ITU Regional Seminar for the Africa Region on Conformance and Interoperability Testing Centres

Accra (Ghana), 4-6 July 2011

Test Suite Development and Selection for ITTC Conformance and Interoperability Testing

Presented by:
Wayne Zeuch
ITU Consultant

1

Presentation Overview

- Discussion of the technologies and standards to be considered for conformance and interoperability testing
- Test specification development
- Test specification availability
- Test objectives for ITTCs
- Selection and development of new test specifications
- Concluding comments

2

Technologies and standards

- The ITU is the primary source for specifying the technologies and producing the standards for which conformance and interoperability testing is planned
- Test specifications come in different forms and from various sources, including the ITU
- The ITU has a long history and experience with the development of test specifications, detailing the requirements and options within its standards and facilitating conformance testing
- Due to the breadth of ITU leading-edge ICT standards development, the ITU is currently determining the optimal set of standards to become candidates for test suite development

3

ITU-T Test Specifications

- ITU-T has identified several hundred Recommendations suitable for testing
  - Most of these have no associated Test Specifications (PICS or Test Suites)
- ITU-T Recommendations cover a very wide range of protocols, architectures, services, and systems

Technologies/Services	
• NGN Architecture and Services	• Multimedia, IPTV
• Fixed-Mobile Convergence	• ISDN
• Optical Networks	• QoS, QoE
• Broadband Cable	• Security

- ITU-T Recommendations cover complex systems/ convergence
  - Wireline/wireless convergence
  - Legacy/IP-based network convergence
  - Services/applications on multiple platforms

4

Technologies for conformity testing

- Global Standards Collaboration
  - ➢ SDOs in close collaboration with and major contributors to ITU standardization efforts (including test specifications)

SDO	Country/Region	Technologies/Services
ARIB	Japan	• NGN Architecture and Services • Fixed-Mobile Convergence • Mobile Multimedia Broadcast/Multicast • *Interoperability* • Optical Networks • Multimedia and IPTV • QoS, QoE • Security and Identity Management • Emergency Communications • Intelligent Transportation Systems • Smart Grid • Machine-to-Machine Communications • Cloud Computing
ATIS	USA	
CCSA	China	
ETSI	Europe	
ISACC	Canada	
TIA	USA	
TTA	Korea	
TTC	Japan	

5

Technologies for conformity testing

- ITU and beyond

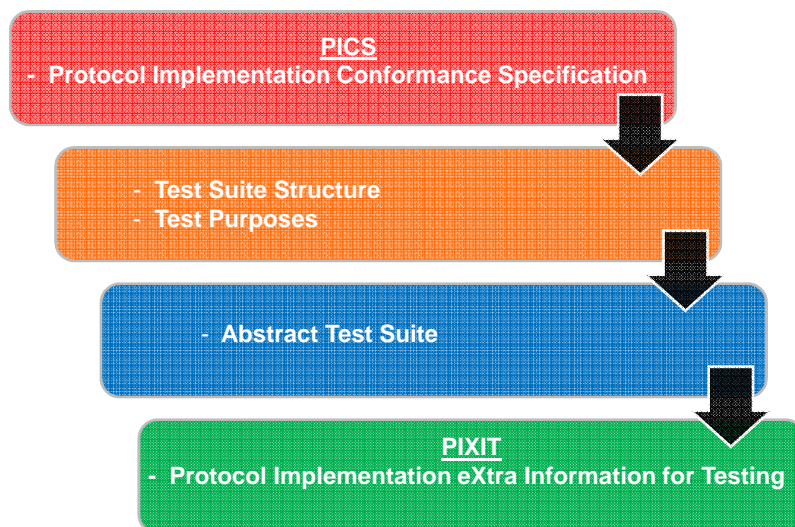| SDO/Organization	Technologies/Services
ITU-T	• NGN Architecture and Services • Multimedia • Fixed-Mobile Convergence • QoS, QoE • Optical Networks • Security
IETF	• Internet-related Protocols (routing, transport, security, applications, operations)
3GPP/3GPP2	• Mobile Telcommunications Systems and Services
OMA	• Service Enablers
ISO/IEC	• Data protocols and management • Multimedia coding • Security
IEEE	• LAN (802.11-series), MAN, WPAN • Measurements and Calibration • Mobile Multimedia Broadcast/ • Sensor Networks (RFID) Multicast (802.16) • Security • RF Exposure/Safety
CableLabs	• Cable networks and transmission of multimedia signals
others	

6

Test Specification Development

- Test Specifications, Test Scripts
- Product or service specific (manufacturer, network/ service provider, industry association)
- SDO-based (Ad Hoc, Product-specific, SDO-based)
- Formal Test Specification Techniques
  - PICS Proforma
  - Protocol Implementation Conformance Statement (PICS)
  - Test Suite
  - Test Suite Structure and Test Purposes (TSS & TP)
  - Protocol Implementation eXtra Information for Testing (PIXIT)
  - Abstract Test Suite (ATS)

