Achieving Interoperability -
the ETSI Approach

EC eInfrastructure Concertation Days

Sophia Antipolis

December 6, 2007

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December 2007

Achieving Interoperability - the ETSI Approach

Standards for Business

ETSI

World Class Standards

ETSI White Paper No. 3
Achieving Technical Interoperability - the ETSI Approach

Download from:
http://www.etsi.org/WebSite/NewsAndEvents/whitepapers.aspx

Why we are here – Interoperability!

❑ **IOP is one of the ultimate aims of ICT standardisation**

❑ **IOP is the red thread running through the entire standards development process, it's not an isolated issue**

  ➢ **Not something to be somehow fixed at the end**

❑ **ETSI philosophy**

  ➢ **Interoperability is built-in!**

Poor Interoperability is Expensive

❑ **In the past, it meant**

  ➢ **Bad publicity in trade magazines**

  ➢ **Embarrassment for the manufacturer**

  ➢ **Annoyance of the end customer**

❑ **Today, interoperability failures in the field means**

  ➢ **Front page headlines in the Financial Times**

  ➢ **Fall in manufacturers stock price**

  ➢ **Loss of investor confidence**

  ➢ **Unrecoverable damage to brand name**

  ➢ **Irretrievable loss of customers**

❑ **We can no longer afford to get it wrong!**

# Different 'levels' of Interoperability

- ❑ **Many definitions but in the context of ETSI/3GPP interoperability is generally defined as**
  - ➢ *"the ability of two or more systems or components to exchange data and use information"*

Technical

Syntactic

Semantic

Organisational

Syntactical Interoperability

Technical Interoperability

Semantic Interoperability
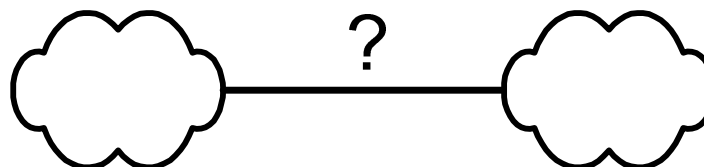
Organisational Interoperability
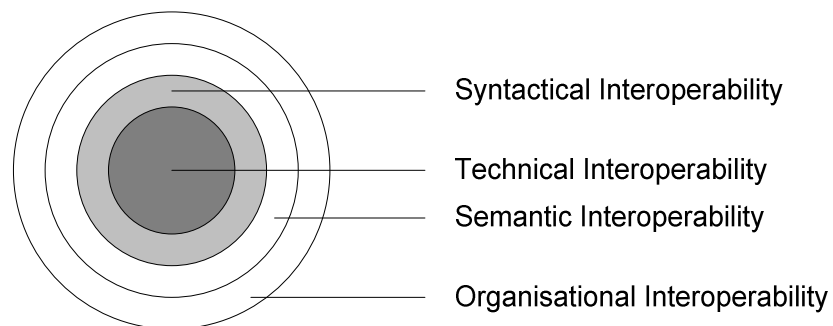
Typical symptoms of non-interoperability
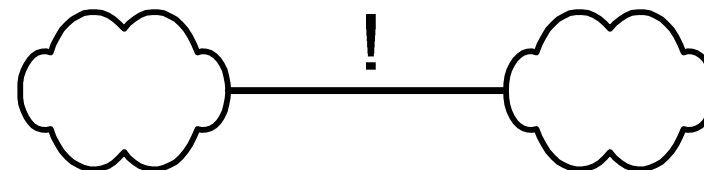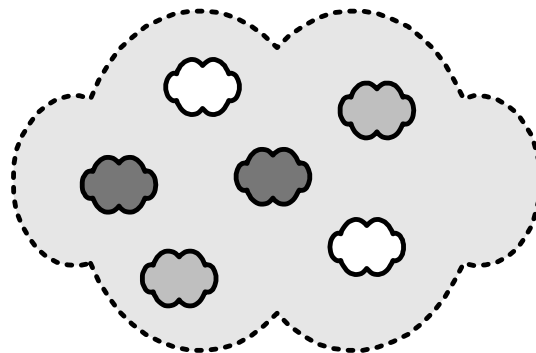
Where are you?
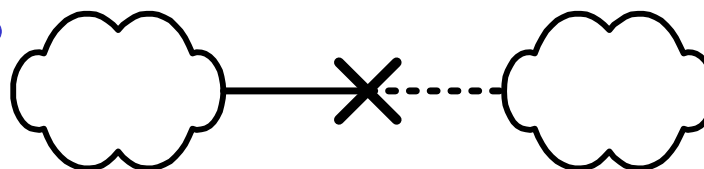
What did you say?

?

Why did you do that?

!

Interoperability and complex systems

❑ **ICT standards increasingly specified by 'islands of standards'**

  ➢ **whole system not specified in detail**

❑ **Multiple sources of standards for one system**

  ➢ **i.e., from several different SDOs**

  ➢ **e.g., NGN is: TISPAN, 3GPP, IETF, ITU-T etc.**

❑ **Multiple specifications (docs) for one protocol**

  ➢ **e.g., IPv6 (many RFCs)**

Root causes of standards failing to provide interoperability

- ❑ **Lack of clarity, requirements not well identified**

- ❑ **Inadequately defined interfaces (reference points)**

- ❑ **Requirements are missing (assumed)**

- ❑ **Poor handling of options**

- ❑ **Poor handling of erroneous behaviour**

- ❑ **Lack of clear system overview**

- ❑ **Poor maintenance**

- ❑ **Using standards beyond their original purpose**

- ❑ **Varying quality of standards (e.g., in multi-SDO situation)**

- ❑ **Inadequate test specifications**

- ❑ **Lack of attention to testability**

Building interoperability into ETSI standards

❑ **Manage for interoperability!**

❑ **Specify for interoperability!**

❑ **Validate for interoperability!**

❑ **Test for interoperability!**

❑ **Maintain for interoperability!**

Management   Specification   Validation   Testing   Maintenance
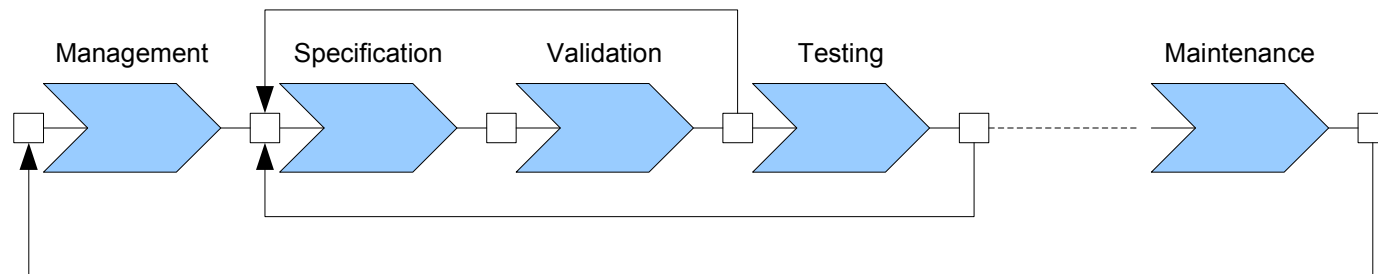
Manage for interoperability!

