ITU Forum on Conformance and Interoperability Testing in CIS and Europe Regions
(Moscow, Russia, 9-11 November 2011)

Achieving Interoperable Standards

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(WP 4/11 Vice-chairman)

Moscow, Russia, 9-11 November 2011

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ETSI

World Class Standards

ACHIEVING INTEROPERABLE STANDARDS
-THE ETSI APPROACH

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TC INT Vice-chairman

Presentation Outline

- What Interoperability Means to ETSI
- Is Interoperability Important?
- Building interoperability into ETSI standards
- Specify for interoperability
- Validate for interoperability
- *Validation through technical reviews and simulation*
- Test for interoperability
- Conclusions

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ETSI and Interoperability (IOP)

- Standardisation enables interoperability
  - One main aim of standardisation is to enable interoperability in a multi-vendor, multi-network, multi-service environment
- IOP is the red thread running through the entire ETSI standards development process
  - Interoperability is specified from the beginning
  - Not something 'bolted on' at the end
- ETSI philosophy
  - Interoperability should be built-in!

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Is Interoperability Important?

- We live in an interconnected world and interoperability is key to drive it forward
  - Digital Home, Smart House
  - M2M (embedded communication)
  - Internet of Things, Intelligent Transport Systems etc.
- Users benefit from increased choice from multiple manufacturers
  - Business, Governmental, Private Consumer
  - And they expect 'stuff to work' (Plug&Play)
- Manufacturers benefit from an increased market
  - Economies of scale
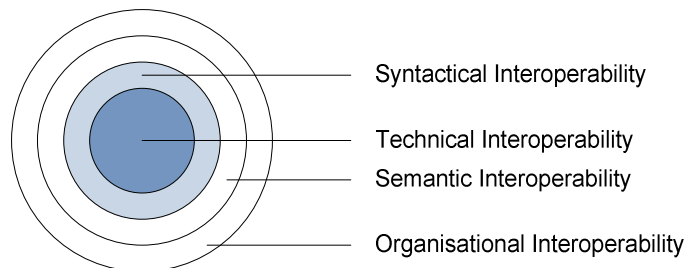
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Different 'Levels' of Interoperability
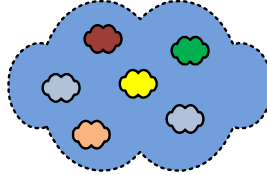
No single definition of Interoperability
  - The ability of two or more systems or components to exchange and use information
  - ...

Syntactical Interoperability

Technical Interoperability

Semantic Interoperability

Organisational Interoperability

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IOP and Complex Standards

ETSI

- Complex ICT standards are increasingly specified by 'islands of standards'
  - From different standardisation bodies
  - Or developed for a different (original) use
  - Complete system not specified in detail
- Results in potentially non-interoperable standards and/or products

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Typical Causes of Non-interoperable Standards

ETSI

- Requirements not well identified or missing

- Ambiguous requirements

- Varying technical quality and use of language

- Inadequate handling of options

- Lack of clear system overview

- Loose definition of interfaces (reference points)

- Poor maintenance

- Using standards beyond their original purpose

- …

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Poor Interoperability Can be Expensive

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- Bad publicity
  - For the technology
  - For the manufacturer
- Annoyance to the end customer
  - Damage to brand name
- Loss of customer base
  - Allegiances change rapidly
- May affect uptake of new technology
- Loss of investor confidence

- We can no longer afford to get it wrong!

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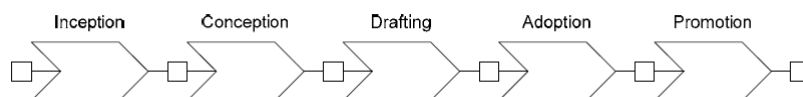## Building interoperability into ETSI standards (1)

ETSI

- The goal of ETSI is to ensure that instances of non-interoperability are not caused by poor or insufficient standardization.
- It is the drafting phase which is of immediate interest to us. Standards need to be designed for interoperability from the very beginning of this phase.

