matching OPC UA NodeSet shall be published that includes the maintenance revision.

Maintenance revisions require a 30-day review.

8   Stages of completion and it's visual display

A released specification is a major milestone. However, specifications may have errors or may not be precise enough for interoperable applications. In additions, the demand for stable implementations grows rapidly which requires certification and other tests. Therefore, the OPC Foundation has defined three essential stages of companion work completion:

1. **Stage: Specification**
   this is the stage when a companion spec has been released. It means that specification and supporting documents (e.g., NodeSet) have been completed and a proof-of-concept implementation exists. The result has been reviewed by OPC Foundation and its joint organization.

2. **Stage: Adoption**
   this stage is reached, when implementations of at least two different vendors exist and have been tested in a Plug Fest – for instance an OPC Foundation Interoperability Workshop.

3. **Stage: Certification**
   finally, this stage indicates the availability of a test specification and the implementation of test cases and tools that allow products to be certified in an OPC Certification Test Lab.

It is planned that the published documents in the OPC Foundation website will provide a visual indication of this state.

9   Certification

The OPC certification program may be made available for EXTERNAL companion specifications. If interested please contact the group via the Email address compliance@opcfoundation.org.

9.1   Introduction

The OPC Foundation's Certification program helps to deliver compliant, interoperable, and robust products of high quality.

To put emphasis on such products, the OPC Foundation has provided certification testing with its "Certified for Compliance" label since 2007. Over this lengthy time period, certified products have generated excellent user experiences and establish a well-known valuable certification label for the OPC Foundation. Independent third-party testing by OPC UA experts ensure high quality of certified products. Testing extends beyond correct message handling and includes verification of the correct use of OPC technology. It includes compliance, interoperability, robustness, efficiency and usability. The testers also provide expert feedback and recommend product improvements, which has been valued by the product vendors.

Certification laboratories are accredited by the OPC Foundation for certification testing (for details see Certification Test Lab specifications on the OPC Foundation website). These laboratories together with the OPC Foundation Director of Compliance can only grant certification for a product.

The certification program is available for all companion specifications (Joint and External). It is highly recommended to apply the certification program to companion specifications to ensure the same high-quality level. Furthermore, having a one-stop certification in OPC Foundation Certification Test Labs for all OPC UA related features, reduces the certification effort for vendors.

The idea of a joint working group is that both organizations are involved in all steps. For certification, this is manifested in the following statement that is part of the Agreement of Use declaration in OPC 11020 – the Companion Specification Template:

> The combination of <other organization> and OPC Foundation shall at all times be the sole entities that may authorize developers, suppliers and sellers of hardware and software to use certification marks, trademarks or other special designations to indicate compliance with these materials as specified within this document. Products developed using this specification may claim compliance or conformance with this specification if and only if the software satisfactorily meets the certification requirements set by <other organization> or the OPC Foundation. Products that do not meet these requirements may claim only that the product was based on this specification and must not claim compliance or conformance with this specification.

In agreement with the OPC Foundation, external organizations may establish their own guide lines for the certification of their companion specification, but they cannot claim that a product based on it is certified for OPC UA, unless the OPC UA aspect has been verified by an accredited OPC Foundation Certification Test Lab.

9.2   Timing: when to prepare for certification

The preparation for certification can start as soon as stable profiles and conformance units are defined. It is recommended to start when the Companion Specification is posted as a release candidate so that testing is available 3-6 months after the formal release of the specification.

