

ETSI IP6 Activities

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Conformance and Interoperability Testing

Structure of this Presentation

- ❑ Overview of ETSI's IPv6 Testing Project
- ❑ ETSI's IPv6 Testing Framework:
 - Requirements Extraction from RFCs
 - Specifying IPv6 Interoperability tests
 - Specifying IPv6 Conformance tests
 - IPv6 test specification library
- ❑ Current project status

Background

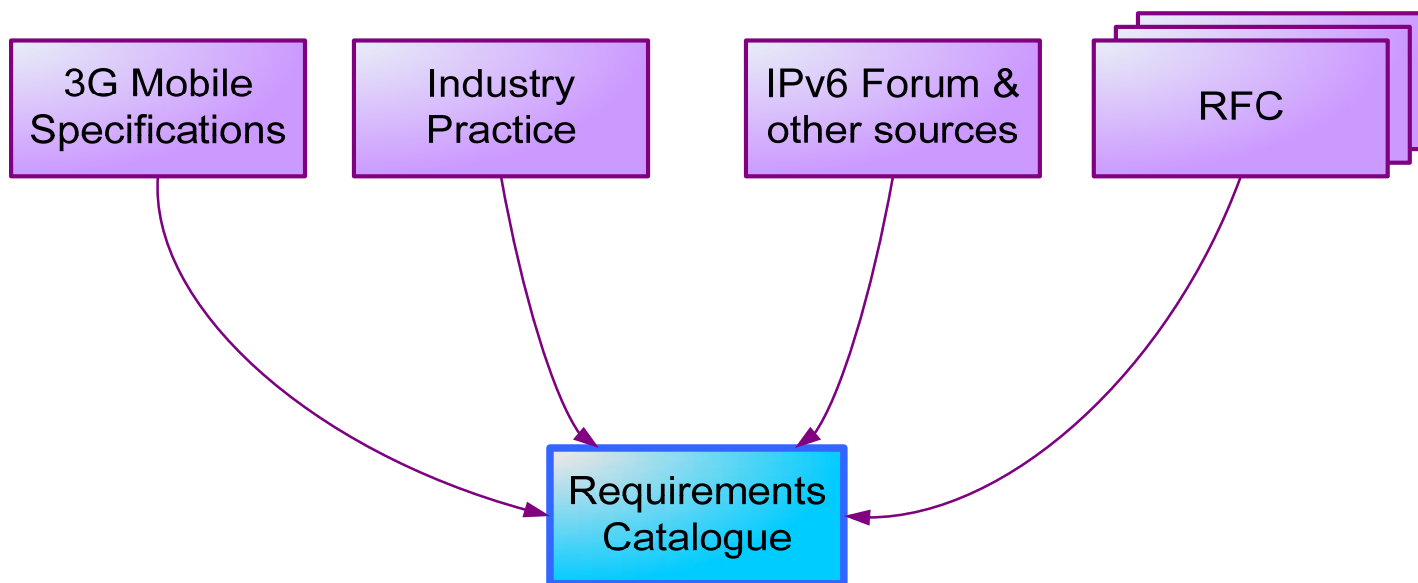
- ❑ 2004: EC awards eEurope funding for IPv6 testing
- ❑ 2005: IPv6 Core test development
- ❑ 2006: IPv6 Security (IPsec) test development
MIPv6 test development
IPv4 to IPv6 Transitioning test development

This is the first major testing project undertaken by ETSI where it has had no influence over the base protocol specifications

IPv6 Testing Framework

- Requirements Extraction
- Interoperability Test Development (using TS 102 237-1)
- Conformance Test Development (using ISO 9646)
- Library

IPv6 Testing Framework Requirements Process



IPv6 Testing Framework

The Requirements Catalogue

- ❑ Needed in lieu of PICS
- ❑ Implemented as a scalable database containing all requirement elements
- ❑ Web interface offering:
 - Browsing by function
 - User-defined search
 - Links to RFC and related test specification

IPv6 Testing Framework

The Requirements Catalogue (cont'd)

□ Each Requirement is categorized as follows:

- Requirement type:
 - Mandatory (MUST, MUST NOT)
 - Recommended (SHOULD, SHOULD NOT)
 - Optional (MAY, MAY NOT)
- Requirement target:
 - Host
 - Router
 - Etc.
- Requirement text
- Functional grouping :
 - Process Fragmented packet
 - Generate ICMPv6 Error Type
 - Etc.

