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SERIES Z: LANGUAGES AND GENERAL SOFTWARE ASPECTS FOR TELECOMMUNICATION SYSTEMS

Formal description techniques (FDT) – Application of Formal Description Techniques

Criteria for use of formal description techniques by ITU-T

ITU-T Recommendation Z.110

ITU-T Z-SERIES RECOMMENDATIONS

LANGUAGES AND GENERAL SOFTWARE ASPECTS FOR TELECOMMUNICATION SYSTEMS

For further details, please refer to the list of ITU-T Recommendations.

ITU-T Recommendation Z.110

Criteria for use of formal description techniques by ITU-T

Summary

In view of the complexity and widespread use of Recommendations, it is imperative that adequate and appropriate description techniques and languages be used to ensure the required quality levels of Recommendations.

The purpose of this Recommendation is to guide the use of Description Techniques to ensure the quality of ITU-T Recommendations. Where special requirements for verification and validation exist, Formal Description Techniques (FDTs) should be used.

The effective use of FDTs requires phased procedures to introduce their use. This Recommendation states the procedures to accomplish this task.

Effective use of FDTs implies the use of state-of-the-art tools.

Supplement 1 to ITU-T A-series Recommendations (09/98) – Guidelines on quality aspects of protocol related Recommendations – states: "Guidelines on the use of FDTs are contained in Recommendation Z.110. It provides criteria for their use and should, therefore, be taken as a reference in conjunction with this Supplement. It is planned to extend the scope of Recommendation Z.110 to cover a wider range of applications developed by groups such as the OMG."

Resolution 4 on Conformity Assessment and Quality of Standards from the Joint Meeting of Global Standards Collaboration-5/RAST, Williamsburg, USA, 23-26 August 1999, concludes:

a)   "that the use of protocol specifications expressed in SDL in conjunction with the available SDL-based commercial software tools will in the end produce higher quality Recommendations;

b)   that approval of protocol Recommendations expressed in SDL will be achieved in a shorter time than approval of Recommendations written in natural language.

and resolves:

1)   to encourage ITU-T Study Groups to apply Supplement 1 to A-series Recommendations, *Guidelines on the Quality Aspects of Protocol Related Recommendations,* when developing new protocol related recommendations;

2)   to encourage ITU to provide editing and technical support for the development and maintenance of complex Recommendations;

3)   to encourage companies that participate in GSC member organizations to make use of commercial SDL/TTCN tools in their reviews of draft Recommendations;

4)   to encourage companies that participate in GSC member organizations to assist in the establishment of facilities for training in the use of formalized methodology and tools; and

5)   to encourage GSC member organizations to participate in the development of the methodologies that they use in their standardization processes."

It should be noted that the ITU-T Description Techniques are not restricted to specification of protocols, but are applicable to a much larger application area.

Source

ITU-T Recommendation Z.110 was revised by ITU-T Study Group 10 (2001-2004) and approved under the WTSA Resolution 1 procedure on 24 November 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

ITU-T Recommendation Z.110

Criteria for use of formal description techniques[1] by ITU-T

1 Scope

This Recommendation applies to the use of Description Techniques in ITU-T Recommendations.

Description Techniques are intended to be used in the development, specification, implementation and verification of Recommendations (or parts thereof).

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

– ITU-T X.292 (1998), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – The Tree and Tabular Combined Notation (TTCN).*

– ITU-T X.680 (1997) | ISO/IEC 8824-1:1998, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*

– ITU-T X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects.*

– ITU-T X.920 (1997) | ISO/IEC 14750:1999, *Information technology – Open distributed processing – Interface Definition Language (IDL).*

– ITU-T Z.100 (1999), *Specification and Description Language (SDL).*

– ITU-T Z.105 (1999), *SDL combined with ASN.1 modules (SDL/ASN.1).*

– ITU-T Z.107 (1999), *SDL with embedded ASN.1.*

– ITU-T Z.109 (1999), *SDL combined with UML.*

– ITU-T Z.120 (1999), *Message Sequence Chart (MSC).*

– ITU-T Z.130 (1999) *ITU object definition language.*

– UML (OMG).

3 Terms and definitions

3.1 Definitions

This Recommandation defines the following terms:

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[1] The content of the previous version of this Recommendation was also published as ISO Resolution ISO/IEC JTC 1/N 145.

The statement on precedence in case of several descriptions contained in the JTC 1 document is omitted in this Recommendation.

