Approbation of new technologies and ETSI specifications in Europe using Plugtests service

-THE ETSI APPROACH

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Presentation Outline

- About ETSI
- What Interoperability Means to ETSI
- Is Interoperability Important?
- The ETSI Approach
  - Validation
  - Testing
- Conclusions

ETSI – Shaping the Future

- European standards organisation setting globally-applicable standards in ICT (Information Communication Technology)
  - Including fixed, mobile, radio, converged, broadcast and Internet technologies
- Independent, not-for-profit, created in 1988
  - Based in the South of France
- More than 760 Member companies and organisations from 63 countries and 5 continents
- Founder member of 3GPP A GLOBAL INITIATIVE
- Over 23,000 publications – available for free!
  - **http://www.etsi.org/WebSite/homepage.aspx**

Achieving Interoperable Standards

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
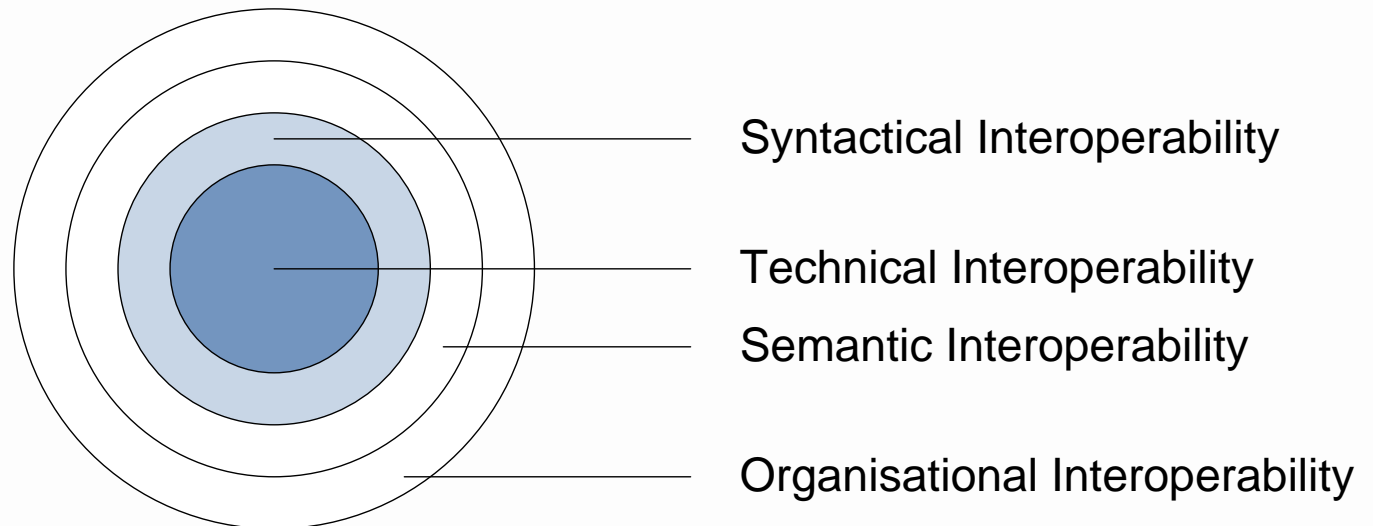 - Interoperability should be built-in!
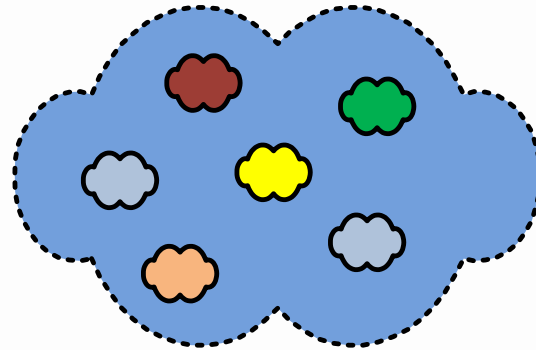
Is Interoperability Important?