9.3   Process to prepare a companion specification for lab testing

The following figure illustrates the work packages required for the lab testing process.
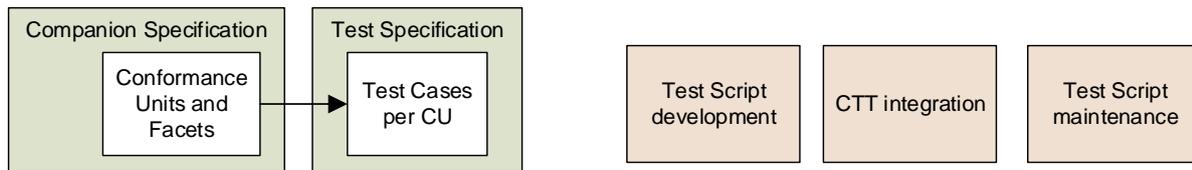
The certification testing is utilizing the Conformance Units which have been defined in the companion specification. Those Conformance Units are defined for each individual testable item. Each Conformance Unit is required to have one or more test cases defined. Test cases shall include verification of successful operation as well as verification of correct behavior with regard to failures. While the support of a conformance unit can be optional, all test cases inside a conformance unit are mandated. Definition of test cases shall include both Client and Server test cases.
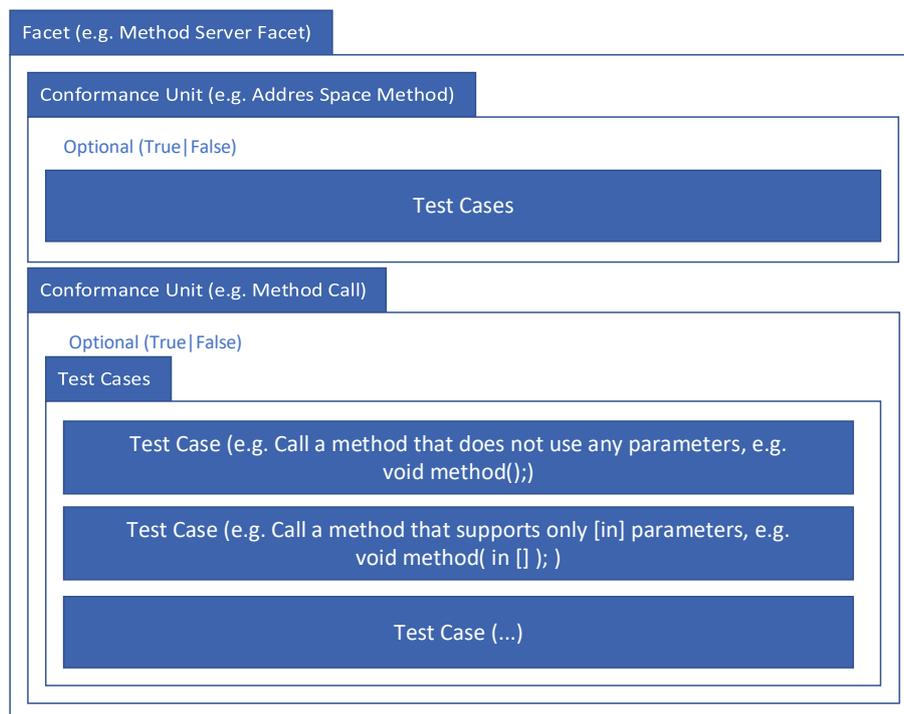
For all test cases that can be automated, development of test scripts is expected. The test scripts can be added to the OPC Foundation Compliance Test Tool (CTT) to allow combined automated testing of OPC UA and the companion specification. The automated test scripts are also useful to prepare for certification.

Once test case definition and test script development are complete, the companion specification can be certified by the OPC Foundation Certification Test Labs.

See also 9.6 for OPC Foundation assistance and services.

9.4   Test Case definition

The OPC Foundation Compliance Working group provides an Excel Template for defining Test Cases. The template is an excel document that provides a tab for every conformance unit defined in the information model. Following is a snippet from an existing testcase specification.