❑ **Professional project management and overview**
  ➢ **Essential in a multi-organisation, multi-specification standards project**

❑ **ETSI has teams of dedicated Technical Officers to support ETSI TBs, and provide project management**
  ➢ **ETSI Standardization Projects (ESP)**
    • **Technical Body Support**
    • **Editing and Document Management**

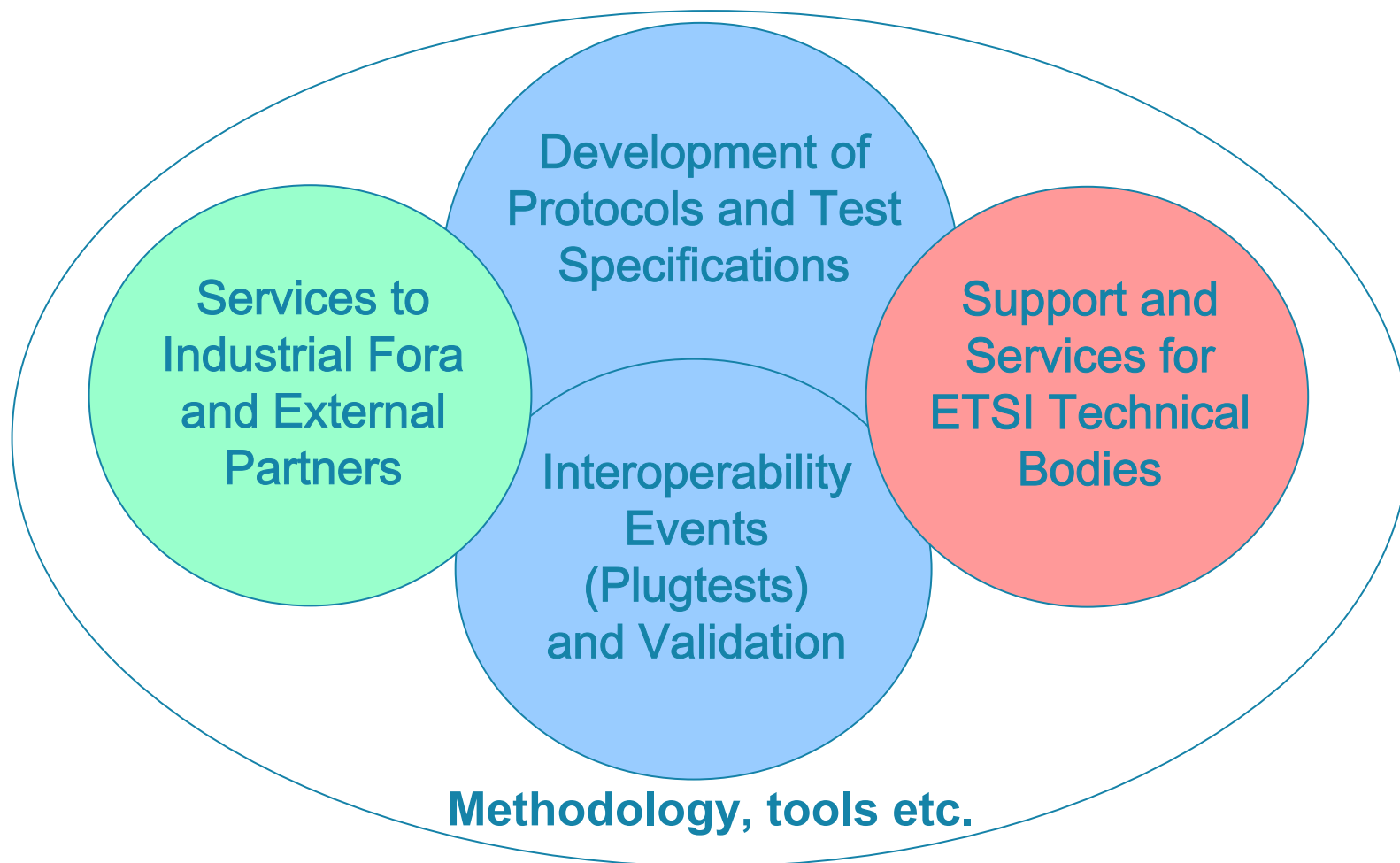❑ **ETSI has unique resources dedicated to improving the quality of standards and interoperability …**

ETSI initiatives and support for interoperability

❑ **Board Champion for Interoperability**
   ➢ **Co-ordination for interoperability issues**
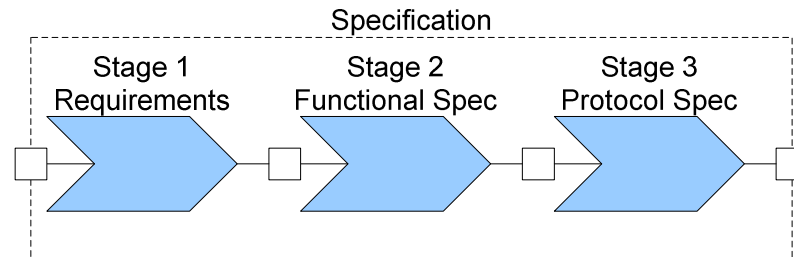   ➢ **Chair of OCG-IOP ad hoc group**

❑ **Technical Committee MTS**
   ➢ **Methods for Testing and Specification**
   ➢ **Standardised frameworks and methodologies**
   ➢ **Making Better Standards:** http://portal.etsi.org/mbs

❑ **Centre for Testing and Interoperability (CTI)**
   ➢ **Direct support to ETSI TBs**
   ➢ **Commercial activities with Fora and other external bodies**
   ➢ **Services include**
      • **Development of protocols and test specifications**
      • **Validation activities**
      • **Interoperability events (e.g., Plugtests™ service)**
      • **Training**
      • **Etc.**

Centre for Testing and Interoperability (CTI)

Development of Protocols and Test Specifications

Services to Industrial Fora and External Partners

Support and Services for ETSI Technical Bodies

Interoperability Events (Plugtests) and Validation

Methodology, tools etc.

Specify for interoperability!