- 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

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
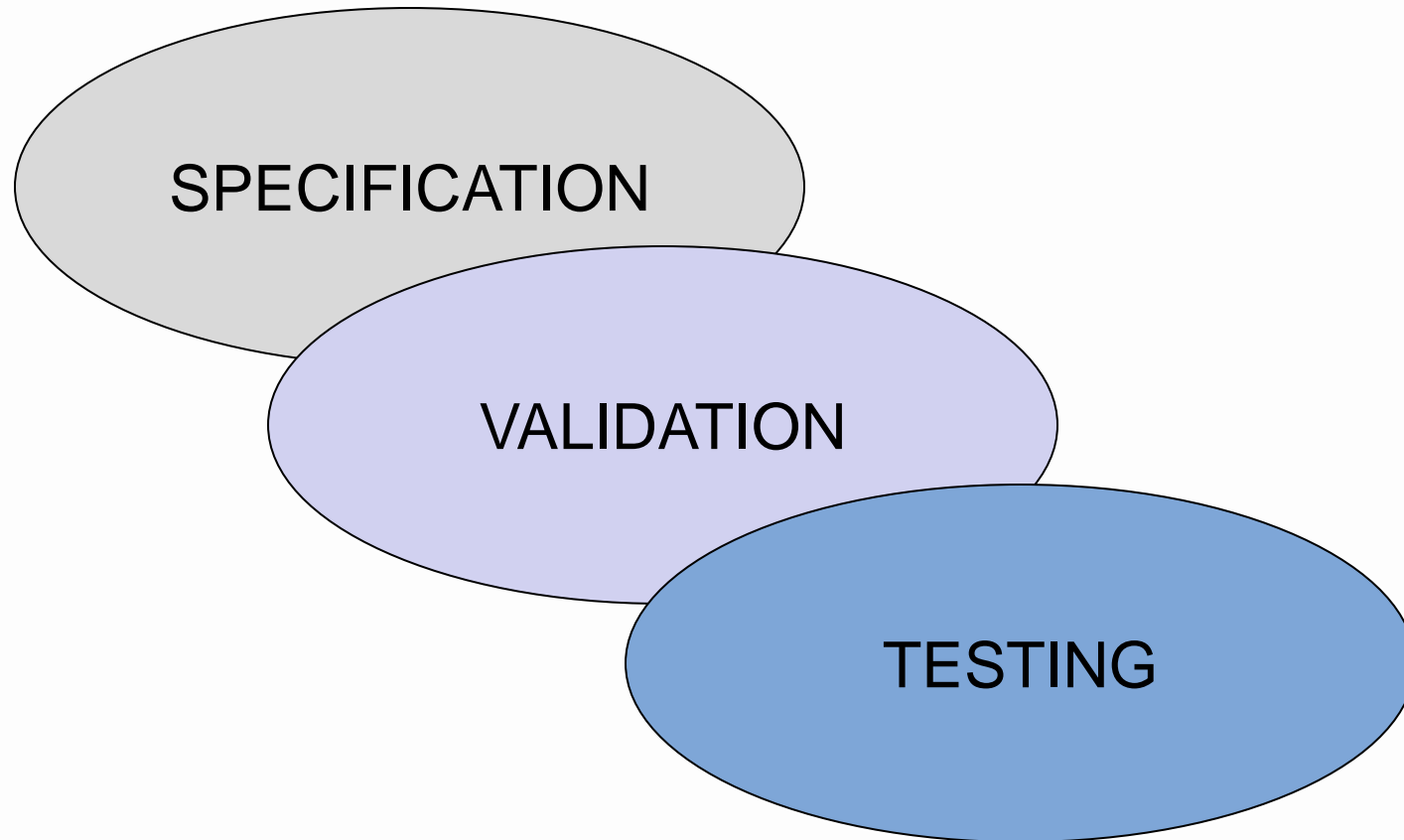
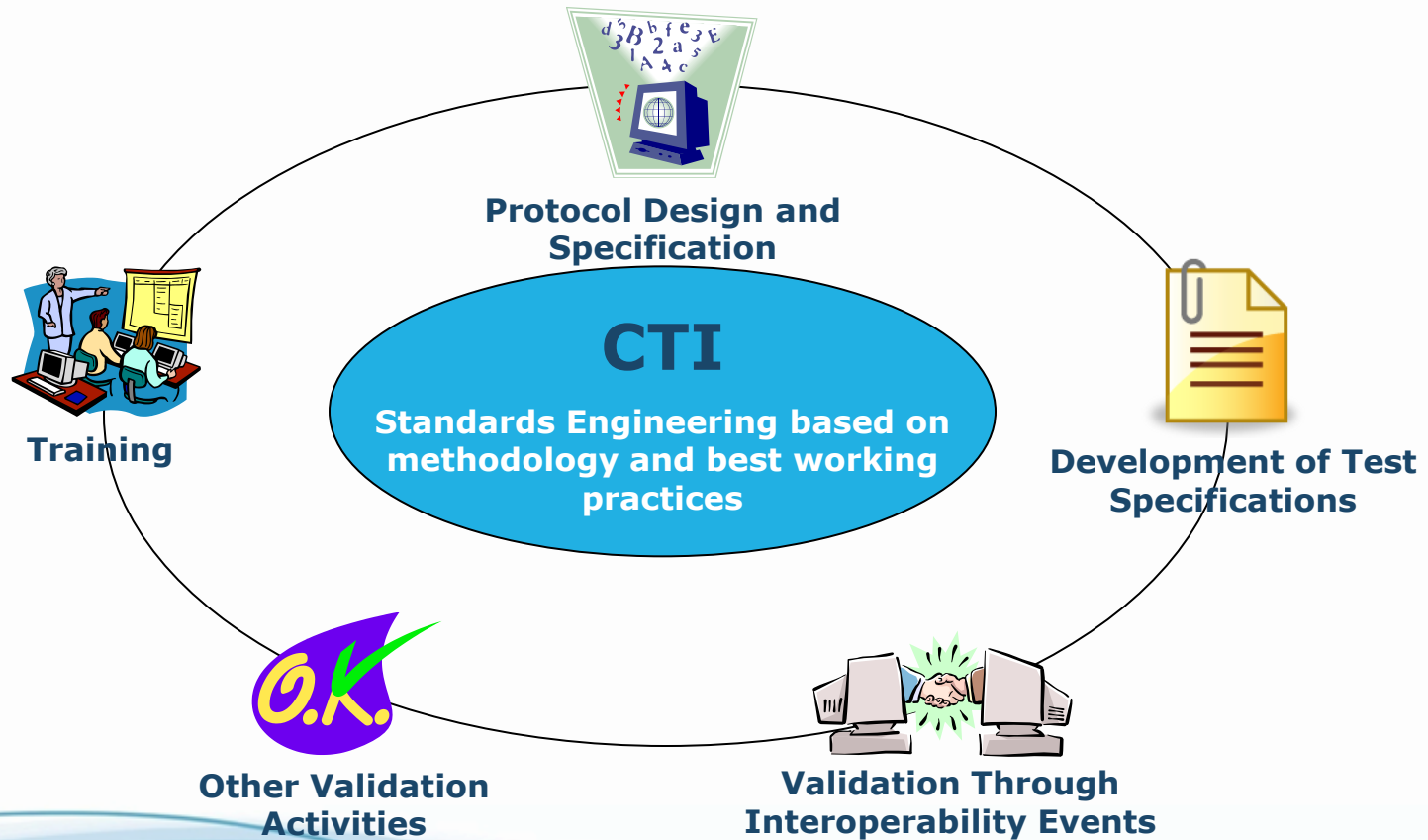# IOP and Complex Standards

- 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

Typical Causes of Non-interoperable Standards

- 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

- …

Poor Interoperability Can be Expensive

- 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!