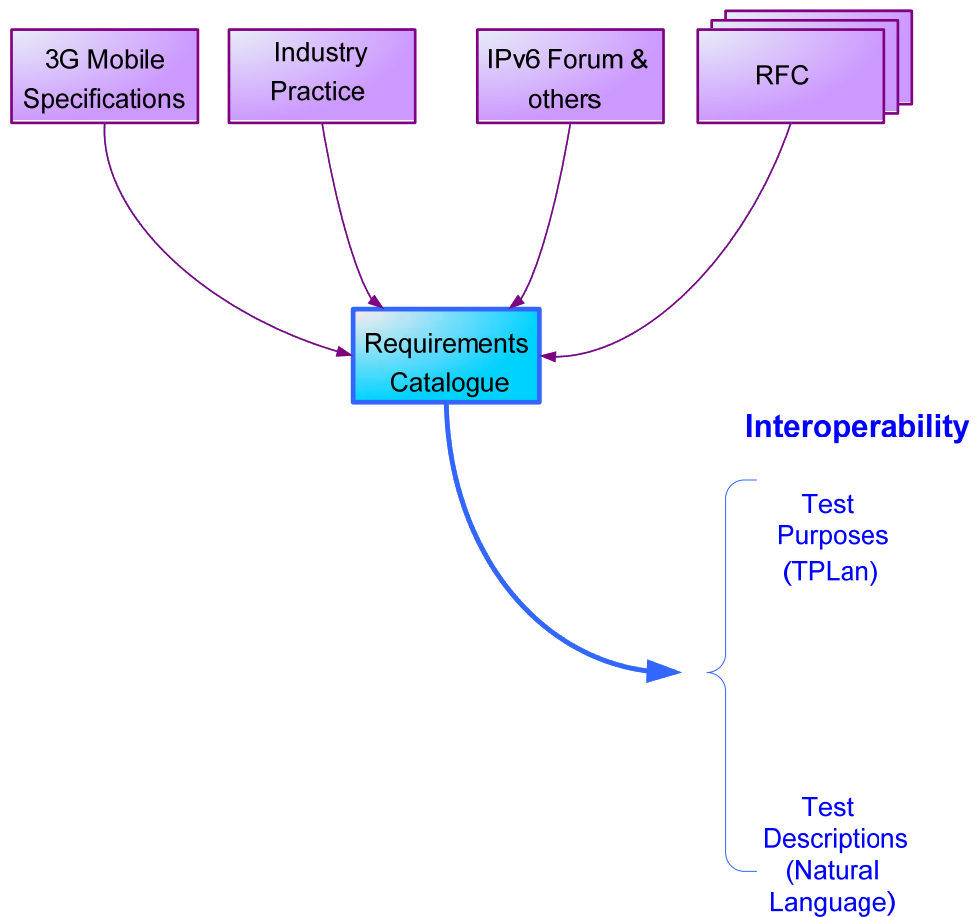
IPv6 Testing Framework Example Requirements

“A host implementation of IPsec MUST support tunnel mode “

“When an IPsec Host sends the first IP packet containing an Authentication Header (AH) on a particular unicast or single-sender multicast Security Association (SA), it MUST set the value in the Sequence Number field to one (1) “

“Packets may be routed to the mobile node using its home address regardless of the mobile node's current point of attachment to the Internet.”

IPv6 Testing Framework Interoperability Process



IPv6 Testing Framework

Interoperability Test Purposes

- ❑ Define the function being tested—the WHAT
- ❑ Do not define HOW to test the function
- ❑ Grouped into a logical structure (Test Suite Structure)
- ❑ One TP may test several Requirements
- ❑ One Requirement may spawn several TPs
- ❑ An interoperability TP is on the *functional* level
- ❑ Specified in ETSI's Test Purpose Language (TPLan)

IPv6 Testing Framework

Test Purpose Notation (TPLan)

- ❑ Pseudo-code approach
 - Limited (but extensible) keyword set + free text linked together in a syntactical framework
- ❑ Base keywords and syntax provide clear and consistent structure
- ❑ User-defined keywords provide project-specific extensions
- ❑ Text provides test-specific information
- ❑ A TP's basic structure:
 - Header
 - Pre-conditions
 - Stimulus
 - Expected response
- ❑ Standardized in ES 202 553 (available 2007)