7

Test Specification Development

PICS
- Protocol Implementation Conformance Specification

- Test Suite Structure
- Test Purposes

- Abstract Test Suite

PIXIT
- Protocol Implementation eXtra Information for Testing

8

Test Specification Development
- Protocol Implementation Conformance Statement (PICS)

- **PICS Proforma**
  - A document that systematically reviews all requirements of a given standard. In particular, it lists all cases, conditions, and options for the protocol messages and requires an indication of the support of each within a particular implementation
  - Presented in the form of a questionnaire
    - Status notations: Each condition, option, response, etc. is reflected by a status designation (e.g., mandatory, optional, prohibited, conditional)
    - Support declarations: Indication of the support status (yes, no, not applicable) for each of the items in the questionnaire for the specific implementation under review
- **PICS**
  - The completed questionnaire of the PICS Proforma document
  - Contains all information regarding a specific implementation
- PICS Proforma and PICS can be utilized for standards other than strictly protocol standards (**ICS Proforma**, **ICS**)

9

Test Specification Development
- Test Suite Structure and Test Purposes (TSS & TP)

- **Test Suite**
  - a collection of **Test Cases**, one for each test purpose
    - A test case verifies conformance/interoperability for a particular Requirement or Option according to the test purpose
    - Each **Test Purpose** focuses on a single conformance requirement
- **Test Suite Structure**
  - A Test Suite must ensure coverage of all conformance requirements. This is facilitated by creating a hierarchical structure for different categories of tests
    - For example: Basic interconnection tests, Mandatory features, Optional features, Data transfer, Variation of parameters
  - The logical construction of a test suite and test purposes optimizes test case coverage and minimizes test duplication

10

Test Specification Development
- Abstract Test Suite (ATS)

- **Abstract Test Suite** (ATS)
  - A test suite composed of abstract test cases and written in test notation (e.g., TTCN-3) that defines
    - test suite structure
    - test suite architecture
    - test methods and port definitions
    - design principles, assumptions, simulator interfaces
    - parameter and data values

11

Test Specification Development
- Protocol Implementation eXtra Information for Testing (PIXIT)

- **PIXIT Proforma**
  - A supplementary questionnaire (to the PICS Proforma) requesting additional specific information regarding the implementation to be tested (IUT: Implementation Under Test)
  - Contains requests for information on the IUT and the testing environment
    - Configuration, parameters, timer values, procedures
- **PIXIT**
  - The completed questionnaire of the PIXIT Proforma document
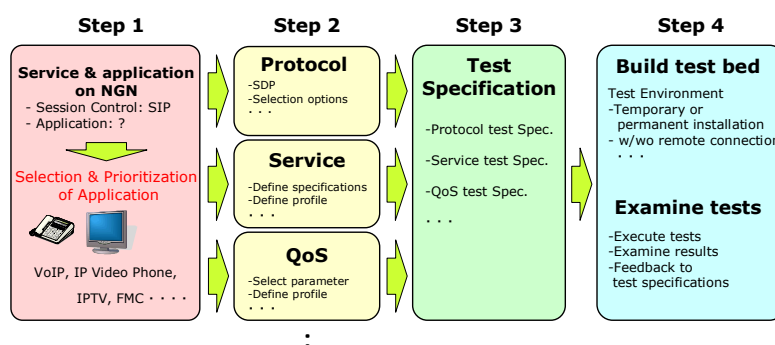 - Contains additional information regarding the specific IUT

12

Test Specification Development
- Testing and Test Control Notation (TTCN-3)

- TTCN-3 is the latest version the standardized TTCN programming/ scripting language used for protocol and software conformance testing
- TTCN-3 is widely used by SDOs, vendors, and test labs to test conformance to standards and product specifications
- TTCN-3 is implementation technology and operating system independent
- Test cases from a variety of standards (e.g., ISDN, IPv6, 3G IMS, VoIP) have been written in TTCN to verify that protocol implementations in products (e.g., network elements, mobile phones) meet the requirements of those standards
- Test cases from test suites are written in TTCN-3, enabling automated test execution

13

Test Specification Development

Step 1	Step 2	Step 3	Step 4

Service & application on NGN
- Session Control: SIP
- Application: ?

Selection & Prioritization of Application

VoIP, IP Video Phone, IPTV, FMC · · · ·

Protocol
-SDP
-Selection options
· · ·

Service
-Define specifications
-Define profile
· · ·

QoS
-Select parameter
-Define profile
· · ·

Test Specification
-Protocol test Spec.
-Service test Spec.
-QoS test Spec.
. . .

