



The background of the poster features a collage of images related to networking and technology, including a satellite dish, a city skyline, and people working at computers.

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IP6

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Executive Summary

On 9 -12 April 2006, ETSI, the European Telecom Standard Institute together with its partner BII successfully organised the first IPv6 Plugtests in Beijing, China. This event was co-located with the Global IPv6 Summit 13 -14 April 2006.

This event was also sponsored by the European Commission, The Information Society Technologies Directorate through a world wide funded project called Go4IT which involved 11 partners from all continents including active involvement of three Chinese partners: BII, China Academy on Telecom and Research (CATR) and the Beijing Post & Telecom University (BUPT).

The event gave great opportunities of strengthening collaboration between EU and China in helping companies to efficiently adopt the IPv6 to face the important market needs in future internet and future technologies. In particular China is at the forefront of this important evolution through the CNGI project, massive and rapid adoption of the IPv6 protocol.

10 key Chinese vendors participated to this event and took the opportunity of the presence of the state-of-the-art world test teams from Japan (TAHI), from Europe (IRISA, ETSI) to get the important IPv6 ready logo thereby showing that they are also "ready" today and for the future.

In conclusion this very successful event gave first a very high demonstration of a successful world wide cooperation to address global market needs and secondly make also evidence on the dynamism of the Chinese companies and the professionalism of the key organising companies hosting such event.

1. Introduction

A framework for IPv6

IPv6 is the next generation Internet. It gives vastly increased address space and true end-to-end communication. It has improved security and mobility features and allows 'plug-and-play' connection to the network. The complexity of implementing IPv6 technology and the relative openness of IETF standards means that wide-ranging and **effective testing of IPv6 products will be one of the key factors in ensuring the deployment, interoperability, security and reliability of the IPv6 infrastructure** on which the success of e-Government, e-Business, e-Health, e-Learning and e-Procurement will eventually depend

The need for interoperability activity:

Quoting from an European report from the European IPv6 task force

"Every new technology must evolve from development to deployment through a trial-and-acceptance stage. The supporters of this trial stage are usually the developers of the new technology (manufacturers), researchers, large corporations interested in the early adoption, or institutions on behalf of the benefiting communities. Technology manufacturers rely upon this stage to move from simulation to final product, from laboratory to the market."

However, the evolution of current Internet infrastructures to the new IPv6 protocol prompts operators to embark on projects with profound implications and

*transformations on the existing network architectures. Adding these implications to the demand for specialised resources, costly early-adopter risk factors, and a long investment-to-return cycle, makes this migration a very high investment for an operator and/or manufacturer to incur alone. The combination of the above constraints generates, at the current stage, a cyclic impasse, whereby the developer cannot deploy without a field trial, and the recipient cannot support the field trial alone. These constraints are understandable in the light of the evolution in large common infrastructures, used by the public community today. As with the railways, bridges, or telephone systems, these infrastructural progresses are very broad in scope, and therefore not wholly containable in the laboratory. Also, having wide communities as potential recipients, these projects need to be born out of partnerships between the scientific community, the manufacturers, the operators, and the governments, on behalf of the common welfare.[IPv6 Task Force] Recommendation – As one efficient way to pool expertise and benefit from collective test beds, **it is encouraged to support the setting up of interoperability events** in particular organized by a neutral organization such as those organized by ETSI.*

These events are an opportunity for engineers from competing organizations to meet together in a commercially secure environment, to share experiences and improve interoperability between their implementations”

Goal of the event

The key objective and benefits of the ETSI IPv6 Plugtests event are:

- Access in one place a **wide range of tests** provided by various test companies
- Check the interoperability of your products with international and active market players.
- Run the tests of the **IPv6 Ready Logo phase-1 and Phase-2**.
- Improve and debug your IPv6 implementation by:
 - Running the available **Interoperability** and **Conformance** tests
 - Run the IPv6 TTCN-3 test cases subject of Research and cooperation with Chinese partners within an EU funded project called GO4IT.

Venue address:

Beijing International Convention Center (BICC)
8 Beichendong Road
Chaoyang District
Beijing 100101,
CHINA

2. The test programme

2.1. The IPv6 Ready Logo Programme

IPv6 Ready logo program is a certifying program initiated by the IPv6 Forum, worldwide members consortium aiming at promoting the deployment of the new Internet Protocol : IPv6. This certification is destined to all the products implementing this protocol.

