TINA-CAT WorkGroup Request For Proposals

TINA Conformance Testing Framework

Document information

Title: TINA Conformance Testing Framework RfP

Version: 1.0: Approved and Released

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1. Objectives and problem statement

1.1. Objectives

TINA's objective is to provide industry with unambiguous specifications and a testing process that assures that TINA compliant and conformant components provide greater business value to telecommunications stakeholders. The specific objective of this RfP is to define the technical process for conformance testing, including a uniform template for the specification of interfaces to be tested. This specific goal fits inside the greater picture documented in the TINA Compliance Framework document [TINA-Compl] (which includes conformance issues, too). In the end, TINA will have an effective, yet business-friendly approach for the technical specification of testing requirements, for conformance testing and branding of TINA products.

In the TINA Compliance Framework document, the technical necessity and the business benefit of TINA Compliance and Conformance has been clarified. The separation of five levels of TINA compliance and conformance leads to two simpler branding levels:

- **TINA Architecture Compliant**. This relates to the three compliance levels: concept compliance, layering/partitioning compliance and information model compliance.
- **TINA Conformant**. This relates to the two conformance levels: technical conformance and operational conformance.

This Request for Proposal (RfP) focuses on the TINA Conformant branding. More specifically, this RfP focuses on testing technical conformance as defined in the framework document. The TINA Architecture Compliant branding will be addressed by a separated RfP.

Technical level conformance involves the verification of functionality to ensure interworking. In the literature, a variety of approaches can be found that contribute to the functional verification of object-oriented systems. There is also an established methodology for conformance testing of protocols. Existing concepts and methods build together a solid basis for the rapid development of the first edition of the TINA conformance testing framework for technical level conformance only.

Research on operational conformance, in terms of responsiveness, availability and other service level guarantees, is not as mature as that of technical conformance. Therefore, this RfP focuses on the technical level conformance. Consequently, in this document conformance refers to technical level conformance. Once the first edition of the TINA conformance testing procedure has been established, it's evolution will take place together with other TINA technologies through the RfP process.

The main objective of the RfP is to identify the key issues in the TINA conformance testing process and to formulate specific elements for implementing that process.

1.2. Problem statement

The intention of this RfP is to define an effective, efficient and as far as possible automated testing process for TINA conformance branding. Currently, there is no standard that guides conformance testing of TINA products. Also, TINA specifications are not mature enough and partially defined only, so that conformance testing can hardly produce results that can assure a known level of interoperability. Even, the term of conformance is sometimes misunderstood. The testing process and the specifications they are testing must be defined so that repeatable, meaningful results can be attained without undue hardship on vendors.

The problem is to determine the whole technical conformance testing process, convering notions and concepts of conformance testing, and including requirements capturing, test specification, test realization, test execution, and reporting. This process needs to consider the externalization of component and/or system functionality only, and be indifferent to the internals of an implementation.

The specification template for technical conformance criteria will be based on the "facet" concept. The definition of a facet from a testing perspective (i.e. in terms of technical conformance requirements for a facet) needs to be matured. The precise limits on what a facet should and should not contain must be determined based on what is and is not testable (considered both from a technical and economic perspective).

Adequate facet specification is required for test generation. It is essential that all parties involved in conformance testing agree on unambiguous facet specifications. The objective is to have a well-founded, facet specification based testing process that assures increased confidence on interoperability.

A core element of the testing process will be the test notation. It provides the description of test cases on an abstract level that is independent on the realization technologies. A test notation will be used to describe facet specific abstract test cases that could be standardized to ensure the comparability of test results. This test notation needs to be defined. Requirements on specification techniques for facet specifications that comply with the test process and that support the effective generation of test cases, will be considered. Available well-proven techniques need to be evaluated, and the best technique or combination of techniques should be proposed. New technologies are not precluded.