IPv6 Testing Framework

TPLan Example for Interoperability

TP id : TP_COR_1719_02
Summary : 'EUT sends packet to All-Routers Link-Local Multicast address'
RQ ref : RQ_001_0327
Config : CF_COR_21
TD ref : TD_COR_1719_02

```

with {
    QE1 configured as a router
    and QE2 configured as a router
}
ensure that
{
  when {
    EUT is requested to send
    packet to
    All_Routers_Link-Local_Multicast_address
  }
  then {
    QE1 indicates receipt of the packet
    and QE2 indicates receipt of the packet
  }
}
  
```

IPv6 Testing Framework

Interoperability Test Descriptions

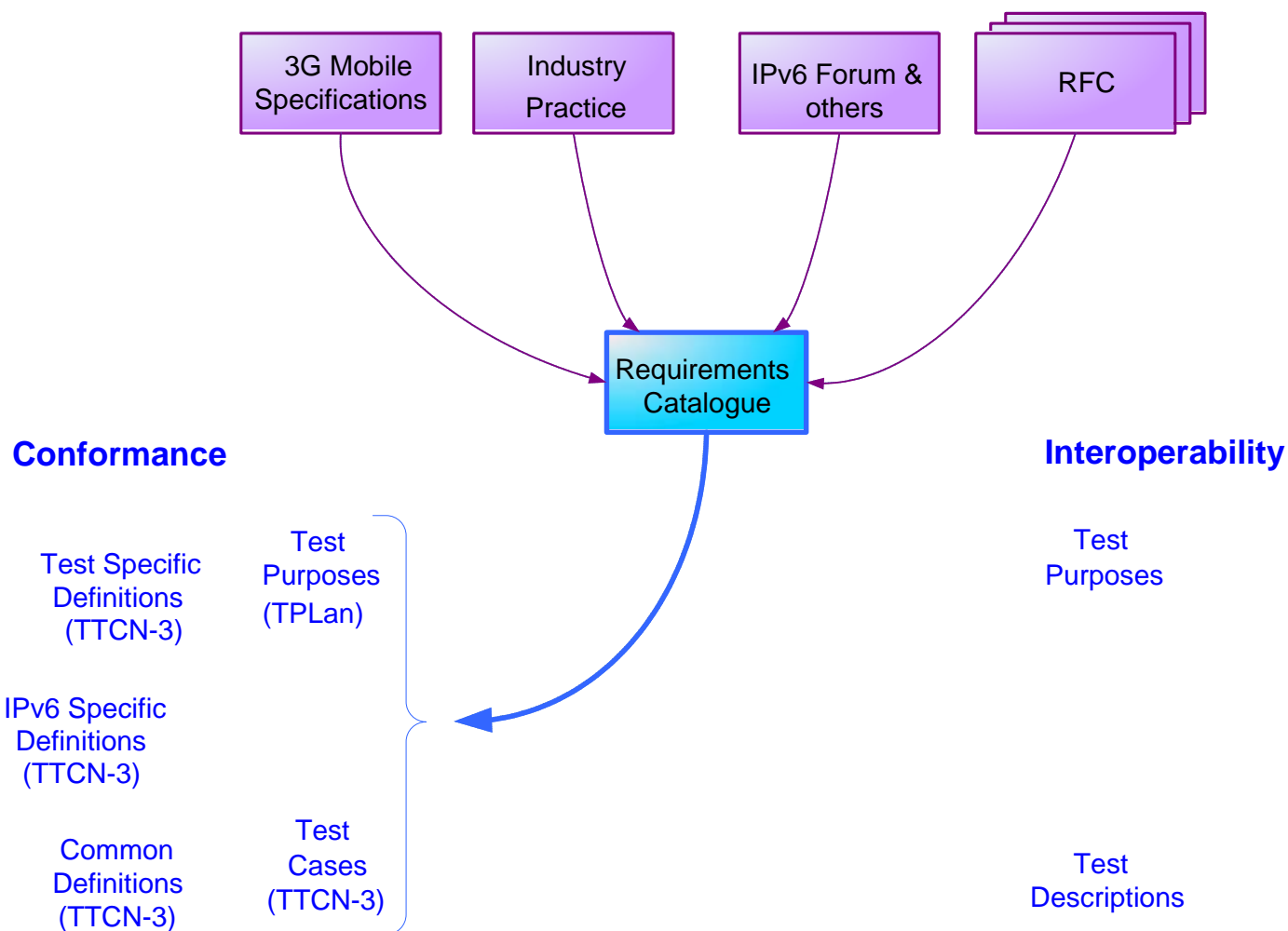
- ❑ Specify detailed steps to be followed to achieve stated test purpose
- ❑ Steps are specified clearly and unambiguously without unreasonable restrictions on actual method:
 - **Example:**
 - Answer incoming call
NOT
 - Pick up telephone handset
- ❑ Written in a structured and tabulated natural language so tests can be performed manually
- ❑ Can be automated using TTCN-3 when EUT has software interfaces