Specification

| Stage 1 Requirements | Stage 2 Functional Spec | Stage 3 Protocol Spec |

❑ **ITU-T I.130 3-stage model for protocol specification**
  ➢ **Used extensively in 3GPP**
❑ **1: High-level requirements on the system**
❑ **2: Functional architecture and Information Flows**
  ➢ **Standardise interoperable interfaces, not internal behaviour**
❑ **3: Detailed protocol specification**
  ➢ **Use appropriate techniques**
    • **text, UML, SDL, ASN.1, XML etc.**
  ➢ **Clearly identify requirements, options and dependencies**
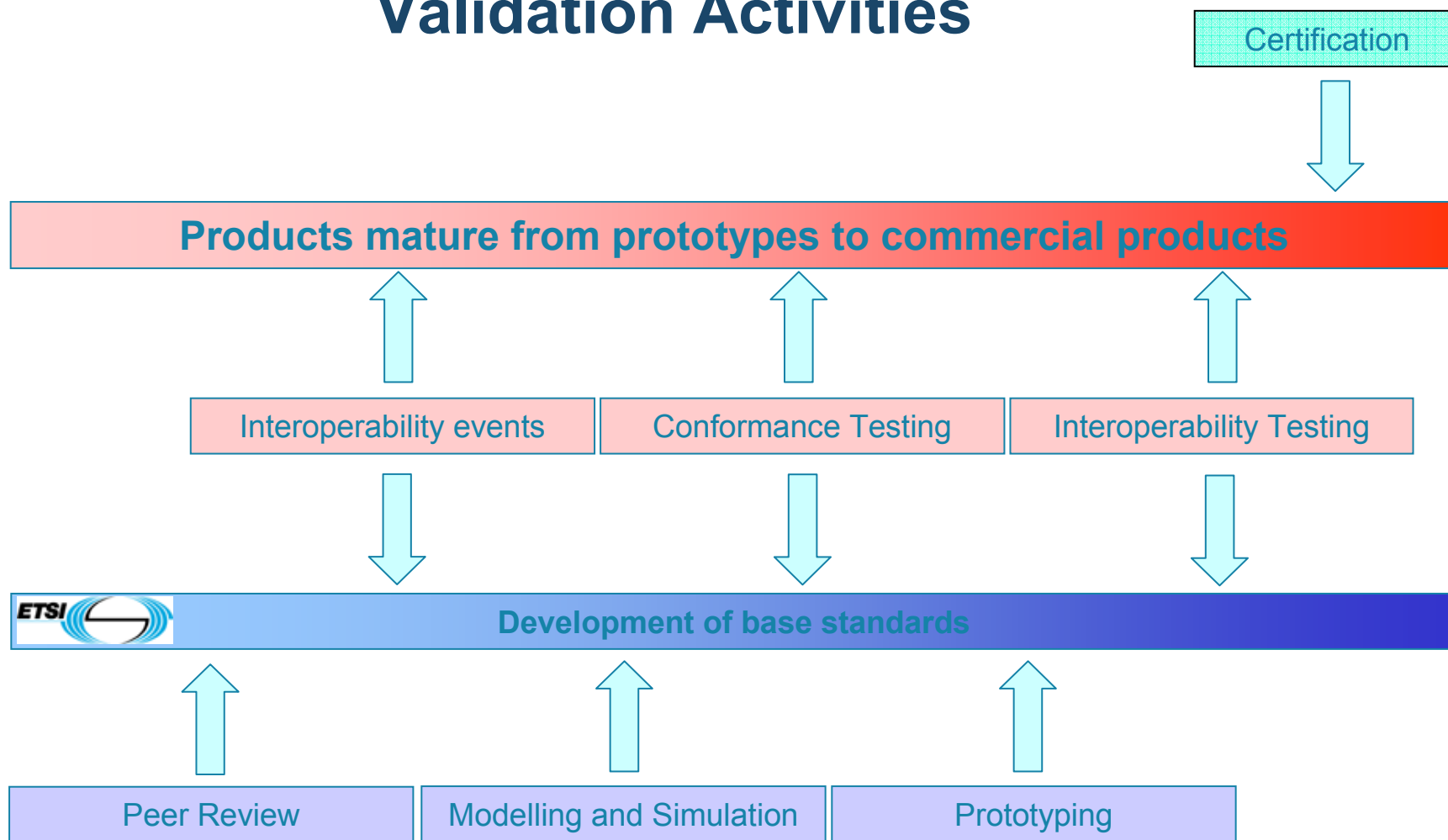
Validate for interoperability!

Validation

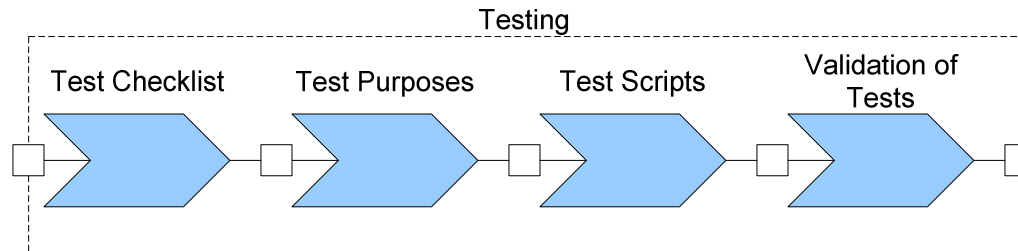| IOP Reviews | Modelling | Prototyping | Plugtests |
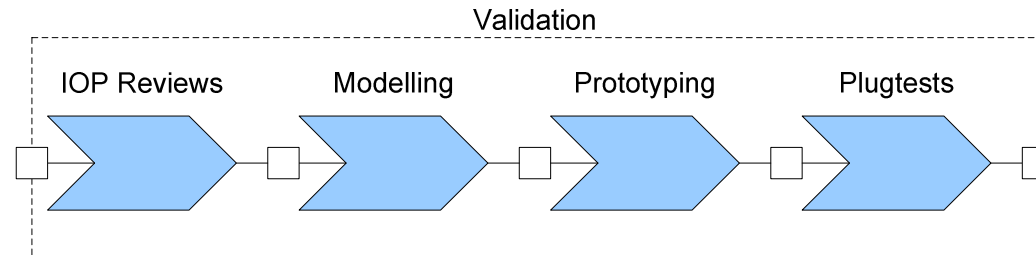
❑ **Plan for validation!**