The technical aspects of this program are managed by the IPv6 Logo Committee (v6LC) which is composed of :

the [TAHI project](#) (Japon),
the [University of New Hampshire](#) (USA),
[ETSI IPv6 Plugtests](#) (Europe),
[TTA](#) (Korea),
[BII](#) (China),
[NICI v6Lab](#) (Taiwan),
[IRISA/INRIA](#) (France).

Logo Committee's missions are :

- setting up specifications for IPv6 conformance and interoperability tests and its associated protocols (self-configuration, mobility, security, transition...),
- producing tests tools,
- defining a procedure to attribute the Logo and guarantee its distribution.

This article introduces in a first part the objectives of the logo, and the technical content of the tests in a second part.

Logo advantages

Why a logo?

Contrary to IPv4 which appeared with the Unix system, there is currently no finalized IPv6 implementation which can be used as a reference to develop and test other implementations. The set-up of series of tests becomes consequently essential and necessary to reduce the divergences between producers and to ease the emergency of a stable standard. Aiming at avoiding any confusion in final user's mind, the different Logo Program's participants agreed to define common specifications tests and distribute one and only label : the "IPv6 Ready" logo.

The logo delivered in its "Silver" version since September 2003 through the first phase of the program was a mean to show how much operational IPv6 already is. Since February 16th 2005, the certification process has been reinforced with its "Gold" version attributed to the products which satisfy the whole test items described for the "Core Protocols" of the standard.

Who is it for?

- to industrials : for development activities as well as for integration activities, the logo allows the products developers to attest the respect of the standard and to accelerate its set-up by detecting its defects more easily and rapidly.
- to final users : the logo allows to validate the interoperability between products coming from different producers and attest a better perenity of investments and installations.

What are the products concerned ?

The logo can be delivered to different categories of products: from stacks (protocol implementation) to final products (routeurs, computers, etc.), as well as operating systems.

The certification is associated to the software/hardware version that has been tested. To avoid the appearance of new bugs, the tests are re-executed at each product updates.

Examples of already certified (Phase 1) products :

- IPv6 stacks (protocol implementation): Kame, Usagi, Ipnet, Kasago, Turbo Trek,
- operating systems: IBM z/OS, Cisco IOS, AIX, Windows Server 2003,
- routeurs, ADSL modems, ethernet routing switches : 6WINDgate 6211, Cisco 12000 series, NEC IX1000 series
- Others: Panasonic KX-CL500-V6 printer, Panasonic KX-HCM230v6 camera, Matsushita FreeFit 1 network lighting controller , Matsushita lcont 0.9 intelligent controller for gate management system, etc.

Tests content

The series of tests specified and produced by the Logo Committee can be divided into two types : conformance and interoperability. The program joined up three steps in 2003, 2005 and 2006 respectively. The series are progressively enriched, from a minimum cover with a Phase 1 to a complete cover with the Phase 3 items.

This section introduces the notions of conformance and interoperability in a first part, and the tests content and its evolution during the three phases in a second part.

Conformance and interoperability

The conformance test aims at validating a product in reference of the standard (or RFC). It is done through a specific tool which emulates an environment of reference for the tested product. The protocol of the test is analyzed, its functionalities and its terms of use are classified as exhaustively as possible, from the most obvious to the most "incredible" ones. Then, the product must face - more or less - critical scenarios created on demand in order to highlight a specific situation (we often speak of "torture test", aiming at "breaking" the system and finding out any fault). The system behaviour is precisely analyzed and compared to what the standard forecasts. In case of divergence, the product is not labelled.

The interoperability test is realised in a real environment, the tested product being interconnected with other products (routeurs, hosts, etc.) in typical configurations. The developed scenarios aim at verifying if the product is able to interact with other products of different origins. This kind of test is more complex to specify and to set-up, in reality only simple cases can be used.

Conformance and interoperability tests cannot be compared in terms of efficiency,

they complete each other. The conformance tests point out the respect of the standard and the interoperability tests point out the appropriate functioning in a real context. If an equipment passes the conformance tests, it can be unusable in practice; and on the contrary, another one can work properly without respecting the standard at all. The use of both tests -interoperability AND conformance- is essential to ease the rise of a stable and functional standard.