2. Background and context

2.1. Introduction

In general, from the technical point of view, the conformance testing process covers the capturing of conformance requirements, the development of test cases, the realization of test cases and the evaluation of test results. In addition, issues such as test report production and the role of test laboratories, that have impact to the quality of branding, are an optional part of the TINA conformance testing framework.

The ITU-T/ISO-IEC standard for conformance testing – the Conformance Testing Methodology and Framework (abbr. CTMF) address both technical and non-technical issues. It has been developed for protocol conformance testing, but can be used in a wider scope. CTMF is supported by a number of professional tools and is widely used in the networking industry.

A framework does not yet exist for the conformance testing of object-oriented systems. In the Reference Model of ODP (RM-ODP), principles for conformance assessment of ODP systems are defined. The terminological distinction of compliance and conformance is made. In particular, the reference point concept for ODP conformance testing is proposed, which is adopted by TINA.

The TINA Reference Points document remains on the conceptual level. It introduces the definition of inter-domain and intra-domain reference points. It formulates the requirements on a reference point specification template. In the TINA Retailer Reference Point document is the most elaborated of the TINA specifications. It also introduces the concept of ”feature” from which the conformance ”facet” concept is derived. Test development and realization are not addressed, neither by RM-ODP nor by TINA.

Currently, ODL is the TINA technical specification language of choice with multiple potential mappings into CORBA or other IDLs or UML. Also, SDL is often used to define object behaviors, but is not officially considered a specification language of choice.

The facet concept was initiated to facilitate the evolution of TINA. TINA conformance branding will be assigned separately for each TINA facet. It allows a vendor to focus on implementing a specific area of functionality. As a new concept, the role of facets in the TINA conformance testing process needs to be further elaborated. In any case, a facet is the smallest testable unit of functionality that can be tested for conformance.

Additional details about CTMF, RM-ODP, TINA reference point and the facet concepts are discussed in the following sections.

2.2. ITU-T/ISO-IEC CTMF

CTMF is initiated by ISO-IEC. It is defined in the ISO-IEC 9646 series that consists of seven parts. In part 2, the test notation Tree and Tabular Combined Notation (TTCN) is specified. Part 2 evolves continually. The most recent version of TTCN is the second edition published in 1998. The third edition, which is intended to include object-oriented concept, is planned for the end of 1999.

In 1992, CTMF was approved by ITU-T and documented in ITU-T X.290-296.

CTMF is a framework covering the conformance testing life cycle: specification of test cases, the means of tests and the conformance assessment process carried out by test laboratories.

”Conformance testing involves testing both capabilities and behavior of a protocol implementation, and checking what is observed against both the conformance requirements in the relevant standards.” [ITU-T X.290] The protocols are in general ITU-T recommendations o standards by other international organization, such as ISO, IETF, ATMF, etc.

TTCN is the core of CTMF. It provides well-defined syntax for the specification of test suites, called Abstract Test Suite (ATS) – a set of test cases including configuration and data. ATSs use abstract test methods defined by CTMF, which enable the capturing of test events at Points of Control and Observation (PCOs). Test cases in a TTCN ATS can be organized in a hierarchical structure. The tabular form of TTCN promotes the readability of test suites.

Requirements on test realization ensure that the execution of test cases complies with the behavior specification in the ATS. CTMF places such requirements on Means of Testing (MOT) which refers to equipment and procedures that perform derivation, selection, parameterization and execution of test cases [ITU-T X.293].

In addition, the role of test laboratories and the role client in preparation for testing, test operations and test report production are also addressed by CTMF [ITU-T X.294]. Protocol profile testing is described in [ITU-T X.295]. Test reports in forms of Implementation Conformance Statements are defined in [ITU-T X.296].

2.3. RM-ODP conformance assessment

RM-ODP was developed by ITU-T/ISO-IEC to address the interconnection of heterogeneous and distributed information processing systems. Central concepts of RM-ODP are the description of distributed processing systems in five viewpoints, the object model, distribution transparency and, of particular importance for the openness of ODP systems, the conformance assessment principles.