➤ **Validation through technical reviews and simulation**

➤ **Validation through interoperability events**

➤ **Validation through test specification development**

➤ **Validation through testing**

❑ **Ensure validation results are fed-back into the standard**
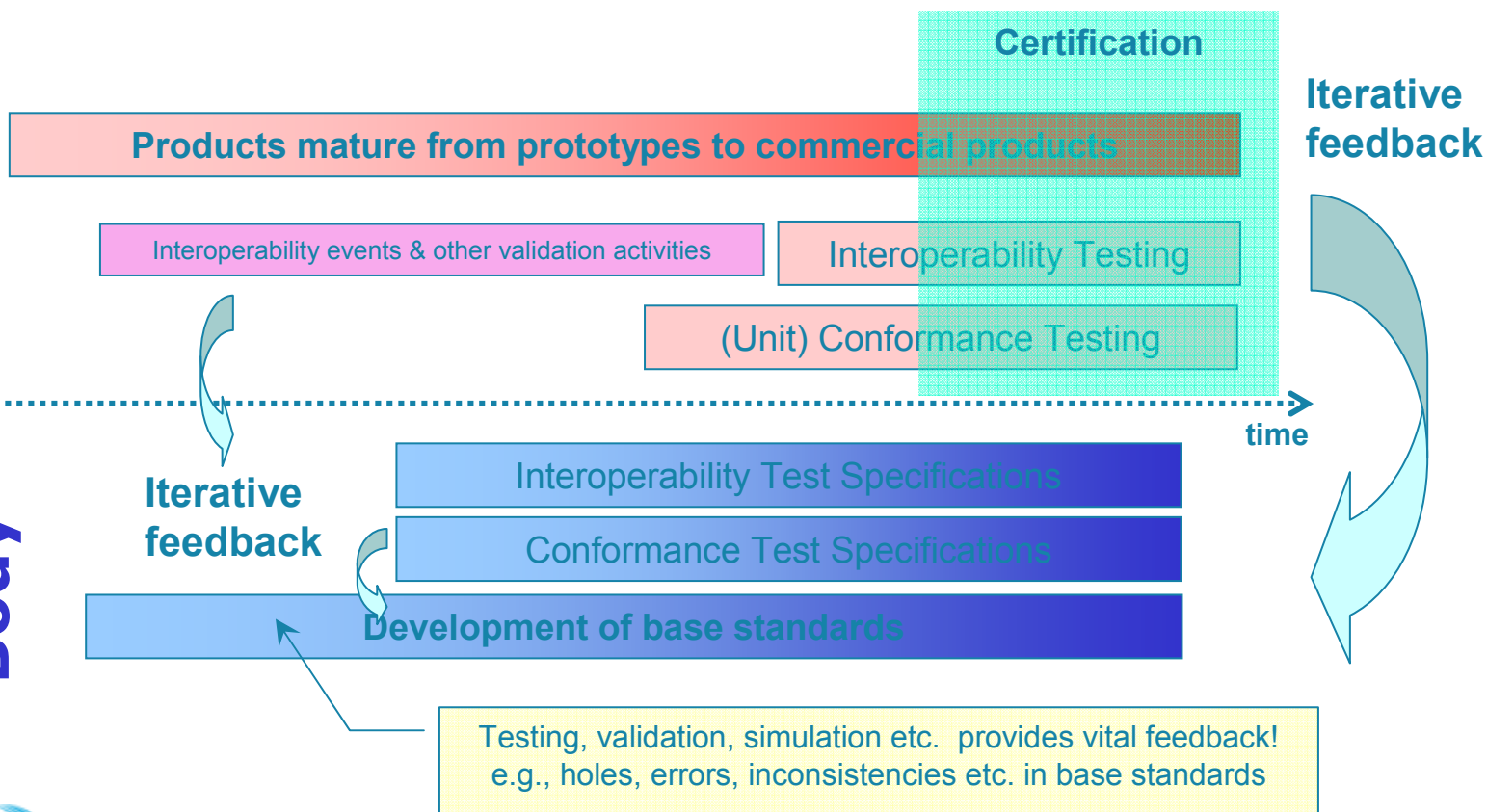
Validation Activities

Certification

Products mature from prototypes to commercial products

| Interoperability events | Conformance Testing | Interoperability Testing |

Development of base standards

| Peer Review | Modelling and Simulation | Prototyping |

Test for interoperability!

Testing

| Test Checklist | Test Purposes | Test Scripts | Validation of Tests |

❑ **Plan for testing!**
❑ **Usually Conformance Testing and Interoperability Testing**
❑ **Use existing methodologies**
  ➢ **ISO/IEC 9646 Conformance Testing Methodology**
  ➢ **ETSI Interoperability Testing Methodology**
  ➢ **TPLan (ETSI standard, developed by PTCC/MTS)**
  ➢ **TTCN-3 (ETSI standard, developed by PTCC/MTS)**

❑ **Validate test specifications**
  ➢ **Use of ETSI members test platforms**
    • **e.g., UMTS, WiMAX, IMS**
  ➢ **In simpler cases some ETSI in-house facilities maintained by PTCC**
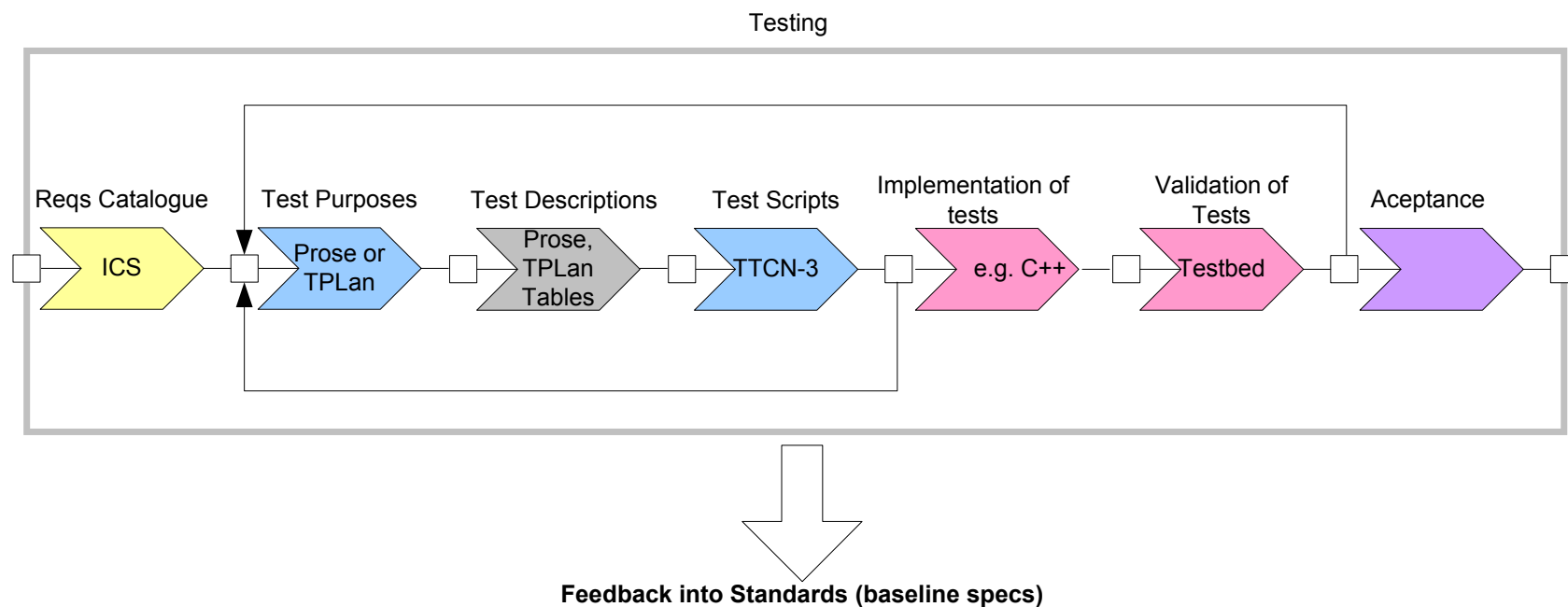   • **e.g., SIP, IPv6**
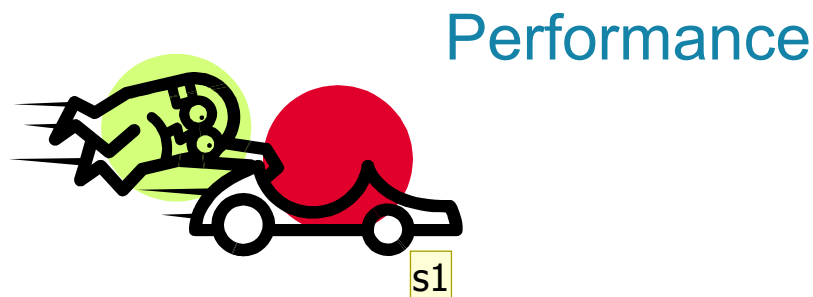
Interdependencies between specification and testing

Test for interoperability!