Covering : two phases



Phase 1 (Silver)

Since September 1st 2003, the Phase 1 logo focuses on "core protocols", meaning IPv6 itself and the basis mechanisms associated with it (i.e. self-configuration). It aims at guaranteeing a minimum IPv6 support.

The logo color is silver and two categories of equipments can be observed : hosts and routeurs (having different items and exigencies in terms of functionalities). In both cases, conformance and interoperability can be found.



Phase 2 (Gold)

Since February 16th 2005, the Phase 2 of the logo is moving in the Phase 1 tracks. The Phase 2 completes the "core protocols" and adds the mechanism of discover of the MTU (RFC 1981). The Phase 2 will be completed by tests for functionalities as follow:

- IPsec (security: authentication/encryption),
- MIPv6 (mobility),
- MLD (multicast hosts announcement),
- SNMP and MIB (remote administration),
- 6to4 and NAT-PT (IPv4 to IPv6 transition mechanisms experimentation).

The logo is golden. A new category has been added to the host and router categories : the "Special Devices" category for all the equipments which have no light IPv6 implementation (i.e.: a controlling camera) for resources reasons.

The Phase 2 has long-term perspectives. The tests specifications are the results of a technical consensus between the logo's members. The specifications have been unified and redefined very precisely. The Committee's goal is to approve a unique logo which is delivered in the same conditions whatever is the testing tool and wherever it is tested.

The IPv6 Forum strongly encourages the firms to obtain the Gold logo as long as it guarantees an optimum quality thanks to complete series of tests including the mandatory functionalities as well as the recommended ones ("SHOULD") for the standard. The Silver logo can be attributed to any product satisfying the sub-set of properties defined for the Phase 1 tests ("MANDATORY").

Phase 3

Planned in the year 2006, the Phase 3 will be the same as the Phase 2 in terms of content, except that the IPsec (security) extension support will be compulsory.

References

Logo Committee's website
<http://www.ipv6ready.org/>

IPv6 Forum's website
<http://www.ipv6forum.org/>

Sum-up of Logo Committee's decisions synthesis about the Phase 2 launch
<http://www.ipv6style.jp/en/apps/20041214/> (part 1)
<http://www.ipv6style.jp/en/apps/20041221/> (part 2)

Official list of "IPv6 Ready" certified products
http://www.ipv6ready.org/logo_db/approved_list.php (Phase 1 logo)
http://www.ipv6ready.org/logo_db/approved_list_p2.php (Phase 2 logo)

2.2. The Logo conformance tests by the TAHI test team



The TAHI team were responsible at the event of all the conformance tests (phase 1 & 2) for the logo

Test Architecture: Figure 1 shows TAHI test architecture.

Physically, the tester and the target are connected by Ethernet. There is just one physical network, but the tester can emulate more than one network because the tester can change MAC address of every packet.

Optionally, the tester and the target can be connected by serial line while connecting by Ethernet. The serial line is used in remote control function. TAHI test can be run manually, but also can be run by automatically using serial line.

The tester has the layer structure.

TAHI test consists of two part.

One is Test Platform, and the another is Test Script.

Test Platform provides common program interface as perl module.

And Test Script can be written as perl script.

There are several Test Scripts and each of them correspond to every test categories.

In the other hand, Test Platform is common part through every test scripts.

This structure makes developing new categories easy.