Build test bed
Test Environment
-Temporary or permanent installation
- w/wo remote connection
· · ·

Examine tests
-Execute tests
-Examine results
-Feedback to test specifications

:

Test Specification Development – NGN example

Source: "Handbook on Testing", ITU-T, 2011

14

Test specification availability
- ITU-T Test Specifications

- **Q.765bis** – SS7 Application transport mechanism: **Test suite structure** and **test purposes** (TSS & TP)
- **Q.780** Signalling System No. 7 **test specification** – General description
- **Q.784** ISUP basic call **test specification**
- **Q.784.2** ISUP basic call test specification: **Abstract test suite** for ISUP'92 basic call control procedures
- **Q.784.3** ISUP basic call test specification: ISUP '97 basic call control procedures – **Test suite structure** and **test purposes** (TSS & TP)
- **Q.788** User-network-interface to user-network-interface compatibility **test specifications** for ISDN, non-ISDN and undetermined accesses interworking over international ISUP
- **Q.1912.5** Interworking between SIP and BICC or ISUP: Part 5 (**Abstract Test Suite** and **PIXIT**)
- **Q.3940** NGN **Interconnection Testing**
- **Q.3941.1** **Network Integration Testing** between SIP and ISDN/PSTN network signalling protocol. Part 1 **TSS & TP**
- **Q.3941.2** Network Integration Testing between SIP and ISDN/PSTN network signalling protocols. Part 2: **PIXIT & ATS**
- **Q.3948** VoIP **services testing** at NGN UNI

15

Test specification availability

- **ETSI**
  - ETSI has created various PICS, TSS/TP, and ATS documents with TTCN-3 Code
  - Publicly available:
    - IP Multimedia Subsystem (IMS)
    - VoIP (SIP)
    - IPv6   IETF
    - WiMax (802.16)   IEEE
- **OMA** (Open Mobile Alliance)
  - Enabler Test Specs (Mobile Broadcast Services, Presence, Multimedia Messaging Service)
- **IETF** (Internet Engineering Task Force)
  - Various Internet protocol tests (e.g., SIP, Email protocols)

16

Test specification availability

- Producing test specifications within the ITTC and/or contracting to produce specifications would be costly and time-consuming
- The existence of test specifications does not necessarily mean they are readily available to an ITTC
  - Some specifications are available free of charge
  - Other documentation is available only to organization members, test event participants, or product/service customers
  - Some documentation may be available through negotiation of confidentiality agreements or specific contracts
- A system must be in place to identify and obtain the required test specifications

17

Test objectives for ITTCs

- Conformance testing
  - Prioritized according to Regional technologies supported and network evolution plans
  - Broad enough in scope to cover multiple technologies
  - Complementary to other test labs/certification activities in the Region
- Interoperability testing
  - Complementary to conformance testing
  - Must support complex system/service testing (ITU-T "model network" concept)
  - Results may help resolve conformance issues
- Type approval testing
  - Based on Regional conditions, type approval should be offered as well as conformance and interoperability testing

18

Selection and development of new test specifications (ITU-T)

- Completed Test Suites: ITU-T already has a number of test specifications covering ISDN protocols/interworking and optical fiber/components.
- Current Test Suite Work Plan: ITU-T has begun work on test specifications for IPTV, VoIP services, NGN interworking, IMS, and NGN supplementary services. Work also continues on ISDN interworking and Optical fiber/component test suites.
- Candidate Recommendations:
  - Hundreds of approved ITU-T Recommendations exist that could be potential candidates
  - Many of these Recs. are legacy technologies. Some of these still have significance in Regional network development, but these technologies have also been tested many times via test specs in the industry.

19

Selection and development of new test specifications (ITU-T)

- The ITU should focus test suite development for its current leading-edge technologies. In addition to protocol specifications for new protocols, the ITU also develops specifications for complex systems and services.
  - Encourage the development of test suites and interoperability events to address complex systems
- The ITU should expand its test suite creation program to support conformance and interoperability testing, thereby accelerating ITU standards-based product deployment
  - Regional priorities should dictate the catalog available to Regional ITTCs
  - Broadband and mobility-related systems/services standards are generally high priorities

Technologies/Services	
• NGN Architecture and Services	• Multimedia, IPTV
• Fixed-Mobile Convergence	• ISDN
• Optical Networks	• QoS, QoE
• Broadband Cable	• Security

20

Concluding comments

- Test specifications come in different forms and from various sources (including the ITU)
- The ITU should focus test suite development for its current leading-edge technologies. ITU should encourage the development of test suites and interoperability events to address complex systems
- The ITU should expand its test suite creation program to support conformance and interoperability testing, thereby accelerating ITU standards-based product deployment
- Regional ITTCs should take advantage of all sources available to obtain test suites for Regionally deployed technologies
- Feedback from interoperability testing should be used to improve standards and verify conformance

21

Thank You!

Wayne Zeuch
ITU Consultant
WayneZeuch@aol.com

22