Testing

Reqs Catalogue	Test Purposes	Test Descriptions	Test Scripts	Implementation of tests	Validation of Tests	Aceptance
ICS	Prose or TPLan	Prose, TPLan Tables	TTCN-3	e.g. C++	Testbed	

Feedback into Standards (baseline specs)

Different Kinds of ETSI Test Specifications

Conformance

Robustness

Interoperability

Performance

Interoperability + Conformance assessment

s1

RF/EMC

s1   Do we really do this?
             schulzs, 13/09/2006
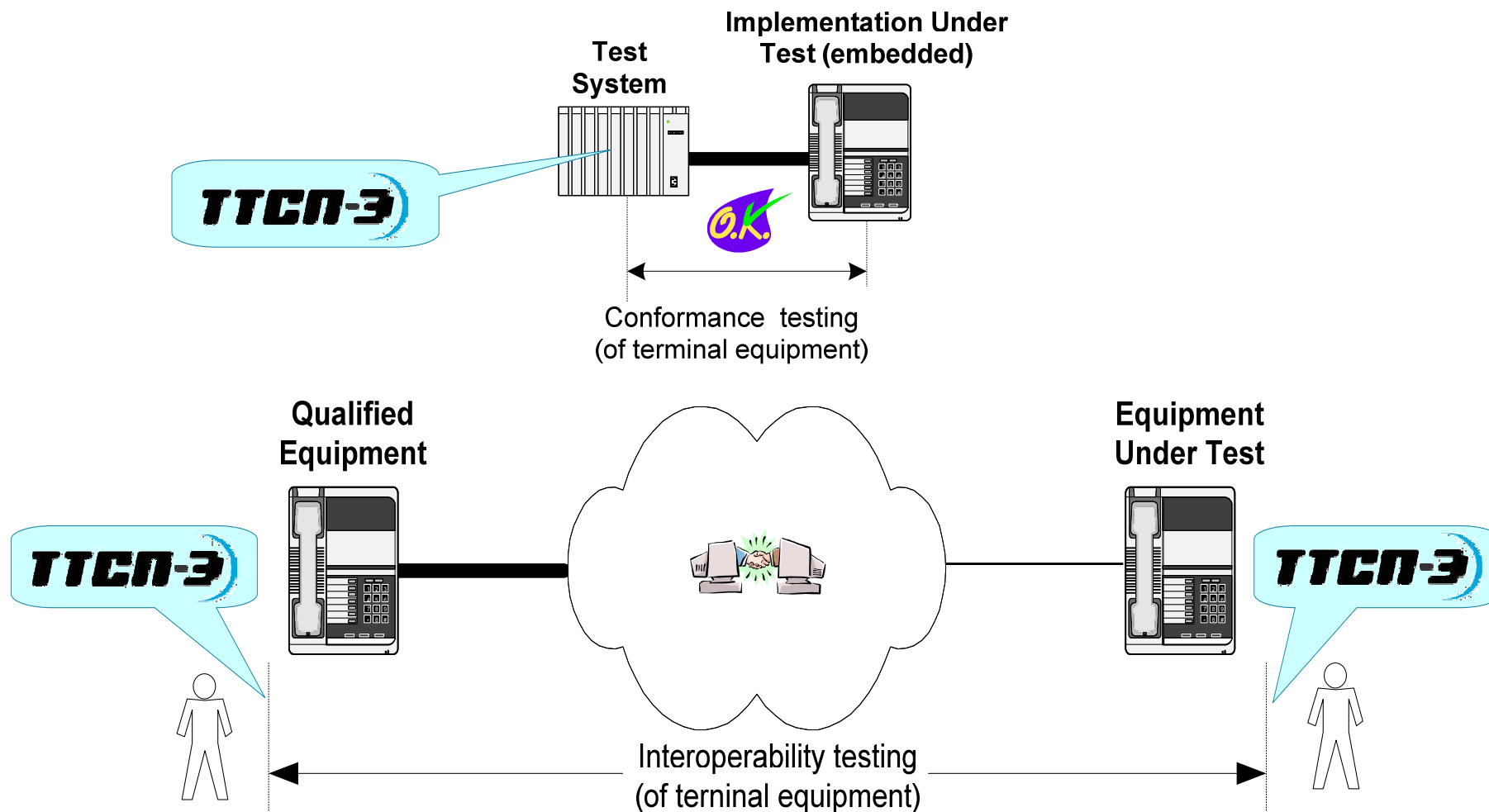
Typical Test Specification Projects

- Cellular: **GSM, 3G UMTS (including IMS/SIP)**
- WiFi: **HiperMAN, HiperACCESS, WiMax**
- VoIP: **H.323, IETF SIP, SIGTRAN**
- Service Creation: **OSA/Parlay (API, IDL, Java)**
- IPv6: **Core, Security, Mobility, v4-v6**
- Cordless phones: **DECT**
- Radio communications: **TETRA, DMR, PMR**
- Access terminals: **FSK, SMS**
- Broadband: **ISDN, DSL**
- Smartcards: **Readers, cards, security modules**
- Intelligent Transport Systems (ITS): **DSRC**
- TISPAN NGN: **IMS Interoperability (interworking)**
- Future: **More Security, more NGN, GRID ...**
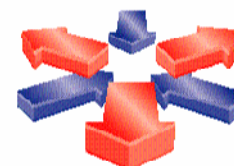
ETSI Specialist Task Forces (STF)

❑ **The CTI STFs develop test specifications**

❑ **CTI experts + experts seconded from ETSI membership**

➢ **15 – 20 test-related STFs per year**

➢ **Typical total yearly resource = 20-25 man-years**

➢ **Various complexity**

• **e.g., 2 man-months maintenance of VoIP tests**

• **e.g., UMTS testing 60 man-months per year over 4-5 years**

❑ **Commercial contracts**

➢ **Negotiated on an individual basis**

ETSI GRID STF 331

❑ **ETSI GRID Technical Committee has created an Specialist Task Force (STF)**

  ➢ **Co-funded by EC DG ENTERPRISE**

❑ **Purpose is to identify gaps in existing GRID specifications, propose a selection applicable to ETSI TC GRID, and develop a testing framework**

  ➢ **Current status: as of 2007Q4 focus is on inventory of available grid specifications/industry specs/common practices = "review of stakeholders"**

  ➢ **Step 2: Gap analysis (2008Q2)**

  ➢ **Review of other GRID testing frameworks, e.g., ETICS project**

  ➢ **Step 3: Actual test specification is expected as last step**

    • **No sense to specify tests without an agreed base specification**

    • **Plugtests event 2009Q3**

❑ **Three phase STF expected to last until end 2009**

  ➢ **Project started in October 2007**

  ➢ **ETSI CTI will provide specification and testing support in later phases of STF**

Typical Plugtest Events

- ❑ **SIGTRAN**
- ❑ **Bluetooth**
- ❑ **IPv6 (Core, IPSEC, etc)**
- ❑ **Triple Play over xDSL, G-PON,**
- ❑ **SIM/Handset**
- ❑ **WLAN IRAP**
- ❑ **RFID**
- ❑ **STQ (Speech Quality)**
- ❑ **Digital Identity**
- ❑ **WiMAX**
- ❑ **ENUM**
- ❑ **OSA/Parlay (ParlayX)**
- ❑ **SIPit, H.323**
- ❑ **J2ME**