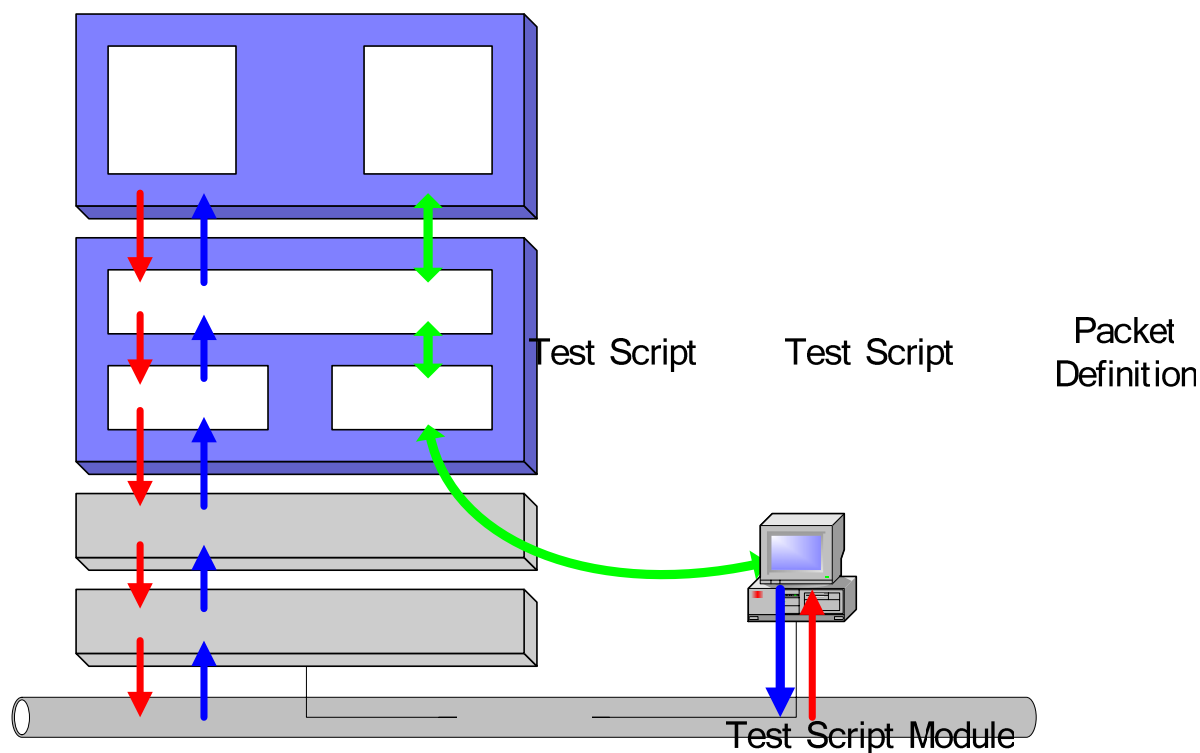


Figure 1: TAHI Test Architecture

Test Plan

Four test categories are provided in this Plugtest.

- IPv6 Ready Logo Program Phase-1
- IPv6 Ready Logo Program Phase-2 IPv6 Core Protocols
- IPv6 Ready Logo Program Phase-2 IPsec
- DHCPv6

The following RFCs are covered by each test.

- IPv6 Ready Logo Program Phase-1
 - RFC 2460 IPv6 Specification
 - RFC 2461 Neighbor Discovery for IPv6
 - RFC 2462 IPv6 Stateless Address Autoconfiguration
 - RFC 2463 ICMPv6
- IPv6 Ready Logo Program Phase-2 IPv6 Core Protocols
 - RFC 1981 Path MTU Discovery for IPv6
 - RFC 2460 IPv6 Specification
 - RFC 2461 Neighbor Discovery for IPv6
 - RFC 2462 IPv6 Stateless Address Autoconfiguration
 - RFC 2463 ICMPv6
- IPv6 Ready Logo Program Phase-2 IPsec
 - RFC 1829 ESP DES-CBC
 - RFC 1851 ESP 3DES
 - RFC 2401 Security Architecture for IP
 - RFC 2403 The Use of HMAC-MD5-96 within ESP and AH
 - RFC 2404 The Use of HMAC-SHA-1-96 within ESP and AH
 - RFC 2405 The ESP DES-CBC Cipher Algorithm
 - RFC 2406 IP Encapsulating Security Payload
 - RFC 2410 NULL and IPsec

- RFC 2463 ICMPv6 (ICMP for IPv6)
- RFC 3566 AES-XCBC-MAC-96 Algorithm
- RFC 3602 AES-CBC Cipher Algorithm Use with IPsec
- DHCPv6
 - RFC 3315 DHCP for IPv6
 - RFC 3633 IPv6 Prefix Options for DHCPv6
 - RFC 3646 DNS Configuration Options for DHCPv6
 - RFC 3736 Stateless DHCP Service for IPv6

Target devices of each test categories are listed below.