The ETSI Approach

SPECIFICATION

VALIDATION

TESTING

Centre for Testing & Interoperability

Protocol Design and Specification

Training

CTI

Standards Engineering based on methodology and best working practices

Development of Test Specifications

Other Validation Activities

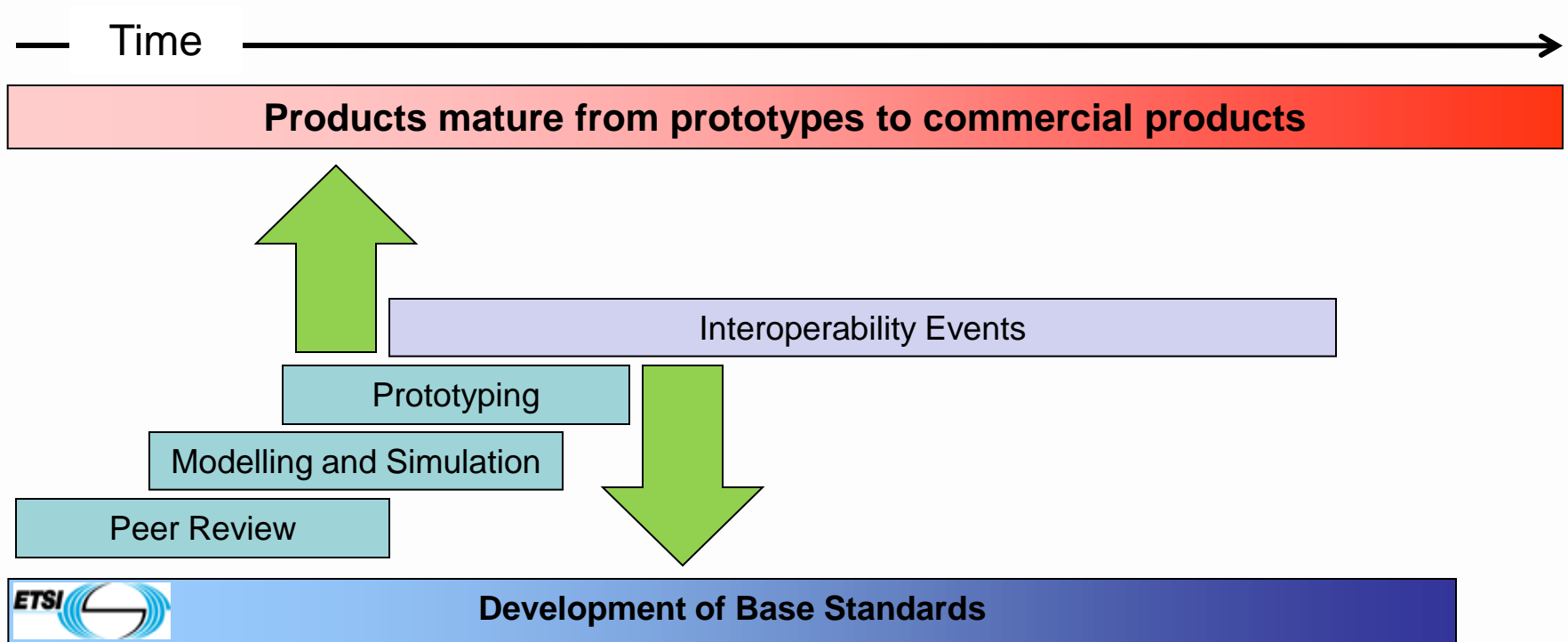Validation Through Interoperability Events

Why Validate Standards?

- Validation reveals problems/errors in
  - Standards and Products
- Validated standards give a higher chance of interoperable products
  - Assurance that they provide the right functionality
  - Gives manufacturers and operators confidence to implement and go to market
- Provides an opportunity to correct errors in a controlled manner
  - Decreases time to market
  - Late fixes in the product cycle are more expensive than early ones

Validation of Standards ...

Time →

Products mature from prototypes to commercial products

Interoperability Events

Prototyping

Modelling and Simulation

Peer Review

Development of Base Standards

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

Series of IOP Events

Maturity of the
Standard

Event 1   Event 2   ....   Event nn
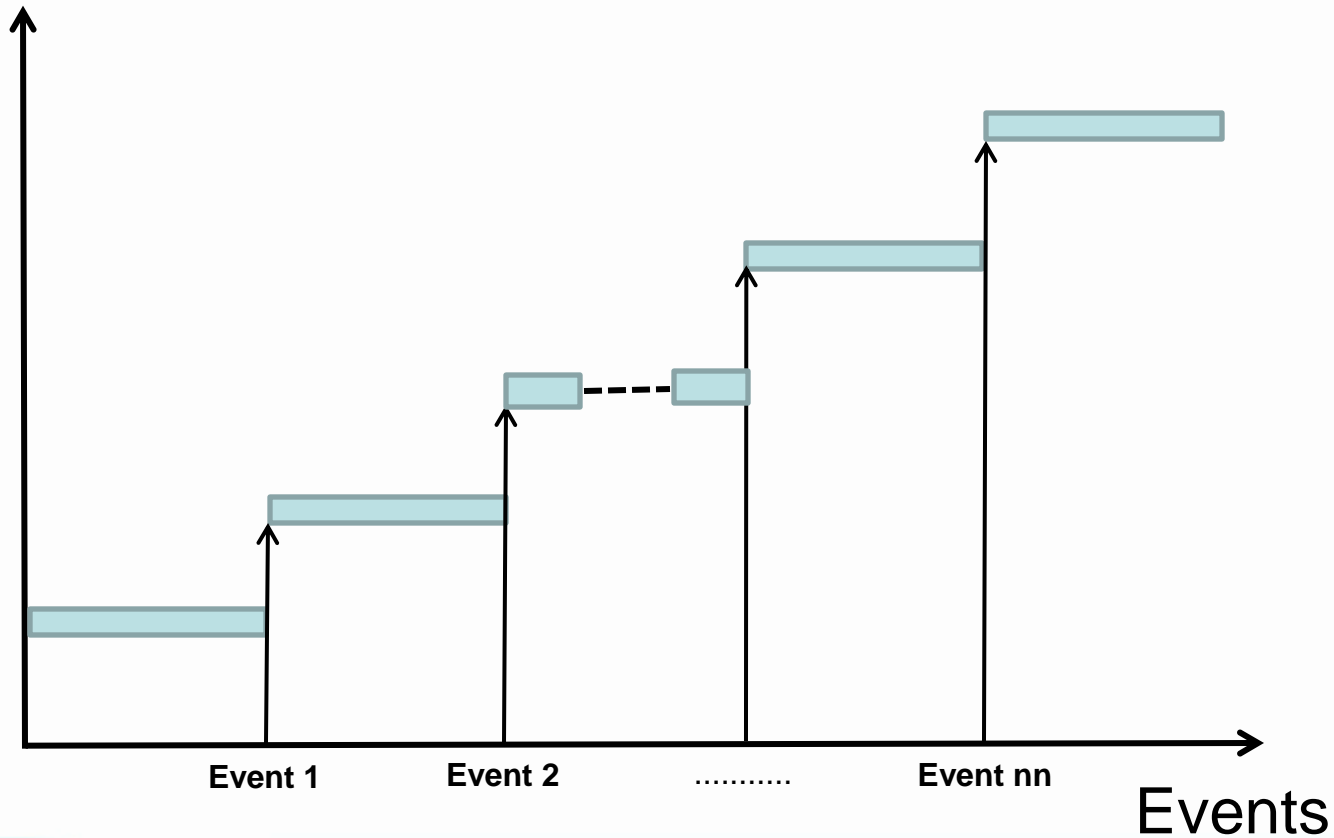
Events