PLUGTESTS™

THE INTEROPERABILITY SERVICE

Recent ETSI Plugtests™ Event

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

Conformance Testing and Interoperability Testing are Complementary

- ❑ **ETSI experience**
  - ➢ **As you move up a system stack the emphasis should change from conformance to IOT**
  - ➢ **Moving from component testing, to more complex interoperability issues**

- ❑ **Lower layer protocols, infrastructure**
  - ➢ **Emphasis on conformance**
- ❑ **Middleware, enablers**
  - ➢ **Combination of Conformance + IOT**
- ❑ **Services, applications, systems**
  - ➢ **Emphasis on IOT**

- ❑ **Conformance testing as a pre-requisite to IOT**
  - ➢ **Ensure interoperability through standardised interfaces**
- ❑ **Interoperability testing with conformance assessment**
  - ➢ **E.g. end-to-end conformance tests with intermediate reference point assessment**

Combining Interoperability Testing with Conformance assessment
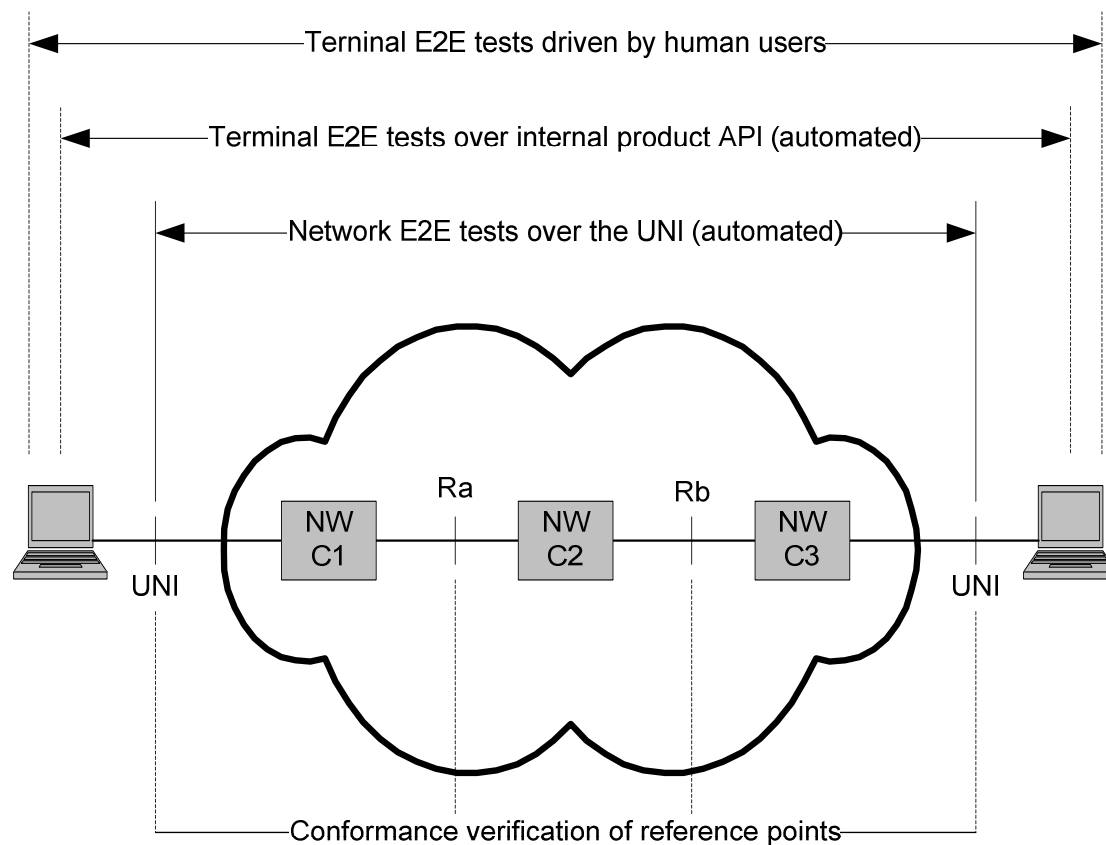
Test Specification Development
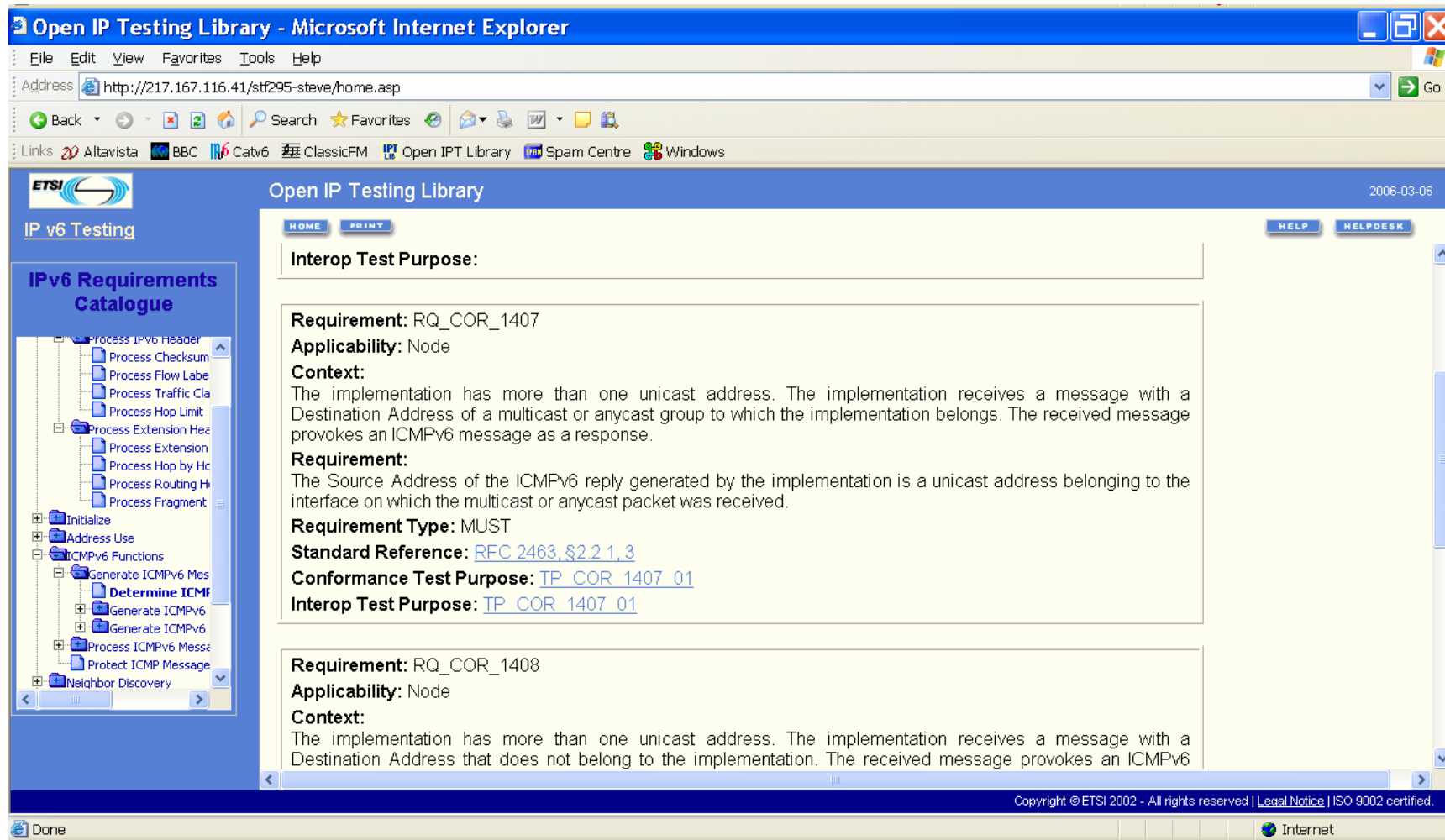## *Successive Levels of Abstraction*