- IPv6 Ready Logo Program Phase-1
 - host
 - router
 - special device
- IPv6 Ready Logo Program Phase-2 IPv6 Core Protocols
 - host
 - router
- IPv6 Ready Logo Program Phase-2 IPsec
 - end node
 - security gateway
- DHCPv6
 - client
 - server
 - relay agent

This is one of the test sequence of IPv6 Ready Logo Program Phase-2 IPv6 Core Protocols for example.

The Purpose of this test is verifying that a node properly originates Neighbour Solicitations when trying to confirm the reach ability of a neighbour.

Figure 2 describes the network topology which used in this test.

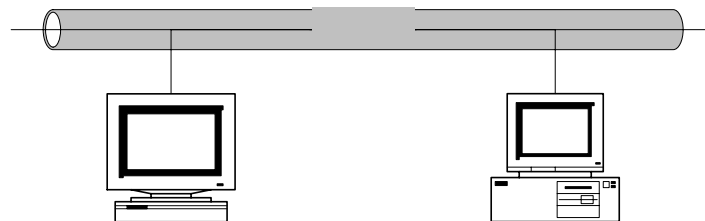


Figure 2: Network topology - Neighbor Solicitation Origination, Reachability Confirmation

Using this topology, tester sends several packets to observe the behavior of target.

Figure 3 is the actual test sequence of this test.

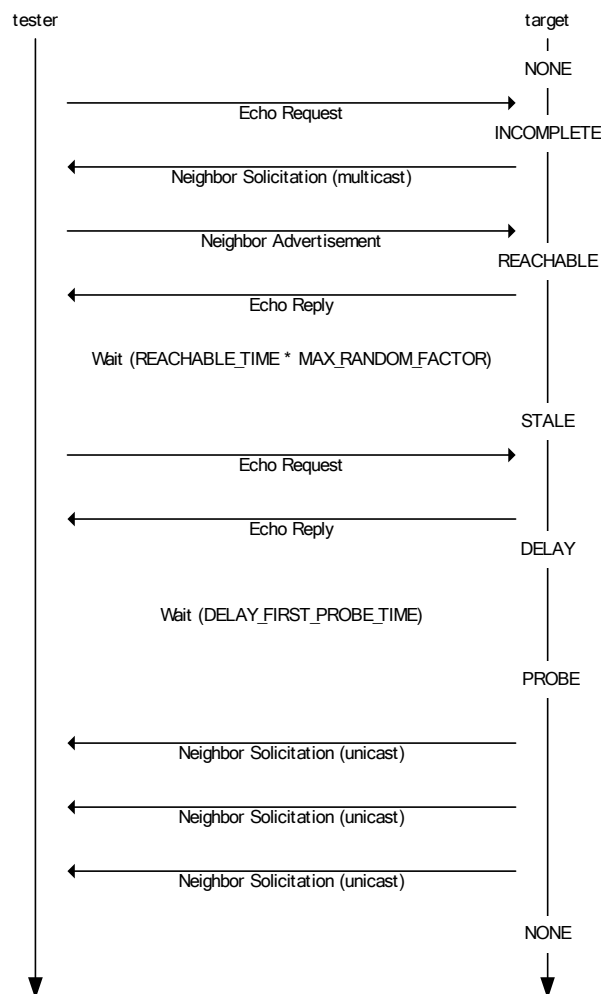


Figure 3: Test sequence - Neighbor Solicitation Origination, Reachability Confirmation

2.3. The Interoperability tests by the IRISA test team

The IRISA test team was responsible, at the event, for all the interoperability tests phase 1 & 2. These interoperability tests are necessary to obtain the logo.



Note that all tests for the phase 1 and 2 are describe at the following website www.ipv6ready.org

However the following part will describe the IPv6 Interoperability test scenarios to obtain IPv6 Ready Logo Phase-1 in order to present the test bed will have been set up for the Plugtests event in Beijing.

In total 6 routers have been set up with different Operating system fedora, Windows XP, free BSD, Solaris, etc. Some routers can also be tune as host depending on the needs

The test bed is used to run the scenarios which cover the functionalities is described in common specifications for IPv6 Ready Logo Phase-1. Different devices are categorized depending if it is an host, router or a special device If the device is a Special Device, the test scenario as a Host must be followed. The "**Condition**" part in each scenario must also be read carefully.

For Host device, the tests to be run are described in the following section.