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.
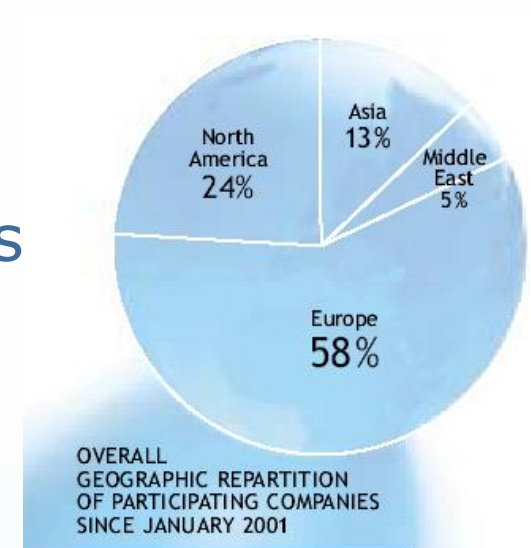
... or this (Car2Car Interop)

Typical ETSI

❑ **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)**

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

Asia 13%

North America 24%

Middle East 5%

Europe 58%

OVERALL GEOGRAPHIC REPARTITION OF PARTICIPATING COMPANIES SINCE JANUARY 2001

Plugtest Test Schedule

- Shows who is testing with whom, when, and where
- Each team tests at least once against every other team
- At least one test engineer is accompanying each scheduled product and knows how to operate it
- Ad-hoc test sessions can be used for multiple purposes
  - Repeat or complete previous test sessions and revise results, e.g., due to equipment upgrade, time limitations
  - Perform any kinds tests with anybody in private (no recording of results) – such sessions have to be organized by participants

Interoperability Test Sessions

- The objective of each test session is to execute as many tests from the test specification as possible

- Test session participants must work in a *very* disciplined manner

  - Test execution should focus on test execution and observation, not on debugging of equipment

Test Result Reporting

- The results of each interoperability test session are recorded in a result form via the online ETSI TSR tool
  - Tool is accessible via event wiki pages
  - Prior to each test session one person must be selected by participating teams to be the test session secretary
    Note: ETSI can help by appointing a neutral test session secretary when small teams test against each other
  - After each test execution the interoperability result must be recorded by the secretary in the form
  - At the end of each test session all results must be agreed among all participants and then submitted

About Test Result Reporting

- An interoperability result is based on *all* equipment involved in a test

- The TSR (Test Event Reporting Tool) is used for recording interoperability test results and conformance verdicts

- The *detailed conformance analysis* (i.e., checking traffic against conformance criteria) and assigning of verdicts is to be done *during test session wrap up and post-processing*

About Test Session Interoperability Results

- Results shall only be assigned based on *end user observations* made while operating products
  - <u>OK</u>: All test sequence steps of a given test description were observed as specified
  - <u>N</u>ot <u>O</u>k*<step>*: A test sequence step was not observed as specified
  - <u>N</u>ot <u>A</u>pplicable: The test could not be executed due to missing feature support by one of the products or a limitation by the event test infrastructure
  - <u>O</u>ut of <u>T</u>ime: The test could not be executed due to time limitations
  - NO and NA results should be clarified with notes without *referring to specific products or companies* in the notes of any test
- Interoperability results shall not be based on analysis of captured traces

Summary of Test Session Handling

1. Assign a test session report secretary from participating teams or ask for neutral test secretary in case of small testing teams

2. Secretary uses web tool to select products and test configuration

3. Execute first (or next) test in the generated report form

4. Secretary records test result (OK or NO*<step>* or NA) and possibly notes in report form

5. Repeat steps 3 & 4 until either test session ends or all applicable tests have been executed

6. All test session results are agreed by participating teams and marked as agreed by the secretary

7. Secretary submits test session report form

Example: 3rd IMS Plugtest 2009, Lannion

- Venue opened for ad-hoc testing Fri Oct 16th
  - Presence of all participating vendors was mandatory
  - Installation of shipped equipment
  - Final connectivity check (including also remote equipment)
  - Set up of exhibition booths
- Event opening and recorded tests started Sun 18th to Thu Oct 22nd
  - Included further possibilities to perform ad-hoc testing
  - Multiple test sessions happened in parallel
  - Each test session lasted half a day and included analysis of selected IOP traces
- Exhibition day in common area Mon Oct 19th
- Joint final event wrap up Fri 23rd in the morning

3rd IMS Plugtest – Participants

- 8 IMS Core Network Vendors
  - ACME Packet
  - Ericsson
  - HOTARU
  - Iskratel
  - Nexcom
  - NSN
  - Starent
  - Thomson
- Several IMS User Equipments to trigger test events

3rd IMS Pluatest – Schedule

PLUGTESTS INTEROP EVENTS

ETSI IMS Plugtest 3
Test Session Schedule

Version 9 - Thursday 22 Oct

	Test Area / Match Station				Sitout/Adhoc
	1	**2**	**3**	**4**	
Sun Morning	Ericsson NSN	Hotaru Iskratel	Thomson Starent	-	-
Sun Afternoon	Thomson Ericsson	Iskratel NSN	Starent Hotaru	-	-
Mon Morning	NSN Thomson	Iskratel Starent	Hotaru Acme	Ericsson Nexcom	-
Mon Afternoon	Nexcom NSN	Starent Acme	Hotaru Thomson	Iskratel Ericsson	-
Tue Morning	Acme NSN	Nexcom Hotaru	Ericsson Starent	Thomson Iskratel	-
Tue Afternoon	NSN Starent	Iskratel Acme	Hotaru Ericsson	Nexcom Thomson	-
Wed Morning	NSN Hotaru	Nexcom Iskratel	Ericsson Acme	Starent/Thomson Iskratel PSTN	Ericsson NTT Ad-hoc
Wed Afternoon	Iskratel Iskratel PSTN	Starent Nexcom	Ericsson Ericsson PSTN	Acme Thomson	Hotaru, NTT
	NSN/Iskratel Iskratel PSTN		Ericsson/Thomson Iskratel PSTN	-	Acme, Hotaru, NTT
Thu Morning	Ericsson NSN (AS tests)		Iskratel NTT Ad-hoc	Acme Thomson Ad-hoc	
		Iskratel Hutaro	Thomson NTT Ad-hoc	Acme Nexcom	Starent Thomson Ad-hoc
Thu Afternoon	NSN Thomson	Ericsson Starent (presence)		Nexcom Iskratel	
	NSN Starent	Ericsson/Iskratel Iskratel PSTN		Nexcom NTT Ad-hoc	