In RM-ODP, conformance and compliance are distinct:

- Conformance is a relationship between a specifications and a real implementations.
- Compliance is a relationship between two specifications.

Conformance testing is the method to determine the conformance relationship. This method can be used at many levels of abstraction. However, the more abstract a specification is, the more complicated it is to test, because the effort required to interpret both the specification and the obtained test results increase with the level of abstraction.

Reference points are part of the ODP architecture. They define conformance requirements on ODP systems. ODP reference points are grouped into four classes. Among them, interworking reference points constrain information exchange between systems.

2.4. TINA reference points

The TINA reference point concept is based on the RM-ODP conformance assessment principles. TINA reference points consist of interfaces that describe potential interactions between TINA entities.

The multi-provider and multi-vendor philosophy of TINA leads to the following two reference point classes:

- Inter-domain reference points between TINA (sub-)systems of different stakeholders.
- Intra-domain reference points between components/(sub-)systems within domains.

The first established TINA reference point is the Retailer Reference Point.

In [TINA-RP], a template for the specification of TINA reference points is proposed. The Object Definition Language (ODL) is defined as the mandatory computational language. For describing the dynamic model, event traces can be used. A behavior language is not specified.

2.5. Facets – vertical partitioning of TINA

Inter- and intra-domain reference points are foreseen in the TINA architecture to facilitate the conformance assessment of implementations. Reference points reflect the business model, the session model and the functional decomposition of the session model. Reference points provide a simple straight-forward means to express the TINA architecture in terms of objective requirements for conformance. However, to allow vendors to incrementally adopt and evolve TINA, a whole reference point is considered to be too large.

Therefore for conformance branding, TINA is partitioned into ”facets”. Reference points can be composed from facets. Each of these facets (or subtopics) has it’s own concepts, partitioning, information model, and other details. TINA conformance needs to brand separately for each of these facets. Thus, a system may be TINA branded at multiple levels with respect to separate facets. This kind of branding is consistent with the current usage of TINA specifications, and allows a vendor to implement limited roles in the business of service provisioning.

Facets will closely resemble the ”feature set” concept seen in the retailer reference point specification. Each reference point should be composed of one or more facets. Typically, there will be a ”core” facet that provides some minimum set of functionality. Additional interfaces and interactions can be specified to provide some additional cohesive set of functionality (like the feature set). These additional facets may depend on the presence of the core facet or any other facet in the reference point, under the condition that a facet is a self-standing portion of functionality.

A facet is a minimal portion of conformance criteria, a TINA branding can be associated with. A facet is to enable interaction among components with separable concerns. At the technical level, a facet will be defined in terms of:

- its interface specification *(i.e. its signature plus behavior description),*
- the roles between which there is interaction *(e.g., the same interface may be used between a retailer and a broker as well as between a broker and a consumer, however an implementation may only implement one of these interactions, and thus are defined in terms of different facets.),*
- the protocol (or object interactions & state changes) that the interface is intended to support,
- the other facets this facet depends on *(e.g., if facet A is a core facet, operation O provides additional functionality to the core, then a new facet B will contain facet A and operation O),* and.
- typical usage of the facet *(e.g., 1000's of parallel calls, or fewer overlapping long transactions, or ….).*

Formal specification of facets reduces misinterpretation and is essential for automated test generation. The current TINA ODL does not provide sufficient mechanism to specify conformance requirements formally. The RfP seeks for extensions to ODL or additional methods to support in particular the behavior specification of facets, from which conformance tests can be derived. The new facet specification language should be a full integration with ODL. Reuse of well-proven description techniques is desired.

It should be noted that a single interface (as defined in ODL) may be reused in multiple facets. The usage, input parameter values, and expected results of the interface may differ among the facets, but the ODL of that portion of the interface remains unchanged.