1. Host vs. Host
2. Host vs. Router

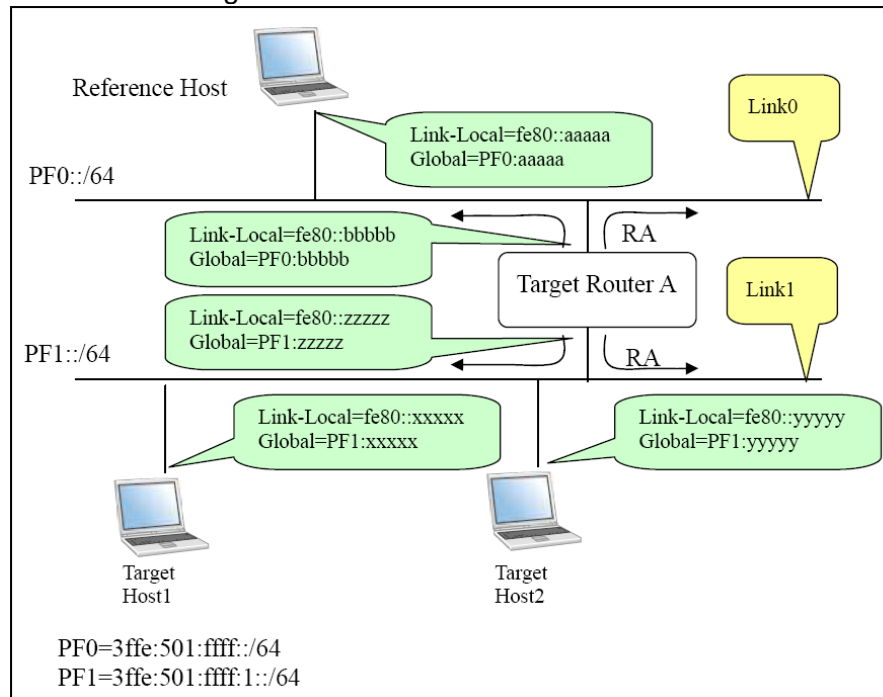
For Router device, the tests to be run are described in the following section.

2. Host vs. Router
3. Router vs. Router

For **Special device**, the tests to be run are described in the sections as a **Host**.

1. Host vs. Host
2. Host vs. Router

The overall configuration can be summarized as follows:



Host vs. Router

The test scenarios are described in the document on the www.ipv6ready.org section are focusing on the interoperability between Host and Router.

The **Special Device** also have to perform this test scenario as a **Host**.

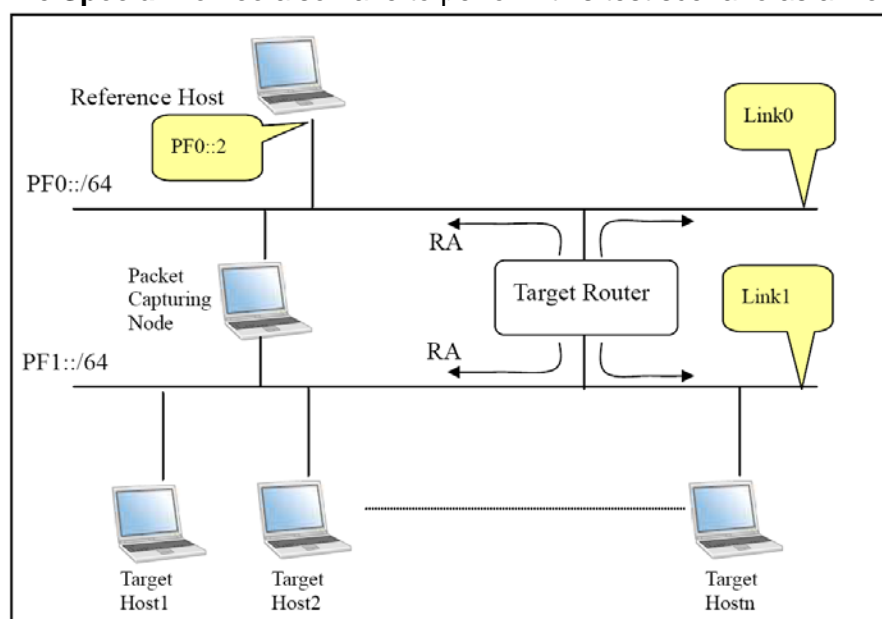


Fig. 2 1. Topology for Host vs. Router

Router vs. Router

The test scenarios described in this section are focusing on the interoperability between Routers, except Routing protocol.