Standard → **Test Purposes** → **Test Descriptions** → **TTCN-3 Test Suite**

Compilation

Requirements Catalogue and/or ICS/IXIT

Test Case Parameterisation and Selection

Executable Tests
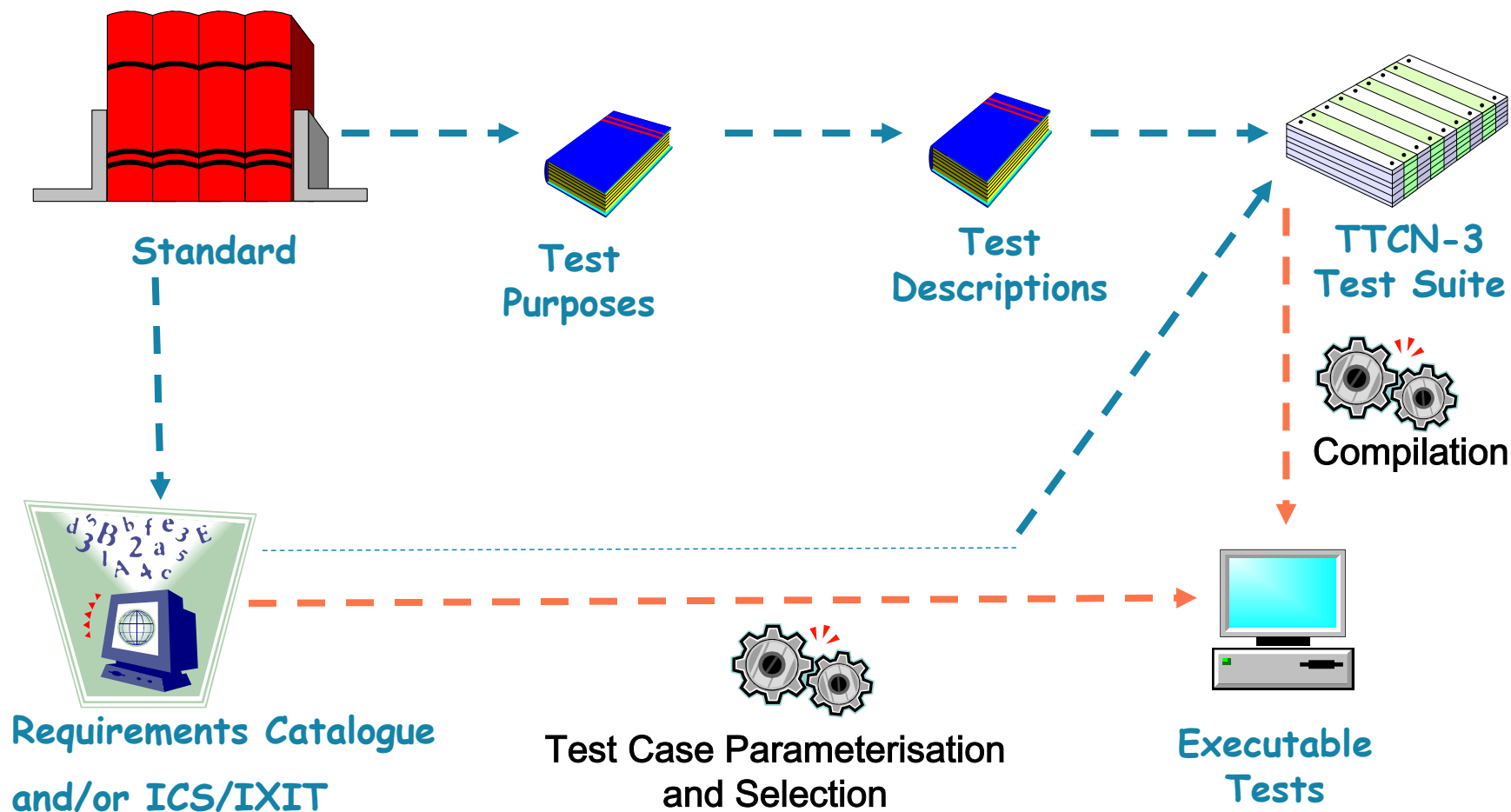
The Requirements Catalogue

□ **Database of all extracted requirements**

- ➤ **REQ name**
- ➤ **Reference to base standard**
- ➤ **Context information**
- ➤ **Status: Mandatory (M), Optional (O) etc.**
- ➤ **Dependencies between optional requirements**

□ **Links to Test Purposes**

□ **Links to Test Cases**

□ **Powerful search and grouping capabilities**

Requirements Catalogue

and/or ICS/IXIT

The Requirements Catalogue

Test Purposes

- ❑ **Test Purposes (TP) are precise descriptions of the purpose of the test for a particular requirement**
- ❑ **Specify WHAT is being tested**
  - ➢ **Do not define HOW to test**
  - ➢ **They are not test code**
- ❑ **Grouped into a logical structure**
  - ➢ **Test Suite Structure (TSS & TP)**
  - ➢ **One Requirement may spawn several TPs**
- ❑ **Specified in**
  - ➢ **Natural language, or**
  - ➢ **ETSI's Test Purpose Language (TPLan)**
  - ➢ **http://www.tplan.info/home.htm**
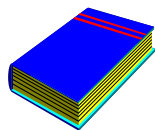
Test Purposes

Test Purposes

```
TP id   : TP_COR_0047_01
Summary : 'hop limit of one'
RQ Ref  : RQ_COR_0047
Config  : CF_02_C
TC Ref  : TC_COR_0047_01
ensure that {
--Stimulus
    when {  IUT receives 'Ipv6 packet' from 'Host'
               containing 'IPv6 Header'
               indicating 'Hop limit' set to '1' }
--Expected response
    then { IUT sends 'ICMPv6 Time Exceeded' to 'Host'
          containing 'ICMP code' set to 'ZERO'

          }
```
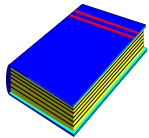
Test Descriptions