Note: In each test session the company listed first acts as IMS A for the first half of the time slot and as IMS B the other half.
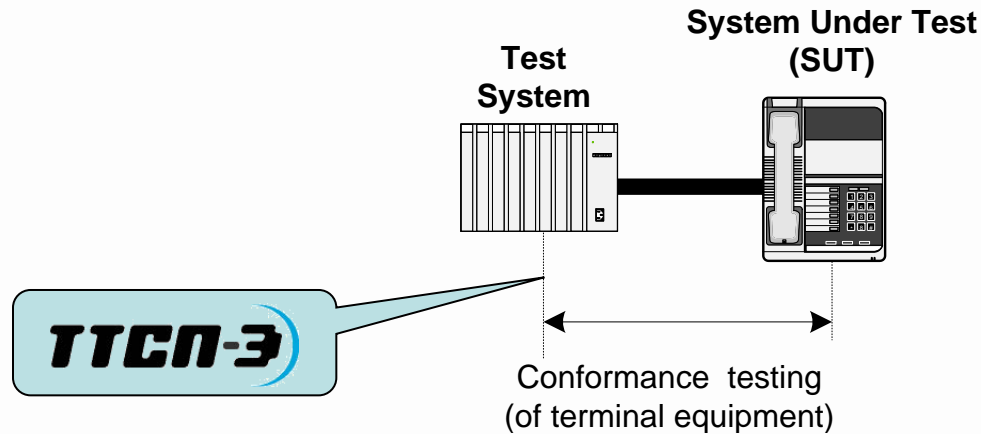
3rd IMS Plugtest – Result Summary

- 56 test sessions
- 495 of 2805 potential IMS NNI tests were executed
  - Overall percentage of IOP success 89%
- 81 of 145 PSTN IMS tests were executed
  - Overall percentage of IOP success 87.7%
- Satisfaction survey indicates 4.6/5
- 100 % of participants indicate they would like a next event

3rd IMS Plugtest – Feedback

- Comments from Participants:
- Clarify Standards, talk with people having same IMS problems.
- Uniforming understanding of standards.
- Many company producing IMS system came to this event. It was a good opportunity to test with various implementations.
- Description and precision of test were really good. It was easy to begin test.
- Well organised, enough time to test. Everything was better than at other test event.
- Opportunity to pair vendors and to tune products getting a quick result on interworking and conformance.

Achieving Interoperable Standards

... and Testing

Certification
(not done by ETSI)

Time

Products mature from prototypes to commercial products

Conformance Testing

Interoperability Events

Prototyping

Modelling and Simulation

Peer Review | Development of Test Specs (Conformance & Interop)

Development of Base Standards
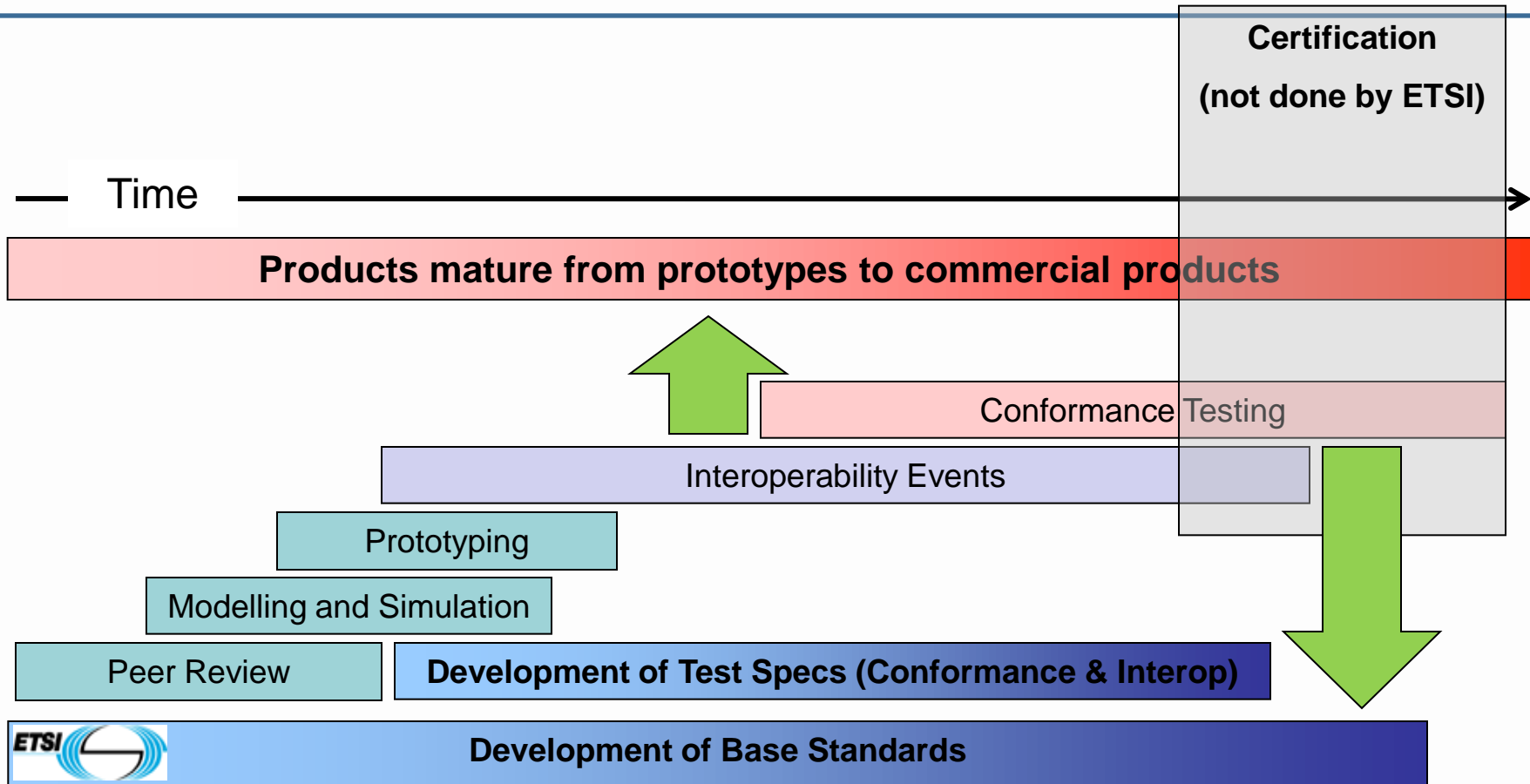
Conformance Testing

Tests a specific (part of a) product for compliance to requirements in a Base Standard

Characteristics of Conformance Testing

- **Gives a high-level of confidence that the standardised parts of a product are working as specified**
- It is component (Black Box) testing
  - Usually *One requirement -> One test*
- Requires a test system (i.e., executable test cases)
  - Test execution is automated and repeatable
  - Tests in controlled conditions
- High degree of control and observation
  - Can provoke and test non-normal (but legitimate) scenarios
  - Can explicitly test error behaviour (robustness)
- Tests are thorough and accurate but limited in scope
  - At level of detailed protocol messages, service primitives, or procedure calls

Scope of Conformance Testing

Scope of Conformance Testing

Conformant products may still not interoperate!