3. Deliverables

A RfP response must include the following information requested in Sections 3.1, 3.2, 3.3, and 3.4 below. The information requested in Sections 3.5 and 3.6 are considered optional. The criteria for judging the deliverables are stated in Section 4. The format and presentation of the deliverables are defined in Section 5.

3.1. Facet Specification Template

The facet specification template should cover all the issues and aspects of facets raised in Section 2.0 and consider them from the testing perspective. The relation of a facet specification to other TINA specifications should be discussed. Specific things to be included in this specification template are:

- Outline of the facet specification template;
- Precise definitional limits on what a facet must and must not for testing;
- Notation for documenting facet dependencies including parameter dependencies for facets ;
- Interface definition specification method (e.g. conformance requirements on the signature);
- Behavior definition specification method (e.g. conformance requirements on the behavior and description of typical usage scenarios of a facet).

3.2. Test method

The major result of this RfP is that a conformance test method for TINA facets is defined. Some questions about the testing method that should be answered are:

- How is the facet specification used to create test cases?
- What are the guidelines to develop conformance test cases for functional and common usage tests?
- How are test cases specified?
- What are the requirements for the realization and execution of test cases?
- Discussion of the requirements for realizing test cases within a vendor-selected interface technology (e.g., C++ or DCOM instead of CORBA)?
- Discussion of the the relationship of conformance tests to regression and interoperability tests?

3.3. Test Documentation

Associated with the testing process there needs to be documentation. This documentation must be defined as part of the RfP response. It should include:

- Structure and outline of test reports including the notation to be used,
- Guidelines and templates for reporting of test results
- Guidelines for the overall assessment of the test results, e.g. when a System Under Test (SUT) is considered to have passed successfully a conformance test

3.4. Testing in Practice

There needs to be an assessment of the viability and effectiveness of the conformance testing process. This includes:

- Analysis of the feasibility of the testing process in a production environment
- Estimates of time and costs associated with the testing process.
- Discussion of what level of interoperability is guaranteed by technical conformance testing.
- Discussion of limits of conformance testing, for example with respect to functional side effects performed by a component.

3.5. Demonstrate Usability [optional]

Solid demonstration of testing methods and technology are strongly advised. One way to show the usability of the specifications and testing process is through a comprehensive example. The information requested in Section 3.1, 3.2. and 3.3 should be given. This includes:

- A test scenario with conformance requirement specification,
- The test generation concept,
- The specification of selected test cases,
- A description of the test realization method, and
- A presentation of the test execution techniques and procedure, as well as documentation of test results.

3.6. Accreditation of Testing Vendors [optional]

TINA will place requirements on conformance testing vendors to assure that their testing results can be used to support official TINA branding of vendor products. This input will be incorporated into a TINA test vendor accreditation process. The following questions should be addressed:

- What are the criteria for test realization and the performance of tests by test laboratories?
- Which test quality assurance requirements should be in place?
- What communications are and are not allowed between test lab and vendor during testing to assure test validity?
- How to prevent the access to test results by unauthorized personal?
- How to setup and handle test report archives?
- How to solve failures in the SUT, tester or TINA facet specification?
- Discussion of the relationship between test labs and the TINA CAT WG and Architecture Board.

4. Criteria for evaluation of submissions

4.1. General criteria for evaluation

The RfP is being out in the context of the TINA Conformance Framework document, and compliance with that document's intent is assumed.

Submissions should propose solutions to the problem presented in sections 1 and 2, and provide the information requested in Sections 3.1, 3.2, 3.3, and 3.4 and optionally in Section 3.5 and 3.6. The information must be provided in a way that enables vendors other than the submitter to perform testing and produce test results. Thus, the clarity and completeness of the RfP response will be judged.

All the specification techniques, methods, and processes will be judged in terms of their practical implementation and their effect on enabling vendors to bring TINA products to the market. RfP responses will also be judged in terms of their solutions effectiveness and efficiency of producing meaningful test results.