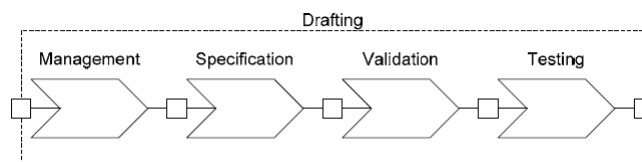Achieving Interoperable Standards

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Building interoperability into ETSI standards (2)

- Interoperability is not something that will somehow get fixed at the end of the process. Ensuring interoperability is the red thread running through the entire ETSI **Standards Making Process (SMP)** from day one. We call this standards engineering.
- ETSI standards includes activities that impact interoperability

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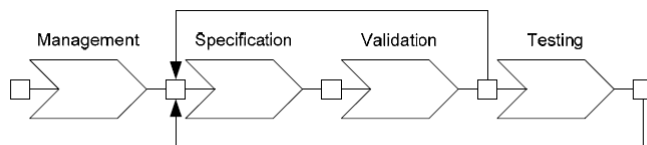# Building interoperability into ETSI standards (3)

The ETSI Standards Making Process

The drafting phase of the SMP

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Building interoperability into ETSI standards (4)

Feedback from validation and testing to base standards

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Relative time-line of standards development, validation and testing

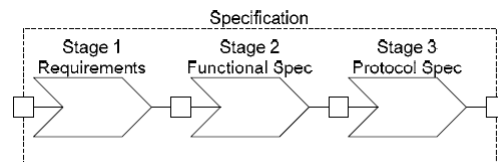Achieving Interoperable Standards

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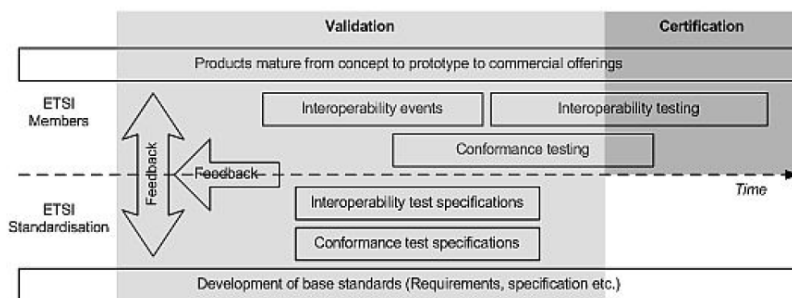
Specify for interoperability (1) ETSI

- A standard is only one part of the design phase of an eventual product, but it is a critical part. A poor standard will inevitably lead to interoperability problems in real systems. ETSI, of course, has no influence over its members' internal design and implementation processes. What we can do is to try and link our processes and outputs as closely as possible to the working processes of our membership.

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Specify for interoperability (2) ETSI

- How that is done will often depend on the individual Technical Committee or Working Group. For example GSM and UMTS standardization has excellent experience of the classical *three-stage approach to specification, where most* protocol standards are developed (and published) in three distinct steps

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10/31/2011

Specify for interoperability (3)

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Validate for interoperability

- Validation of standards should be an integral part of the standards engineering process. It is impractical to prescribe a rigid process for performing effective yet economic validation, but there are a number of techniques available of which some, all or none may be applied as necessary.

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Validate for interoperability

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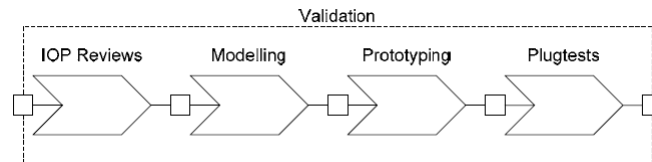
Validation through technical reviews and simulation

- Technical reviews (e.g. walk-throughs) and simulation through modeling or prototyping are typical early validation techniques. Modeling can include the use of UML and SDL, which can provide executable simulations of protocol behaviour. The use of Message Sequence Charts (MSC) is strongly encouraged.

- The ETSI Secretariat has the latest tool support for all these techniques.