Conformance to Requirements

Performance

Interoperability

Robustness

Performance not usually addressed – requirements not standardised and testing is under ideal conditions

Can simulate error conditions – but only standardised robustness requirements addressed

Limitations of Conformance Testing
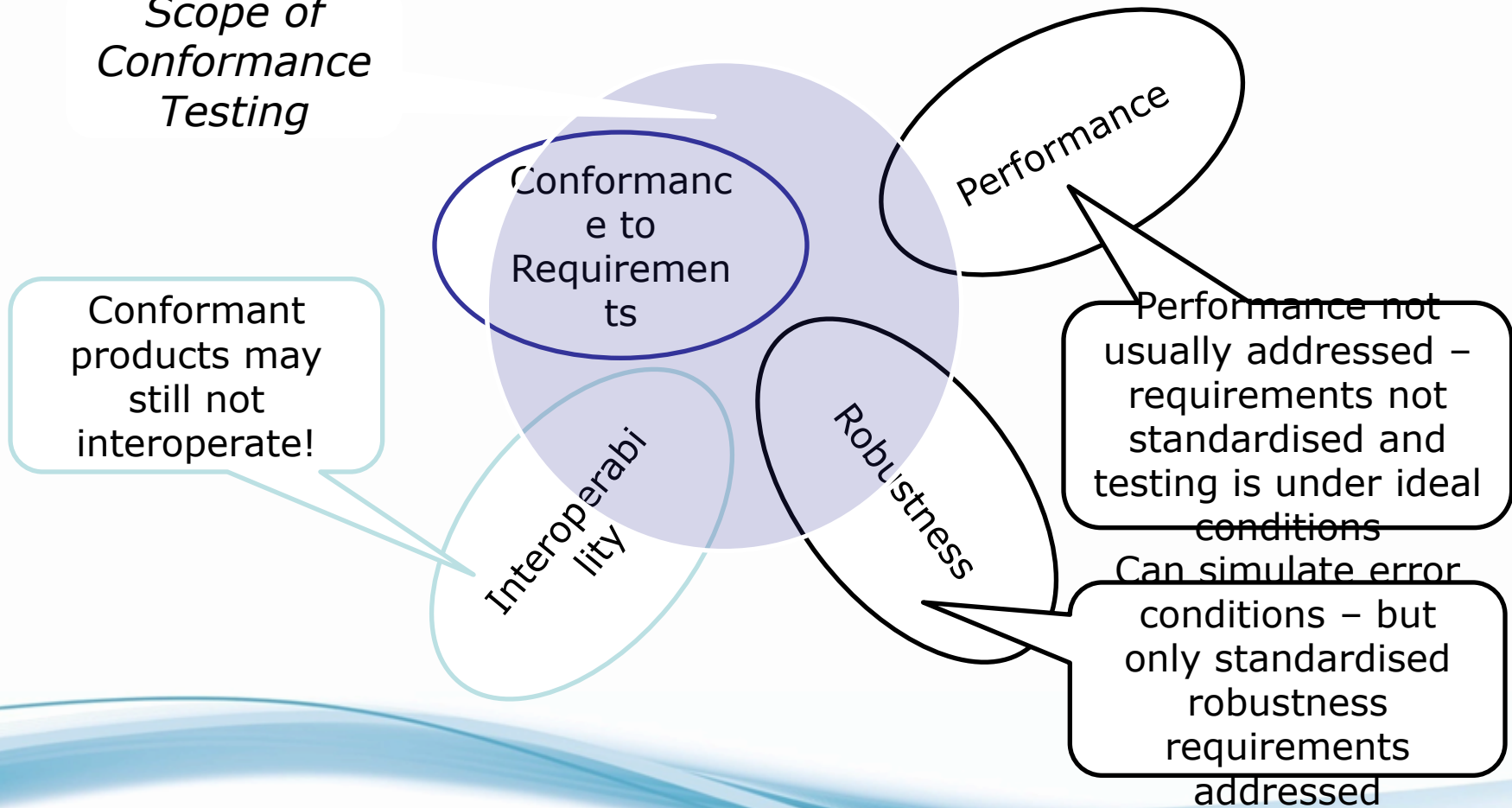
- **Does not necessarily prove interoperability with other products**
- Tests are focussed on part of a product
  - A system is often greater than the sum of its parts!
  - Does not test the user's 'perception' of the system
  - Standardised conformance tests do not include proprietary features
- Test systems may be expensive
  - But cost may be relative to size of the market
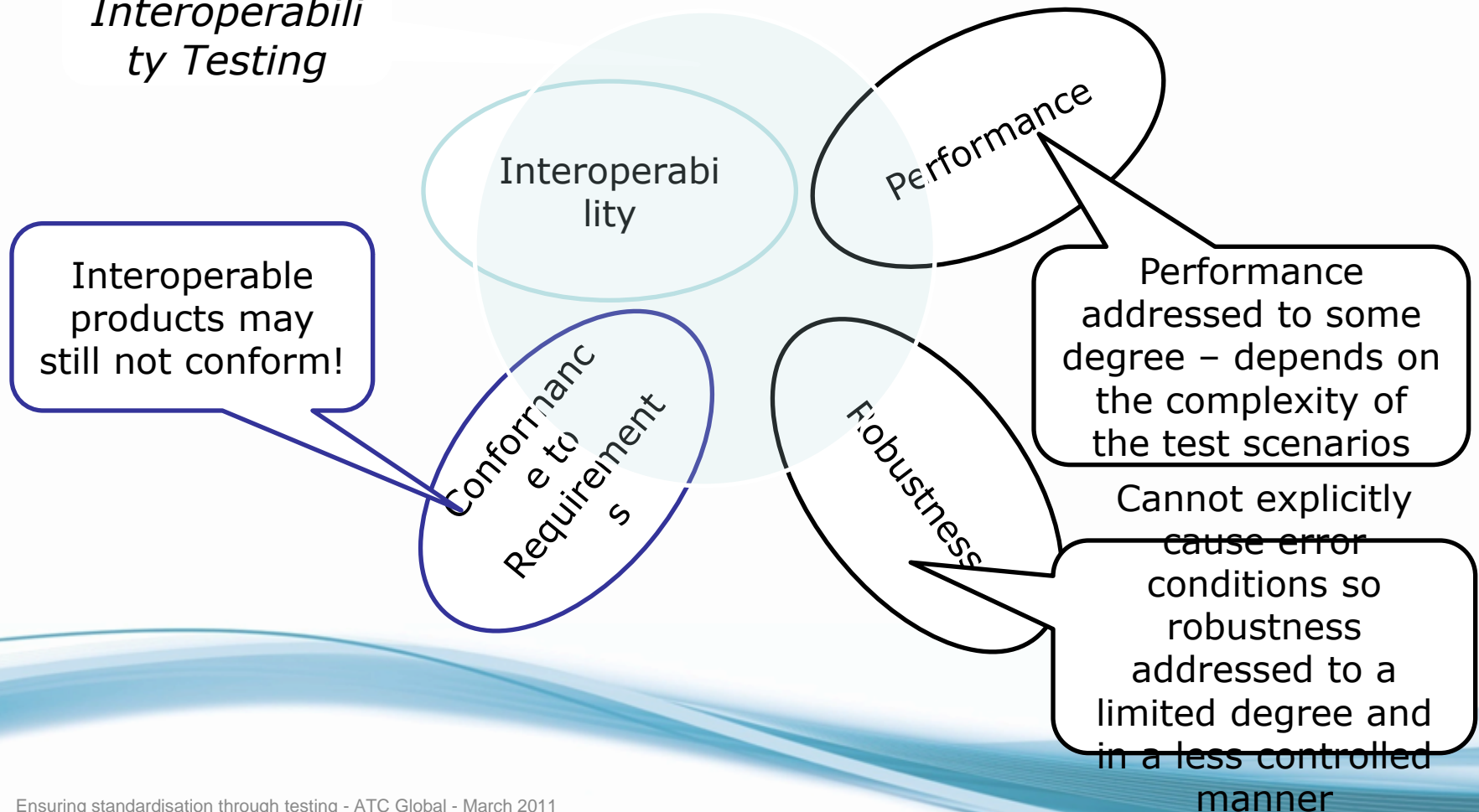
Interoperability Testing