IPv6 Testing Framework

Example Test Description

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_001_2935
		Configuration:	CF_COR_11
<pre>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>			
Pre-Test Conditions:	<ul style="list-style-type: none"> 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	<i>Check: Does protocol monitor show that the Echo Request was sent from QE to EUT?</i>	Yes	No
3	<i>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"?</i>	Yes	No
Observations			

IPv6 Testing Framework Conformance Process



IPv6 Testing Framework Conformance Test Purposes

- ❑ Define the function being tested—the WHAT
- ❑ Do not define HOW to test the function
- ❑ Grouped into a logical structure (Test Suite Structure)
- ❑ One Requirement may spawn several TPs
- ❑ One TP may test several Requirements
- ❑ A conformance TP is on the *protocol* level
- ❑ Specified in ETSI's Test Purpose Language (TPLan)

IPv6 Testing Framework

TPLan Example for Conformance

```

TP id      : TP_COR_2139_01
Summary    : 'hop limit of one'
RQ Ref     : RQ_001_0047
Config     : CF_COR_02
TC Ref     : TC_COR_2139_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 0 }
}

```

IPv6 Testing Framework

Conformance Test Cases

- ❑ Detailed TTCN-3 test script that implements test purpose
 - can be compiled and executed
- ❑ Composition
 - a preamble
 - test body (i.e., implementation of the Test Purpose)
 - A postamble
- ❑ 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, e.g., SUT address

IPv6 Testing Framework

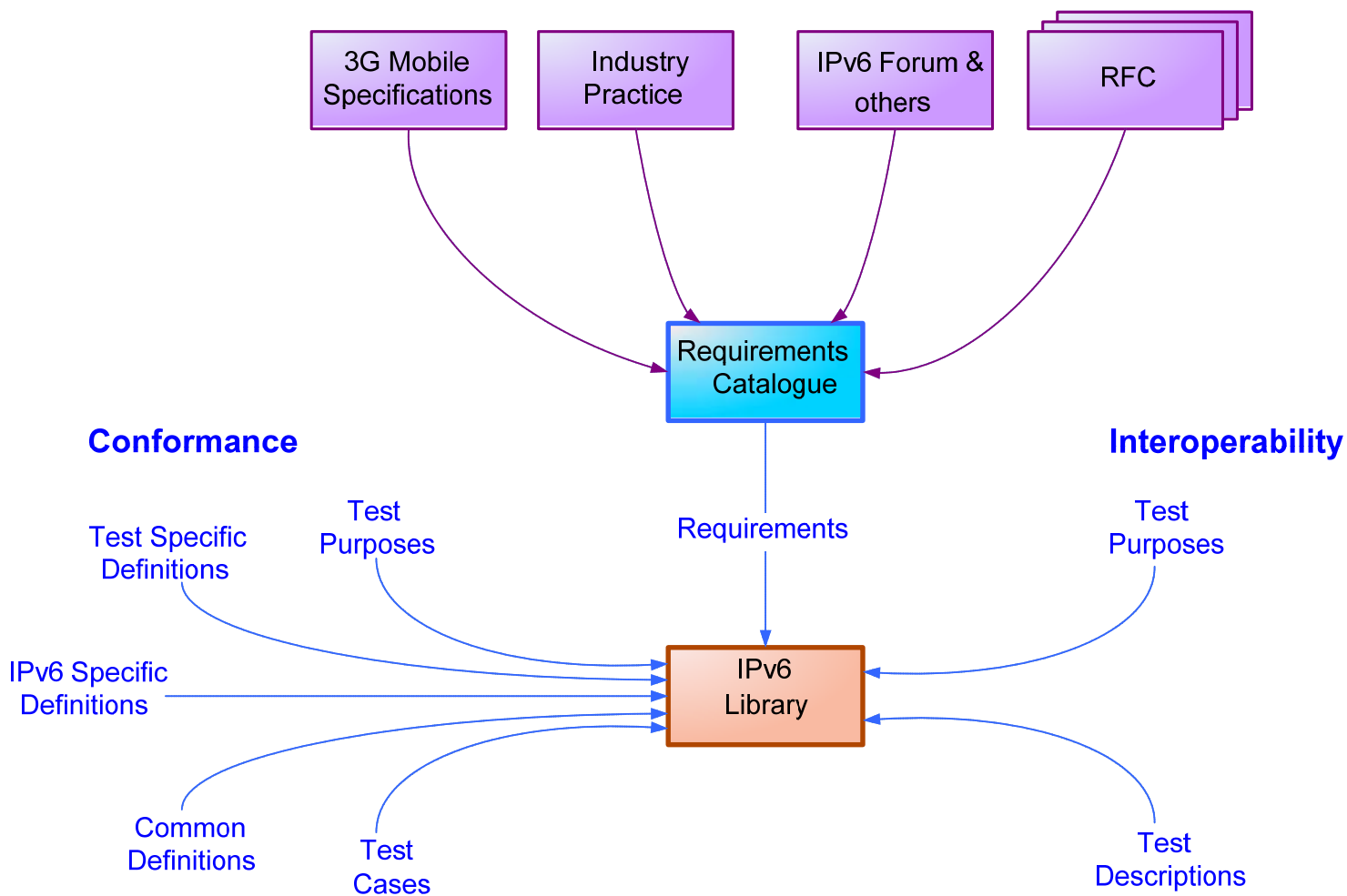
Example TTCN-3 Test Case

```

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 initial state
}
function f_TP_HopsSetToOne() runs on Ipv6Node {
    var Ipv6Packet v_ipPkt;
    var FncRetCode v_ret := f_echoTimeExceeded( 1, v_ipPkt );
    if ( v_ret == e_success and v_ipPkt.icmpCode == 0 )
    { setverdict(pass);}
    else { setverdict(fail); }
}
function f_echoTimeExceeded(in UInt8 p_hops, out Ipv6Packet p_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 } }
}