Potential risks or delays in implementing production use of the testing processes will be judged as well. Any submission including examples, demonstration of testing processes, tooling, etc. such as described in the optional deliverables section will be viewed very favorably.

4.2. Specific criteria for evaluation

4.2.1. Facet Specification Template

Facet specification will be judged in terms of:

- How well it enables unambiguous definition and generation of (preferrably automated) tests?
- How cumbersome it will be for product and testing vendors to use?
- Compatibility with existing TINA specification techniques (100% compatibility is NOT expected).
- Commonality with other industry accepted standards.

4.2.2. Test Method

The test method will be judged in terms of

- How well others may be able to use the test method. The process should also be as streamlined as possible, yet provide meaningful results?
- How well others may understand the test case specification? The test case notation should be understandable by others in the industry with well-defined syntax and semantics for test configuration, data, and test case relevant activities. Formality and transparency for the test process is valued.
- Whether the coverage of testing can be evaluated with respect to a facet specification? Whether a complete testing coverage (with respect to a facet specification) is supported?
- How well the test method can be automated (ranging from automated test execution, automated analysis of test results to automated test implementation and test generation)?.

4.2.3. Test Documentation

Documentation standards will be judged in terms of

- How well they support an efficient branding of vendor products
- How well they allow the understanding and comparison of test results by others.

4.2.4. Testing in Practice

The means of test realization have impact on the quality of conformance tests. The discussion of practical ramifications of the testing process should show that the submitted process is feasible. It should also discuss the degree of validity of the testing results. RfP responses will be judged in terms of the overall practicability and the added value the testing produces.

4.2.5. Demonstrate Usability

This RfP does not require that tools are prescribed rather it focuses on the criteria for the test realization. Any examples of tooling , actual or virtual testing will help to validate the claims made in the RfP response.

4.2.6. Accreditation of Testing Vendors

Input to the TINA accreditation of testing vendors will be judged with respect to the practicability of realizing the proposed test method by testing vendors. It is a possibility for a vendor to suggest criteria for TINA to use when deciding what facilities can give out TINA Conformant branding certification.

4.3. Format of submissions

Submissions and Letters of Intent should follow the template presented in this section, and comply with the instructions provided in section 5.

4.3.1. Template for LoI (Letters of Intent)

Letter of Intents should include the following statement:

> *On behalf of Company XXX, I express the intention of XXX to submit a response to RFP [ref] in accordance to TINA legal procedures.*

4.3.2. Template for Submission

Submission in response to the current RFP should follow the template outlined below:

-0- Document Information

-1- General description

-1.1- Submitters

-1.2- Background of the proposal

-2- Detailed description

-2.1- Facet Specification Template

-2.2- Testing method

-2.3- Test documentation

-2.4- Testing in practice

-2.5- Demonstrate Usability [optional]

-2.6- Accreditation of Testing Vendors [optional]

-3- Compliance to evaluation criteria

-4- Related standards and documents

4.4. Specifications

The facet specification language and the test case description language must be proposed with formal definitions. For reuse of known specification techniques, references should be provided.

4.5. Other criteria for evaluation

Whenever possible, available prototypes, pre-products or products will be considered as an important indication of the practical ability to implement a proposal.

5. Process for submission and timetable

The following process should be followed for submitting a contribution in response to RFP:

T0. A TINA work group (referred to as "WG") issues a request for proposal (RFP).

T1. Submitters should first provide a Letter of Intent (LoI) to the contact name provided in Section 0, expressing their wish to submit a proposal.

T2. Submissions should be sent to the contact name provided in Section 0.

T3. WG is in charge of evaluation of the submissions, in collaboration with representatives from the submitters.

T4. After evaluation, revision may be requested from submitters. This may involve merging of some of the submissions if feasible.

T5. WG is in charge of making the final evaluation.

T6. WG submits the proposal to TINA Architecture Board for endorsement, and TINA Technical Forum for adoption.