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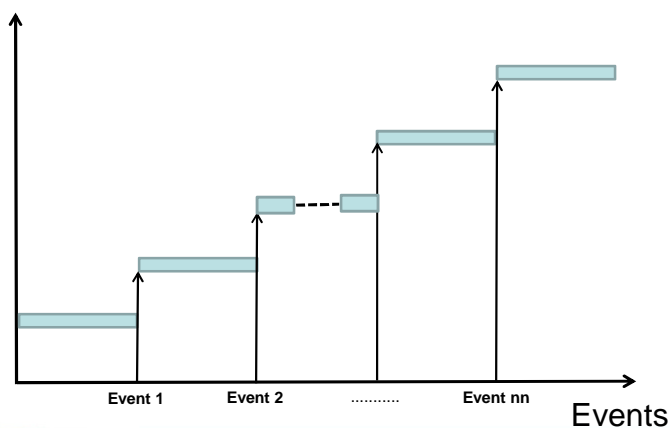
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Validation through IOP Events

- ETSI Plugtests events
  - Open to members and non- members
- Aim is to validate *standards*
  - Feedback (*Change Requests*) to relevant technical bodies
  - A tool to develop and mature standards
- But testing and debugging are useful by-products
  - Vendors validate their understanding of standards and their implementation
  - Achieve in one week what would otherwise take months
- Promote technology and community
  - Develop new ideas, confirm existing ones

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Series of IOP Events

Maturity of the Standard

Event 1   Event 2   ....   Event nn

Events

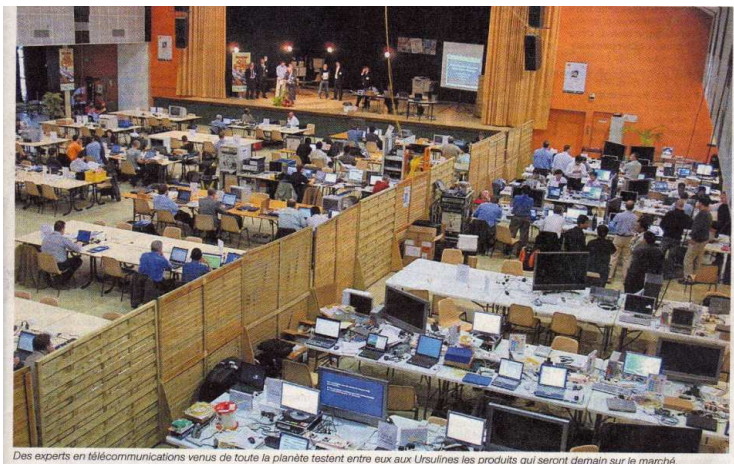Achieving Interoperable Standards

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Plugtests™ can look like this...

Des experts en télécommunications venus de toute la planète testent entre eux aux Ursulines les produits qui seront demain sur le marché.

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... or this (Car2Car Interop)

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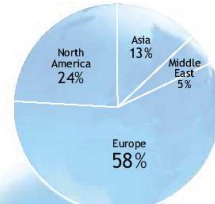
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Typical ETSI PLUGTESTS INTEROP EVENTS

❑ **In operation since 1999**

❑ **Over 100 events, more than 3000 engineers**

❑ **Technologies include:**

- IMS
- Bluetooth
- IPv6
- Triple Play over xDSL
- SIM/Handset
- WLAN IRAP
- RFID
- STQ (Speech Quality)
- WiMAX
- SIGTRAN
- Femtocell
- OSA/Parlay (ParlayX)

- B2B (Business-to-Business)
- SIPiT
- J2ME
- HDMI
- Air Traffic Control (EUROCAE)
- Electronic Signature (XadES, CadES)
- Lawful Interception
- Optical Fibre (GPON)
- Power Line (PLT)
- Intelligent Transport Systems
- Femtocell
- Fixed Mobile Convergence (FMCA)

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Who attends Plugtests™ events?