```

IPv6 Testing Framework Library Process



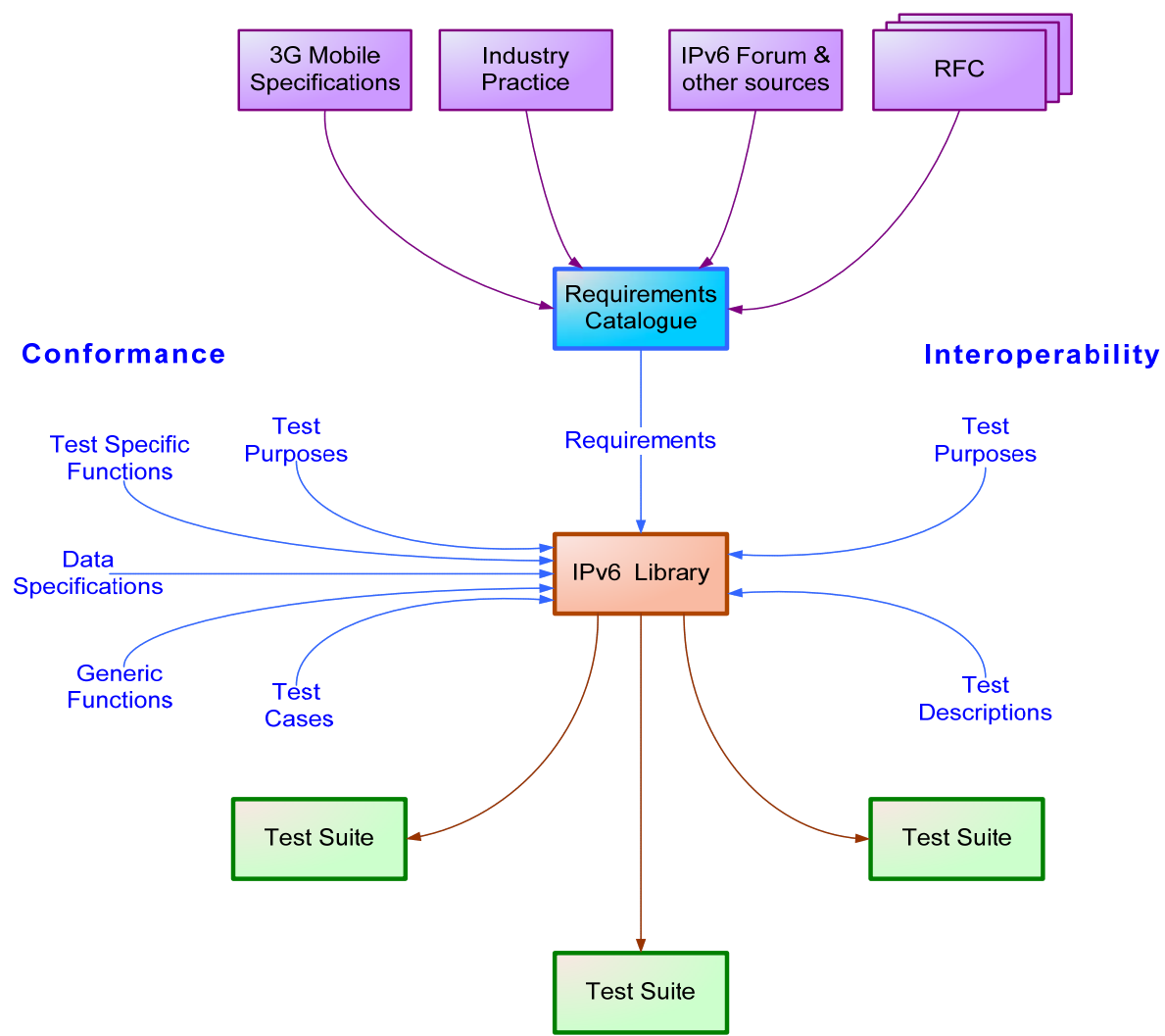
IPv6 Testing Framework

The TTCN-3 Library

- ❑ Each test uses this library
 - Decreases test code size and improves its quality
 - Reduces time to develop new tests
- ❑ Contains useful definitions for different purposes
 - Test component synchronization
 - Basic IPv6 packet exchanges
 - Preamble, test purpose, and postamble code
 - Test configurations
 - Code for driving upper IPv6 interface
- ❑ Extensively documented
- ❑ Easily add tests to test suites
- ❑ Will be freely available on the web

IPv6 Testing Framework

IPv6 Test Library



Project Status

Phase 1

□ IPv6 Core RFCs

- RFC2460 IPv6 Basic Specification
- RFC2373 IPv6 Addressing Architecture
- RFC2461 Neighbor Discovery & Redirect
- RFC2462 Stateless Address Autoconfiguration
- RFC2463 ICMPv6
- RFC1981 Path MTU Discovery
- RFC2675 IPv6 Jumbograms

□ Results

- 1112 requirements
- 356 validated conformance tests
- 99 validated interoperability tests

Project Status

Phase 2 - Security

□ Ipv6 Security (IPsec) RFCs

- RFC4301 Security Architecture for the Internet Protocol
- RFC4306 Internet Key Exchange (IKEv2) Protocol
- RFC4302 IP Authentication Header
- RFC4303 IP Encapsulating Security Payload (ESP)
- RFC2405 The ESP DES-CBC Cipher Algorithm With Explicit IV
- RFC2410 The NULL Encryption Algorithm and Its Use With IPsec