Equipment Under Test

Equipment Under Test

TTCN-3

TTCN-3

Interoperability testing
(of terninal equipment)
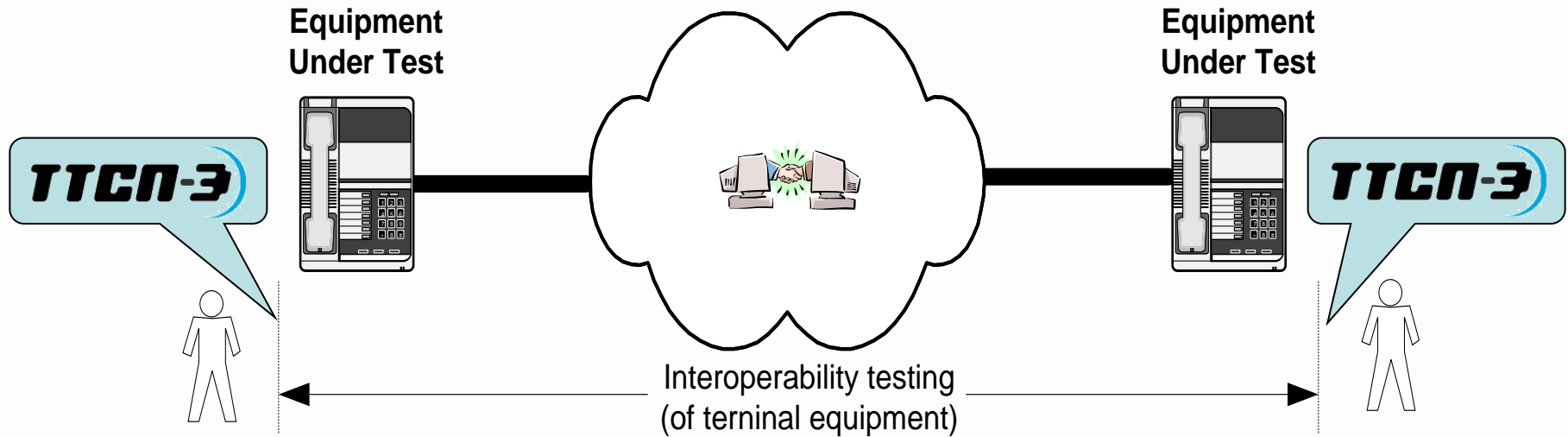
Tests end-to-end functionality between a collection of products

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

Scope of Interoperability Testing

Scope of Interoperability Testing

Interoperability

Performance

Conformance to Requirements

Robustness

Interoperable products may still not conform!

Performance addressed to some degree – depends on the complexity of the test scenarios

Cannot explicitly cause error conditions so robustness addressed to a limited degree and in a less controlled manner

Limitations of IOP Testing

- **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'