3.1.1 **formal definition**: Part of a Recommendation based on the use of a formal description technique.

3.1.2 **formal description technique**: A specification technique based on a technical language using rigorous and unambiguous rules both with respect to developing expressions in the language (formal syntax) and interpreting the meaning of these expressions (formal semantics). The main FDTs recommended by ITU-T are ASN.1 (ITU-T X.680), TTCN (ITU-T X.292 and Z.140), GDMO (ITU-T X.722), SDL (ITU-T Z.100), MSC (ITU-T Z.120), SDL with ASN.1 (ITU-T Z.105), SDL combined with UML (ITU-T Z.109) and ODL (ITU.T Z.130).

3.1.3 **natural language description**: An example of an informal description technique using one of the languages used by ITU-T to publish Recommendations. It may be supplemented with mathematical and other accepted notation, figures, etc.

3.2 Abbreviations

This Recommendation uses the following abbreviations:

EDH   Electronic Document Handling

FD   Formal Definition

FDT   Formal Description Technique

4 FDTs

4.1 Objectives of an FDT

The goal of an FDT is to permit precise and unambiguous specifications. FDTs are also intended to satisfy objectives such as:

– a basis for analysing specifications for correctness, efficiency, etc. (by simulation, verification or systematic test derivation);

– a basis for determining completeness of specifications;

– a basis for validation of specifications against the requirement of the Recommendation;

– a basis for determining conformance of implementations to Recommendations;

– a basis for determining consistency of specifications between Recommendations;

– a basis for implementation support.

In some areas more than one Description Techniques may be needed to accomplish all objectives.

If only ITU-T is involved, then only Description Techniques Recommended by ITU-T shall be used. If for any reason other techniques are used, the rationale for not using existing ITU Description Techniques shall be provided. This restriction may not apply if the standard is being developed in collaboration with other standards organizations.

4.2 Benefits of a description technique

The application of a description technique can provide benefits such as:

– improving the quality of Recommendations, which in turn reduces maintenance costs to both ITU-T and to users of Recommendations;

– reducing dependency on the natural language to communicate technical concepts in a multilingual environment;

– supporting the validation of Recommendations and the easier generation of conformance tests for Recommendations, which then makes it easier to test products;

– reducing development time of implementations by using tools that are based on the properties of the Description Techniques;

– making the implementation easier, resulting in better products.

4.3 Use of description techniques

Description Techniques are advanced techniques which are widely used in industry. Significant investment in training and tools have been made by ITU-T members.

There are limited resources for the development (rather than use) of Description Techniques. The development of Description Techniques tends to be a lengthy and costly task.

Although there is expertise within the ITU-T Study Groups both to assess the technical merits of the formally described Recommendations and to reach consensus on them, this is also limited.

4.4 Support for description techniques

The development and availability of tutorial and educational materials helps to provide widespread understanding of the complexities and capabilities of Description Techniques. The benefits of using Description Techniques can only be assured after some training.

Tools to support a Description Technique that is used in a Recommendation is an important facility that can ensure that many defects in draft Recommendations can be removed before they are published, and that the Description Technique is used with the semantics defined in the FDT Recommendation. The use of EDH enables ITU-T members to analyse draft Recommendations y clause be utilize approved Recommendations in their own preferred FDT tools.

4.5 Criteria for the use description techniques

The description techniques used within a Recommendation shall be decided by the Study Group responsible for the Recommendation taking the factors in 4.1, 4.2, 4.3, 4.4 and 4.5 and the procedure in clause 6. The primary criteria for the decision shall be the technical quality of the Recommendation. As a consequence the description techniques in 3.1.2 should normally be used for those parts of a Recommendation that can be described in this way.

In some cases other criteria such as existing documentation and urgent market need are sufficient to justify an alternative description approach. Where a Recommendation could use one of techniques described in 3.1.2, but a different technique or just natural language is used, the Recommendation should include the rationale for the choice taken.

5 Criteria for development and Recommendation of description techniques

It is important to avoid unnecessary proliferation of Description Techniques, because of the cost and difficulty of supporting many Description Techniques both for ITU-T and for its members. The following criteria shall be met before adopting a new Description Technique for use in ITU-T Recommendations:

– the need for the Description Technique shall be demonstrated;

– evidence that it is based on a significantly different model from that of an existing Description Technique shall be provided;

– the usefulness and capabilities of the Description Technique shall be demonstrated;

– there shall be at least two tools that adequately support the Description Technique available to any party on fair and reasonable terms.