- Participants do NOT have to be ETSI members
- Plugtests™ are addressed to any company developing a product such as operators, vendors or equipment manufacturers, content or application providers
- Standardization Bodies, Fora or interest groups may also attend
- Plugtests™ also welcome Universities and Research Institutes

North America 24%
Asia 13%
Middle East 5%
Europe 58%

OVERALL GEOGRAPHIC REPARTITION OF PARTICIPATING COMPANIES SINCE JANUARY 2001

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Test for interoperability

- The development of standardized test specifications is an integral part of the ETSI strategy for ensuring interoperability. There is no silver bullet. Testing will not eliminate all possible instances of non-interoperability, though it can do a lot to help. For example, the use of ETSI conformance test specifications in the Global Certification Forum (GCF) certification of GSM and UMTS handsets guarantees interoperability of these terminals over the air interface.

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Test for interoperability

- In the context of standardization ETSI focuses on the development of two types of test specifications, which reflect the principle: *test the components first, then test the system, i.e.:*
  - conformance test specifications; and
  - interoperability test specifications

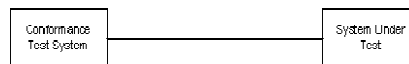Achieving Interoperable Standards

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NGN testing methods

- Conformance testing or type testing
  - The purpose of conformance testing is to determine to what extent a **single implementation** of a particular standard **conforms** to the individual **requirements** of that standard.

Conformance Test System		System Under Test

- Interoperability testing
  - Interoperability testing is the activity of proving that **end-to-end functionality** between (at least) two communicating systems is as required by those systems' base standards.

Qualified Equipment		Equipment Under Test
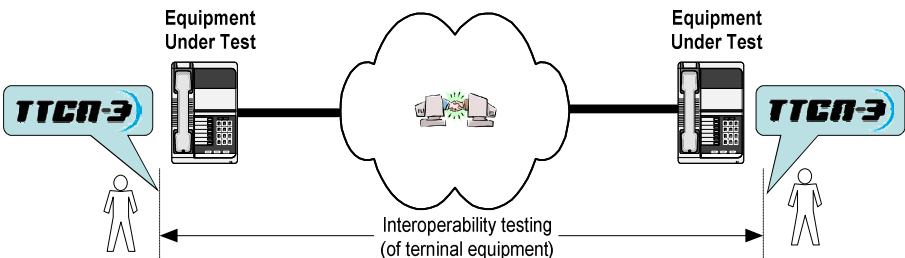
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Combining Interoperability and Conformance Testing

- **Conformance and Interoperability**
  - **both important and useful approaches to the testing of standardized protocol implementations**
  - **although it is unlikely that one will ever fully replace the other**

- **Conformance testing**
  - **able to show that a particular implementation complies with all of the protocol requirements specified in the associated base standard**
  - **difficult for such testing is to be able to prove that the implementation will interoperate with similar implementations in other products**

- **Interoperability testing**
  - **can clearly demonstrate that two implementations will cooperate to provide the specified end-to-end functions cannot easily prove that either of these implementations conforms to the detailed requirements of the protocol specification**

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Interoperability Testing

Tests end-to-end functionality between a collection of products

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Characteristics of IOP Testing

- **Gives a high-level of confidence that products will interoperate with other products**
- It is <u>system</u> testing
  - Tests a complete product or a collection of products
  - Is functional testing
- Tests can be performed manually
  - Users operate the product via existing interfaces (standard/proprietary)
  - Can also be automated with test drivers
- Testing includes perception of end users
  - Exercises the whole product
- Less thorough than conformance testing but wider in scope