- RFC4305 Cryptographic Algorithm Implementation Requirements for ESP and AH

□ Results

- 695 requirements
- 105 conformance tests
- 40 validated interoperability tests

Project Status

Phase 2 - Mobility

- ❑ IPv6 mobility (MIPv6) RFCs
 - RFC3775 Mobility Support in IPv6
 - RFC3776 Using IPsec to Protect Mobile IPv6 Signaling Between Mobile Nodes and Home Agents
 - RFC2473 Generic Packet Tunneling in IPv6
 - RFC4068 Fast Handovers for Mobile IPv6
- ❑ Results
 - 1098 requirements
 - 163 validated conformance tests
 - 100 validated interoperability tests

Project Status

Phase 2 – IPv4 to IPv6 Transitioning

□ IPv4 to IPv6 Transitioning RFCs

- RFC2529 Transmission of IPv6 over IPv4 Domains without Explicit Tunnels
- RFC2765 Stateless IP/ICMP Translation Algorithm (SIIT)
- RFC2766 Network Address Translation – Protocol Translation (NAT-PT)
- RFC3056 Connection of IPv6 Domains via IPv4 Clouds
- RFC4213 Basic Transition Mechanisms for IPv6 Hosts and Routers
- RFC4214 Intra-Site Automatic Tunnel Addressing Protocol (ISATAP)

□ Results

- 427 requirements
- Ongoing development of conformance and interoperability test specifications

Project Status

What Next?

- Complete development of Transitioning test specifications
- “Normalization” of Phase 1 and Phase 2 data
- Validation of test specifications against IPv6 Forum Gold Logo tests
- Test specifications used as the basis for 3G/NGN IMS test development

Thank You!

ETSI **IPU6** Activities