❑ **More detailed than Test Purposes**

➢ **But not directly executable**

Test Descriptions

❑ **Act as a design specification for test cases**

❑ **Or for manual execution**

➢ **E.g. Interoperability testing**

❑ **Contains more information**

➢ **Configuration details**

➢ **Postamble and Preamble sequences**

➢ **Detailed message sequences for test body**
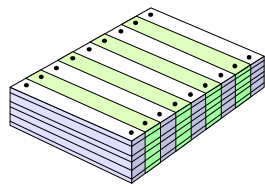
➢ **Parameter values**

➢ **Etc.**

Test Descriptions

Test Description	
Identifier:	TD_COR_1100_01
Summary	EUT reassembles a fragmented packet of an original length less than 1500 octets
Test Purpose: TP_COR_1100_01 **Reference:** RQ_COR_1100 **Configuration:** CF_011_I	

```
with { 'the MTU on Link1 set to 1400 octets' }

ensure that {
  when { QE is requested to 'send data requiring a packet
                          length greater than 1500 octets' }
  then { EUT indicates 'receipt of the same data without
                      modification' }
       }
```

Pre-Test Conditions:	• MTU set to 1400 octets on link1		
Step	**Step**	**Verdict**	
		Pass	**Fail**
1	Cause QE to send an Echo Request to EUT with a packet size of 1450 octets and with each octet set to the hexadecimal value "F0"		
2	*Check: Does protocol monitor show that the Echo Request was sent from QE to EUT?*	Yes	No
3	*Check: Does QE receive an Echo Reply from EUT with the packet length the same as the Echo Request and with each octet containing the hexadecimal value "F0"?*	Yes	No
Observations			

TTCN-3 Test Cases

❑ **Detailed TTCN-3 test script that implements test purpose**
  ➢ **Can be compiled and executed**
❑ **Specifies HOW to test not WHAT to test**
  ➢ **Preamble**
  ➢ **Test body (i.e., implementation of the Test Purpose)**
  ➢ **Postamble**

TTCN-3 Test Suite

❑ **Assigns test verdicts**
❑ **Handles unexpected behaviour as well as the behaviour in the test purpose**
❑ **Can be distributed over parallel test components**
❑ **Can be entirely automated**
❑ **Configurable at run-time**

Example TTCN-3 Test Case

```
testcase TC_COR_0047_01() runs on Ipv6Node system EtherNetAdapter {
  f_cf02Up();              // Configure test system for HS->RT
                           // No preamble required in this case

  f_TP_HopsSetToOne();     // Perform test
                           // No postamble required in this case

  f_cf02Down();            // Return test system to initi
}
function f_TP_HopsSetToOne() runs on Ipv6Node {
  var
  var FncRetCode
  if (        == succes       v_ipP
  { s  verdict(        )}
  else         tverdict(fai
}
function f_echoTimeExceeded(in UInt8 p_hops, out Ipv6P        ipPkt )
runs on Ipv6Node return FncRetCode {
  var Ipv6Packet v_ipPacket; var FncRetCode v_ret;
  ipPort.send( m_echoReqWithHops(p_hops) );
  alt {
    [] ipPort.receive( mw_anyTimeExceeded ) -> value p_ipPkt
       { return e_success }
    [] ipPort.receive { return e_error } }
}
```
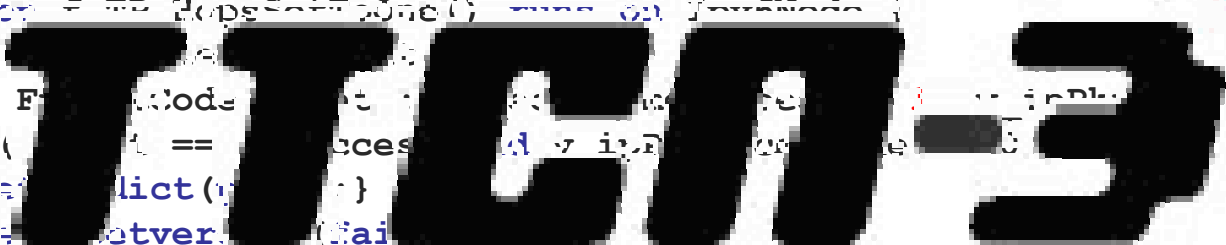
Why TTCN-3?

❑ **Specifically designed for testing**

➢ **Concentrates on the test not the test system**

➢ **Independent of the execution environment**

❑ ~~Wide range of application~~

http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0470012242.htm

❑ **Unifies different (all) testing activities**

➢ **Education and training costs can be rationalized**

➢ **Maintenance of test suites (and products) is easier**

➢ **Facilitates a common methodology and style**

➢ **Both on a corporate level and within standardization**

Maintain for interoperability!
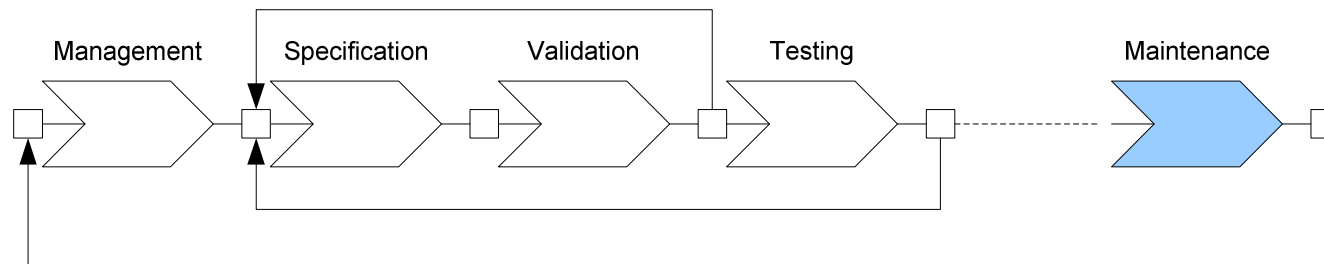
❑ **Good standards can be broken by poor maintenance**
  ➢ **Or no maintenance!**
  ➢ **Corrections must be made with care**
❑ **Requires well-defined Change Request (CR) process**
  ➢ **Feedback needs to be sought and captured**
  ➢ **Implementation of CRs should follow same process as original development**
❑ **Especially important with multiple releases and where test specifications are following behind**

Conclusions

❑ **In today's world of complex multi-SDO standardisation interoperability <u>is</u> an issue**

❑ **ETSI has methodology and pragmatic support for the systematic development of base specifications and test specifications**
  ➢ **Project management including administrative, technical and editorial support**
  ➢ **Making Better Standards: http://portal.etsi.org/mbs**

❑ **Standards engineering**
  ➢ **High-quality technical content**
  ➢ **Standards should be designed for interoperability**
    • **Readability, completeness, testability, maintenance etc.**
❑ **Validation**
  ➢ **For example interoperability events, feedback to standards**
❑ **Testing**
  ➢ **Conformance and/or interoperability**
  ➢ **Combining interoperability with conformance assessment can be effective**
  ➢ **Plan for validation and testing (early)**
    • **Develop tests and start testing in parallel with the development of the standard**
    • **Hold regular interoperability events (e.g., once or twice a year)**

Thank you!

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Whitepaper can be downloaded from

http://www.etsi.org/WebSite/NewsAndEvents/whitepapers.aspx