When a significant modification to an existing Description Technique is considered, this shall be treated in basically the same way as a new Description Technique, regardless of whether the change

is backwards compatible or not. The objectives are to keep both the number of Description Techniques low and each Description Technique itself stable to the benefit of all parties.

Any adoptions of new Description Techniques or modifications of existing Description Techniques should be communicated to the Lead Study Group for Description Techniques.

6   Procedure for development of formal definitions

6.1   Only standard FDTs (or FDTs in the process of being standardized) shall be used in Formal Definitions (FDs) of Recommendations.

6.2   The adoption of a Description Technique for any particular Recommendation is a decision of the Study Group (in consultation with involved standardization organizations for collaborative standards). If a FD is to be developed for a new Recommendation, the FD shall be progressed at least as fast as the Recommendation.

6.3   For the evolutionary introduction of FDs into Recommendations, three phases can be identified. It is the responsibility of the Study Group to decide which phase initially applies to each FD and the possible evolution of the FD toward another phase. It is not mandatory for a FD to go through the three phases described below and, more generally, it is not mandatory for a FD to evolve.

Phase 1

This phase is characterized by the fact that widespread knowledge of Description Techniques and experience in FDs are lacking; there may not be sufficient resources in the Study Groups to produce or review FDs.

The development of Recommendations has to be based on conventional natural language approaches, leading to Recommendations where the natural language description is the definitive Recommendation.

Study Groups are encouraged to develop FDs of their Recommendations since these efforts will contribute to the quality of the Recommendations by detecting defects, may provide additional understanding to readers, and will support the evolutionary introduction of FDTs.

A FD produced by a Study Group that can be considered to represent faithfully a significant part of the Recommendation or the complete Recommendation should be published as an appendix to the Recommendation.

Meanwhile Study Groups should develop and provide educational material for the Description Techniques to support their widespread introduction in the ITU-T and Liaison Organizations.

Phase 2

This phase is characterized by the fact that knowledge of Description Techniques and experience in FDs are more widely available; Study Groups can provide enough resources to support the production of FDs. However, it cannot be assured that enough ITU-T Members can review FDs in order to enable them to approve a proposed formally defined Recommendation.

The development of Recommendations should still be based on conventional natural language approaches, leading to Recommendations where the natural language description is the definitive standard. However, these developments should be accompanied and supported by the development of FDs of these Recommendations with the objective of improving and supporting the structure, consistency, and correctness of the natural language description.

A FD, produced by a Study Group, that is considered to represent faithfully a significant part of the Recommendation or the complete Recommendation should be published as an Annex to the Recommendation.

Meanwhile educational work should continue.

Phase 3

This phase is characterized by the fact that a widespread knowledge of FDTs may be assumed; ITU-T Members can provide sufficient resources both to produce and review FDs, and assurance exists that the application of FDTs does not unnecessarily restrict freedom of the implementations.

Study Groups should use FDTs routinely to develop their Recommendations, and the FD(s) become part of the Recommendation together with natural language descriptions.

Whenever a discrepancy between a natural language description and a FD, or between two FDs, is detected, the discrepancy should be resolved by changing or improving the natural language description or the FDs without necessarily giving preference to one over the other(s). Any inconsistency between any two parts of a Recommendation (regardless of whether either part uses an FD or not) means that there is an error in the Recommendation that needs to be corrected.

6.4   The above procedures for phased development of FDs are intended to aid the progression of FDs within the standards process, not to hinder their progression. Should procedural problems arise, the Lead Study Group for Description Techniques should be informed and, where possible, recommended procedural modifications should be proposed to alleviate the problems.

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Series D   General tariff principles

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Series F   Non-telephone telecommunication services

Series G   Transmission systems and media, digital systems and networks

Series H   Audiovisual and multimedia systems

Series I   Integrated services digital network

Series J   Cable networks and transmission of television, sound programme and other multimedia signals

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Series L   Construction, installation and protection of cables and other elements of outside plant

Series M   TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits

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Series R   Telegraph transmission

Series S   Telegraph services terminal equipment

Series T   Terminals for telematic services

Series U   Telegraph switching

Series V   Data communication over the telephone network

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Series Y   Global information infrastructure and Internet protocol aspects

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