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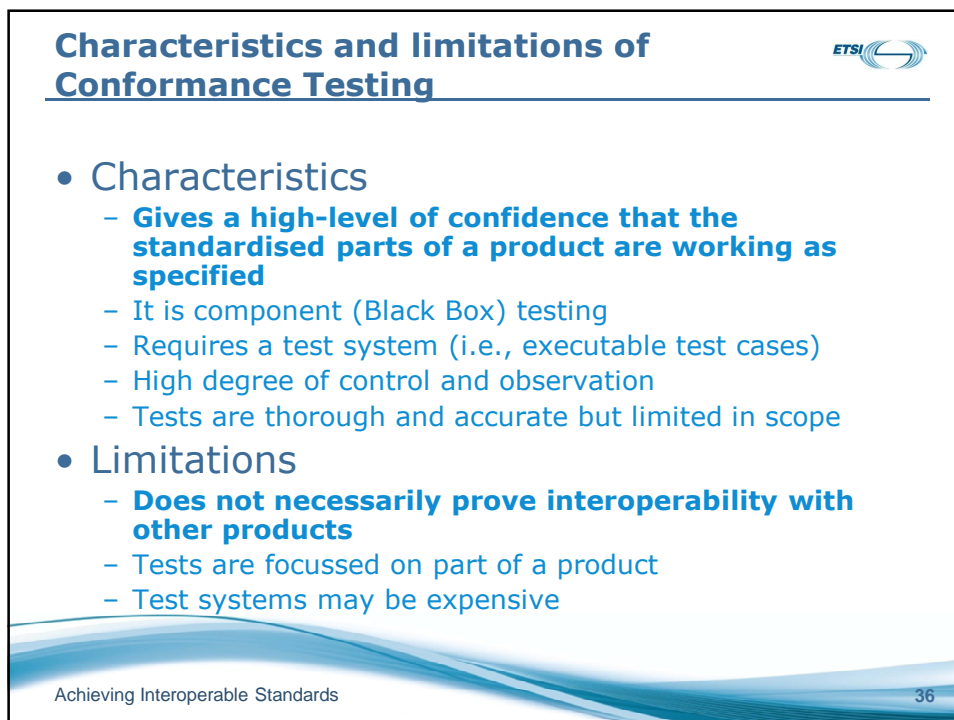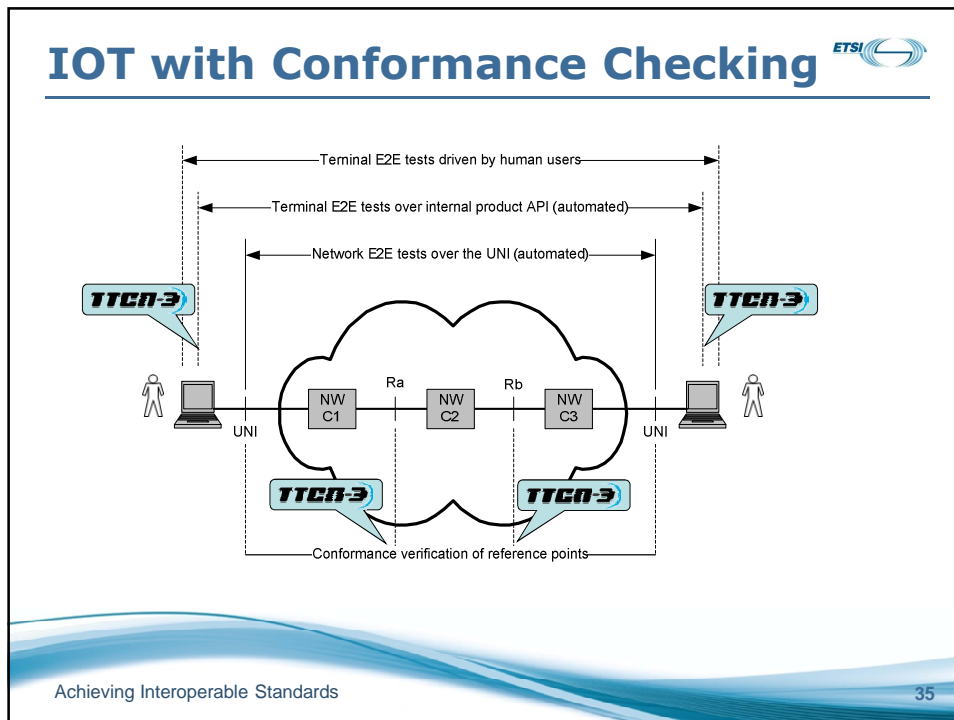
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Limitations of IOP Testing