Achieving Interoperable Standards

# Conformance and IOP Testing are Complementary

- **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**

Achieving Interoperable Standards

IOT with Conformance Checking
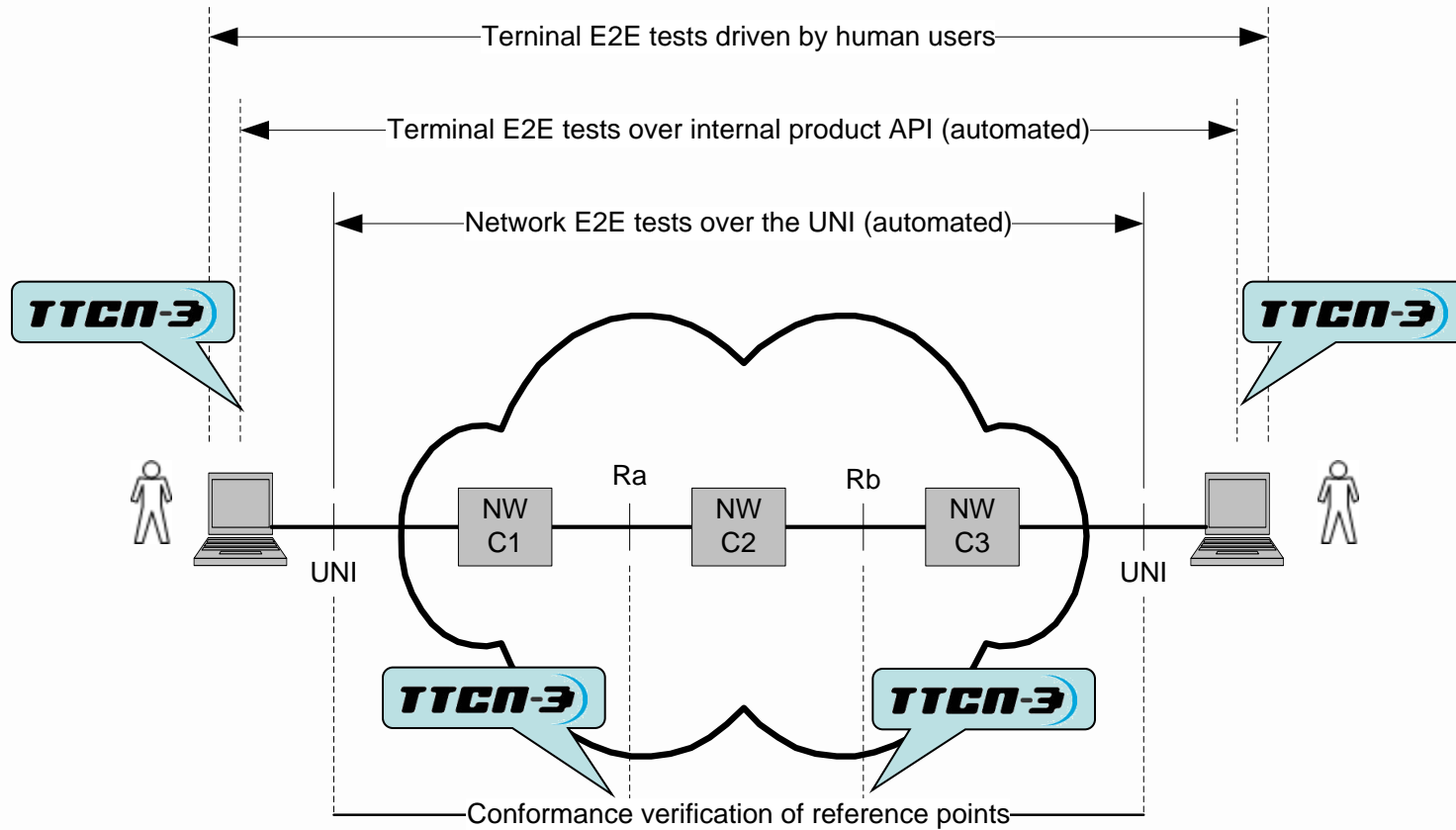
WiMAX Interoperability Testbed

Conclusions
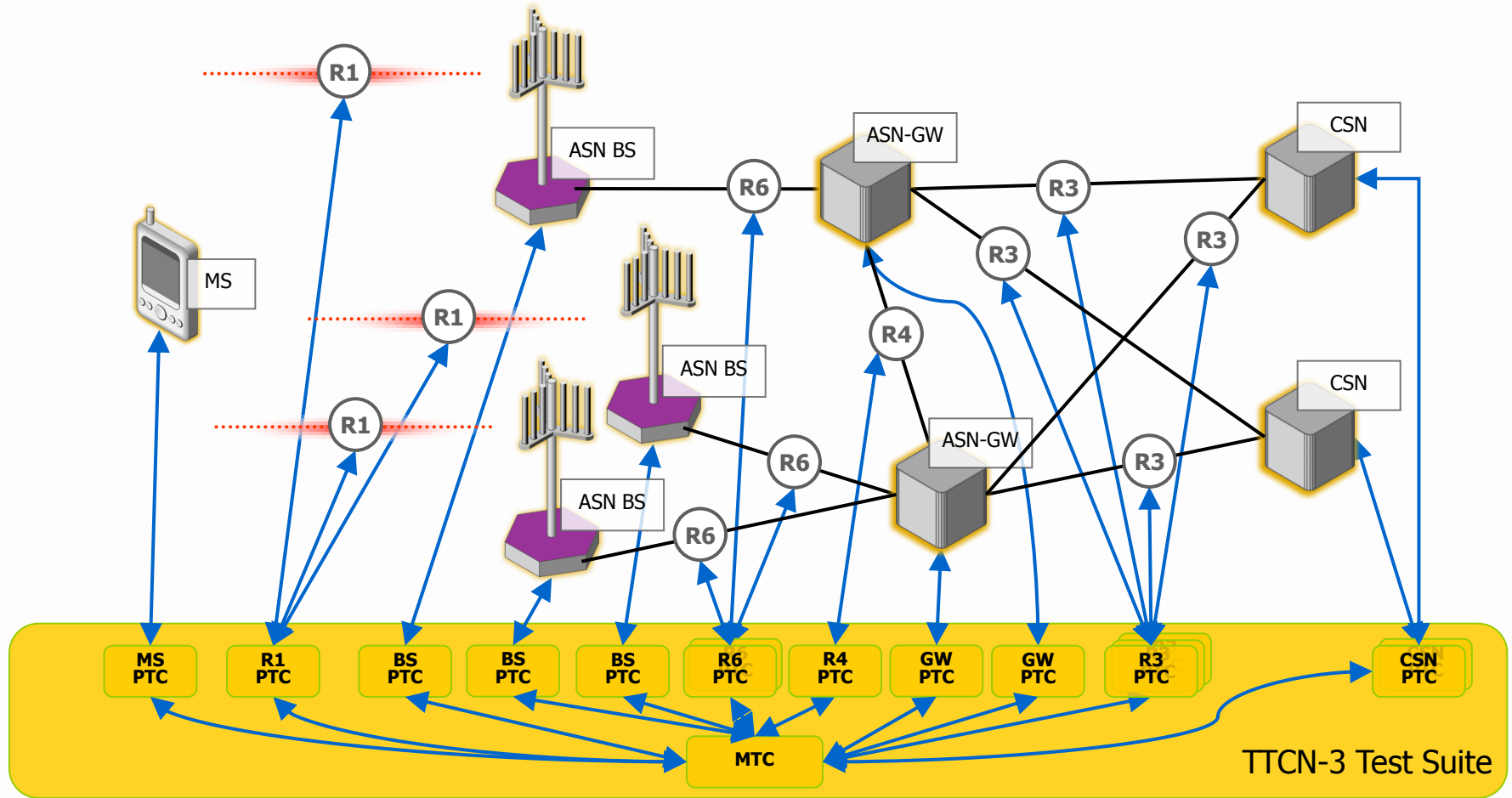
- An interconnected world demands interoperability
- Standards enable interoperability
- Validation and Testing are cornerstones in the development of ETSI standards
  - Validated standards mean interoperable standards
  - Interoperable standards facilitate interoperable products
- Plan for validation 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

THANK YOU!