CTT	No	Step	TestCase	TestRequirements	ExpectedResults	ServiceResult	OperationResults	Reviewed	SpecLink	Comments
Y	1		Find any MDIS object instance in the address space and verify the Fault variable is initially False (not set). Monitor the Fault variable	MDIS object can be set to fault state on demand	Object found, variable available and initial value is false	Good	Good	Y	5.2.2	All test for base objects are invoked by other object type testing, the test scripts must be able to accept the type that is being tested and then requestobject of the provided type.
N	2		Manually set the object to a faulted state		Fault variable is set (TRUE)	Good	Good	Y	5.2.2	
N	3		Manually clear the object fault		Fault variable is cleared (FALSE)	Good	Good	Y	5.2.2	
N	4		Manually set and clear the object's fault state numerous times		Fault variable alternates between set (TRUE) and clear (FALSE) according to the manual setting.	Good	Good	Y	5.2.2	

Send a request to compliance@opcfoundation.org to get Excel template and instructions.

9.5   Test Scripts for the CTT

The OPC Foundation Compliance Test Tool (CTT) is a script-based tool that can easily be extended. Extension can be generated for companion specification testing or for vendor specific product testing. The CTT comes with a library of functions to perform standard service calls and the existing test scripts can be used as examples for generating custom scripts. Here is an example of an implementation that checks that the object types available in the type system are derived from the core type defined in the companion specification.
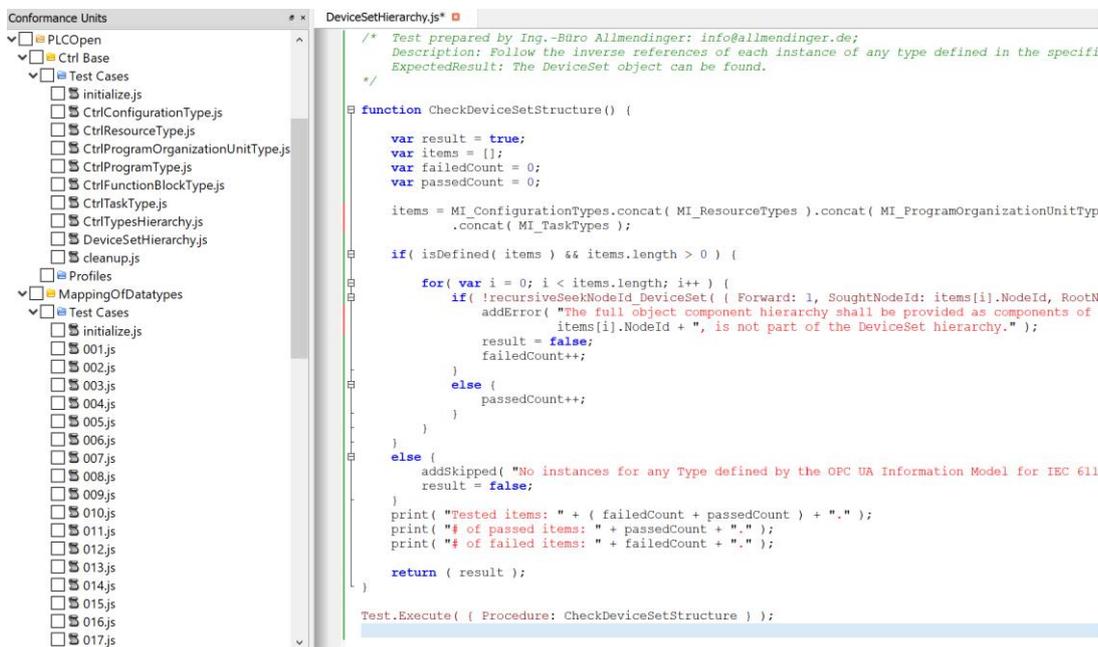
9.6   OPC Foundation assistance and services

The OPC Compliance Working Group (Email address compliance@opcfoundation.org) has developed and is responsible for the certification program and the development of tools for lab certification. It defines and maintains the test cases for the OPC UA standard but is also willing to assist and advice Joint Working Groups. Please contact the group for assistance and templates.

The OPC Foundation also offers paid services to develop and maintain test scripts and integrate them with the Compliance Test Tool (CTT). If interested, please contact the Compliance working group.

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