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- **Does not prove that a product is conformant**
  - Products may still interoperate even though they are non-conformant
- Requires availability of suitable interfaces
- Limited ability to trigger error behaviour or unusual scenarios
  - Less controllability than in conformance testing
- Interoperability can be elusive!
  - Configuration may be simplified (not a fully operational system, e.g., no billing, no load)
- Does not prove interoperability with other products with which no testing has been done
  - 'A' may interoperate with 'B' and 'B' may interoperate with 'C'. Does not necessarily follow that 'A' will interoperate with 'C'

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Conformance and IOP Testing are Complementary

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- **As you move up a system stack the emphasis should change from conformance to interoperability testing**
- Lower layer protocols
  - Mainly conformance testing
- Middleware, enablers, infrastructure
  - Combination of conformance and interoperability testing
- Services, applications, systems
  - Emphasis on interoperability testing

- **Conformance testing should be a pre-requisite to interoperability testing**

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IOT with Conformance Checking

Terminal E2E tests driven by human users

Terminal E2E tests over internal product API (automated)

Network E2E tests over the UNI (automated)

TTCN-3   TTCN-3

UNI   NW C1   Ra   NW C2   Rb   NW C3   UNI

TTCN-3   TTCN-3

Conformance verification of reference points

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Characteristics and limitations of Conformance Testing

- Characteristics
  - **Gives a high-level of confidence that the standardised parts of a product are working as specified**
  - It is component (Black Box) testing
  - Requires a test system (i.e., executable test cases)
  - High degree of control and observation
  - Tests are thorough and accurate but limited in scope
- Limitations
  - **Does not necessarily prove interoperability with other products**
  - Tests are focussed on part of a product
  - Test systems may be expensive

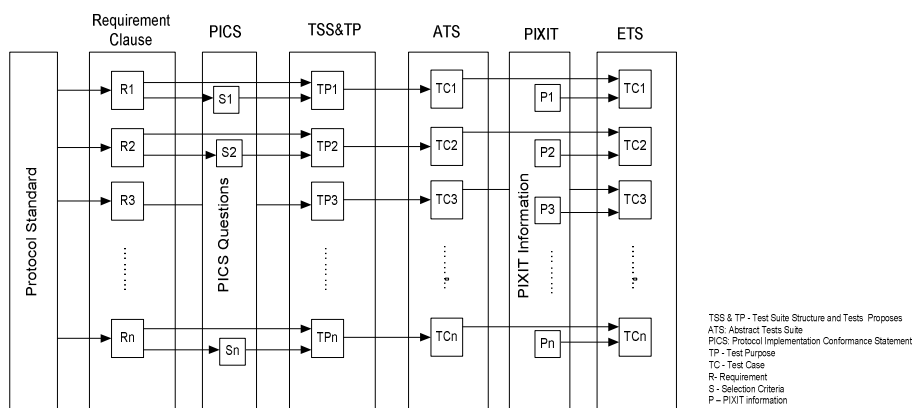Achieving Interoperable Standards   36

Conformance Testing Methodology Recommendations

ETSI

- **X.290 - General Concepts**
- **X.291 - Abstract Test Suite Specification**
- **X.292 - (Superceded by Z.140 series Recommendations)**
- **X.293 - Test Realization**
- **X.294 - Requirements on Test Laboratories and Clients**
- **X.295 - Protocol Profile Test Specification**
- **X.296 - Implementation Conformance Statements**
- **Z.140 - through Z.146 - Testing and Test Control Notation**

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Overview of Conformance Testing Procedures

ETSI

TSS & TP - Test Suite Structure and Tests Proposes
ATS: Abstract Tests Suite
PICS: Protocol Implementation Conformance Statement
TP - Test Purpose
TC - Test Case
R- Requirement
S - Selection Criteria
P – PIXIT information

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Conclusions

- An interconnected world demands interoperability
- Standards enable interoperability
- Validation and Testing are cornerstones in the development of ETSI standards
  - Validated standards mean interoperable standards
  - Interoperable standards facilitate interoperable products
- Plan for validation and testing (early)
  - Right mix of conformance and/or interop
- Synchronise testing activities with the development of the standard
  - Ensure feedback to the base standard
- Perform (regular) interoperability events
  - Synchronise with availability of products
- **For ETSI, TTCN-3 is the future of testing, today!**

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THANK YOU!

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