The following timetable will be applied:

T0	**Ju1. 19, 1999**	Approval and Release of RFP	Date of the initial release of RFP

T1	**Sept. 30, 1999**	Reception of LoI by submitters	Deadline for reception of LoI from submitters
T2	**Dec. 19, 1999**	Reception of submissions	Deadline for reception of submissions
T3	**Jan. 15, 1999**	Evaluation of submissions	Evaluation of submissions will take place between T2 and T3
T4	**Feb. 5, 2000**	Revised submissions	Deadline for reception of revised submission
T5	**Feb. 21, 2000**	Final evaluation	Evaluation of revised submissions will take place between T4 and T5
T6	**March 7,1999**	Adoption	Final adoption of proposal by TINA

Time Table notes:

- Times T4-T6 may change based on the quality and number of submissions received.
- Time T2 may be flexible based on number and expectations set by of received LoIs.

5.1. Adoption

Acceptance of a proposal by TINA implies that the specification as presented by the vendor will be adopted by TINA. The technical view of the testing process will be augmented by other TINA documents which supply the organizational context for the testing. The facet specification may be amended by TINA as long as it does not weaken the testing process results. TINA reserves the right to reject all RfP responses, or may request to negotiation or that responses be combined.

6. How to submit

LoIs and submissions should be addressed electronically to:

Eric H. Nielsen (Sprint), TINA-CAT-WG chair, at eric.nielsen@mail.sprint.com .

Additionally, they should be sent to the TINA-CAT-WG mailing list, at tina-cat-wg@tinac.com .

7. Glossary

- CTMF Conformance Testing Methodology and Framework
- IDL Interface Definition Language
- ODL Object Definition Language
- RM-ODP Reference Model of Open Distributed Processing
- SUT System under Test
- TTCN Tree and Tabular Combined Notation

8. References

Most documents referenced hereafter are available at:

http://www.tinac.com/wg_sig/cat/index.htm

8.1. Standards

[TINA-BM] TINA Business Model and Reference Points, Version 4.0, May 1997.

[TINA-SA] Service Architecture, Version 5.0, June 1997.

[TINA-Ret] Retailer (Ret) Reference Point, Version 1.0, January 1998.

[TINA-SCS] Service Component Specifications, Version 1.0b, January 1998.

[TINA-RP] TINA Reference Points, Version 3.1, June 1996.

[ITU-T X.290] OSI Conformance Testing, Methodology and Framework for Protocol Recommendations for CCITT Applications – General Concepts, 1992.

[ITU-T X.291] OSI Conformance Testing, Methodology and Framework for Protocol Recommendations for CCITT Applications – Abstract Test Suite Specification, 1992.

[ITU-T X.293] OSI Conformance Testing, Methodology and Framework for Protocol Recommendations for CCITT Applications – Test Realization, 1992.

[ITU-T X.294] OSI Conformance Testing, Methodology and Framework for Protocol Recommendations for CCITT Applications – Requirements on Test Laboratories and Clients for the Conformance Assessment Process, 1992.

[ITU-T X.295] OSI Conformance Testing, Methodology and Framework for Protocol Recommendations for CCITT Applications – Protocol Profile Test Specification, 1992.

[ITU-T X.296] OSI Conformance Testing, Methodology and Framework for Protocol Recommendations for CCITT Applications – Implementation Conformance Statements, 1992.

[ITU-T X.901] Reference Model of Open Distributed Processing – Part 1: Overview, 1995.

[ITU-T X.902] Reference Model of Open Distributed Processing – Part 2: Foundations, 1995.

[ITU-T X.903] Reference Model of Open Distributed Processing – Part 3: Architecture, 1995.

[ISO/IEC 9646-3] Information Technology – Open Systems Interconnection – Conformance Testing Methodology and Framework – Part 3: The Tree and Tabular Combined Notation (TTCN), second edition, 1998.

8.2. Related papers

[TINA-Compl] TINA Compliance Framework, TINA CAT (Compliance and Testing) Working Group,1999.