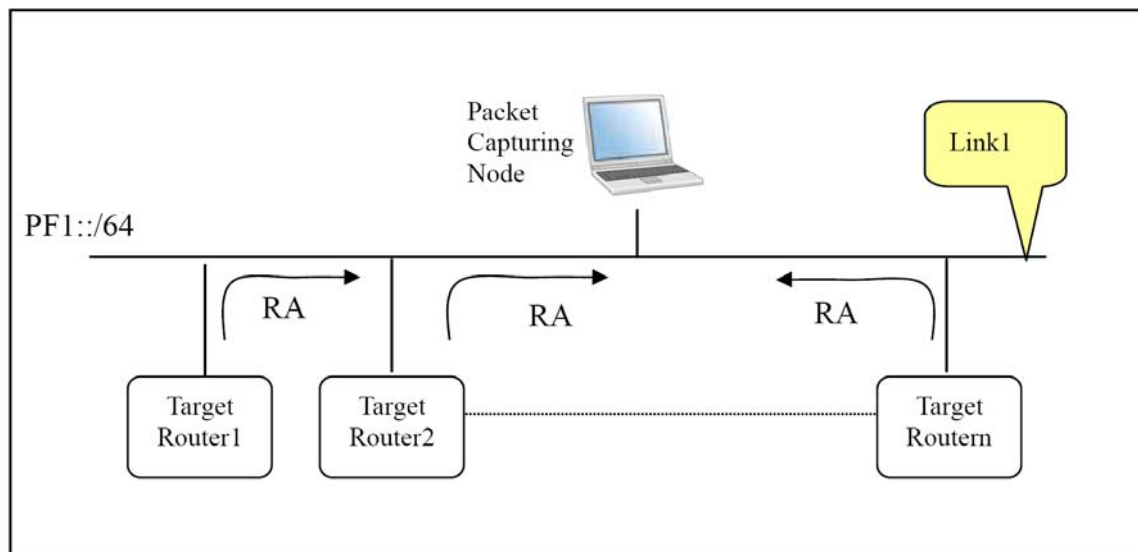
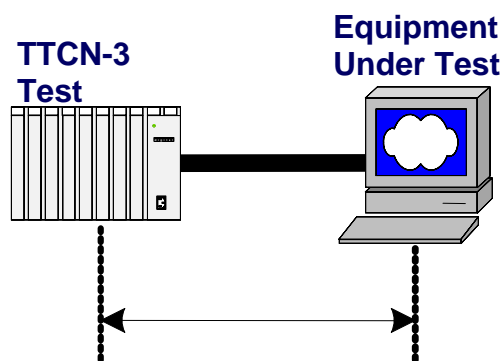
Topology:

Fig. 3.1. Topology for Router vs. Router

Phase 2 test beds and tests scenarios are complex. For more information look at the documents at www.ipv6ready.org

2.4. The additional tests by the ETSI STF 276 test team

ETSI, through its Specialist Task force 276 brought its full "IPv6 Core" test suite. This test suite encompasses 245 TTCN-3 Test Cases that were written in 2005 and have been fully validated since. For more information on the ETSI STF 276 project and TTCN3 see paragraph 4.3. as well as the EU IST GO4IT project in paragraph 5.3.



SUMMARY IPv6 Core Test Suite:

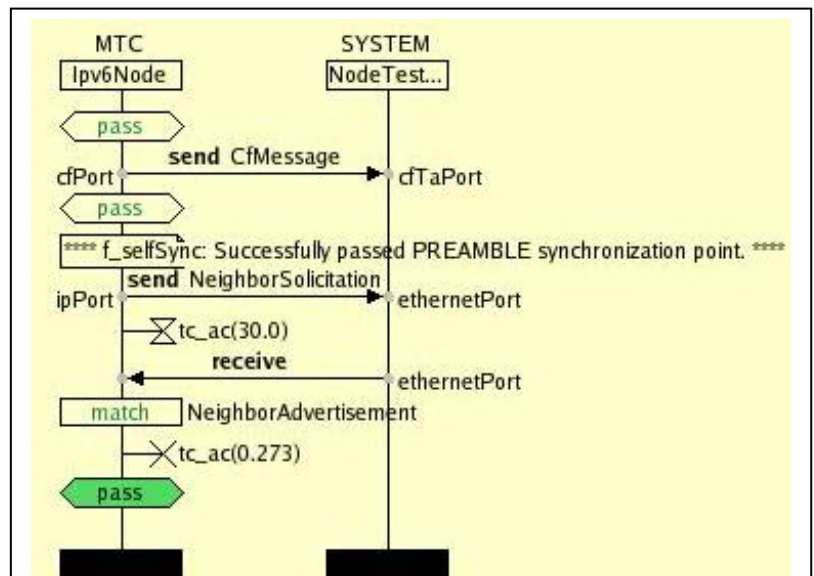
245 fully validated TTCN_3 Test Cases on "IPv6 Core protocols":

RFC1981 "Path MTU Discovery"	3 tests
RFC2460 "IPv6 Basic Specification"	27 tests
RFC2461 "Neighbor Discovery & Redirect"	173 tests
RFC2462 "Stateless Address Autoconfiguration"	11 tests
RFC2463 "ICMPv6"	30 tests

Details of IPv6 Core conformance test groups:

11 Test Groups for **hosts**:

1. Generate & Process IPv6 Packets (Generate & Process Extension Headers)
2. Initialize (DAD, Address Configuration)
3. ICMPv6 Functions (Echo Request, Echo Reply, Source Address)
4. Address Resolution
5. Reachability Determination
6. Neighbor Discovery (Process & Generate Neighbor Solicitations & Neighbor Advertisements)
7. Anomalies in ND messages
8. Anomalies in Router Advertisements
9. Process Redirect Messages
10. Process Router Advertisement
11. Anomalies in Redirect



Example of a simple test extracted from RFC2461, Clause §7.2.4 paragraph 1

Applicability: Host

Requirement Type: MUST

Context: The implementation receives a valid Neighbor Solicitation. All conditions are met for the implementation to respond with a Neighbor Advertisement message. The implementation is generating the advertisement.

Requirement: The implementation sets the advertisement's Router flag to zero.

11 Test Groups for **routers**

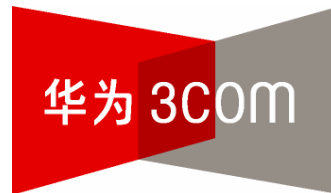
1. Generate and Process IPv6 Packets (Generate & Process Extension Headers)
2. Initialize (DAD, Address Configuration)
3. ICMPv6 Functions (Echo Request, Echo Reply, Source Address, Generate Error Messages)
4. Address Resolution
5. Reachability Determination
6. Neighbor Discovery (Process & Generate Neighbor Solicitations & Neighbor Advertisements)
7. Anomalies in ND messages
8. Process Router Solicitations
9. Anomalies in Router Solicitations
10. Generate Router Advertisements
11. Generate & Process Redirects

ETSI also brought a few "prototype" tests for IPv6 Mobility

- 1 **MobileNode** Test cases
 - Primary Care-of Address Registration + Returning Home
- 7 **HomeAgent** Test cases
 - Dynamic Home Agent Address Discovery
 - Mobile Prefix Discovery
 - Sending Binding Error message
 - Primary Care-of Address Registration
 - Return Routability Procedure
 - Handling Reverse Tunneled Packets
 - Returning Home

3. The Participants – The IPv6 vendors

10 vendors participated to the interoperability event. They are :



	Company	Product	Logo tests passed at Beijing Plugtests
1	Huawei 3Com	Router: SR8800 Series Switch: S8500 Series	IPv6 Ready Logo Phase 2 Core
2	North Jiaotong University	Router: R2600	IPv6 Ready Logo Phase 2 Core
3	Beijing Univ. of Posts&Telecoms	IPv6 IDS, DNS, NTP, MIPv6	IPv6 Ready Logo Phase 2 Core
4	Institute of Acoustics, CAS	Router: NG2008	IPv6 Ready Logo Phase 1
5	DYNA Technologies, Inc.	Application: dynaPhone	IPv6 Ready Logo Phase 1
6	Bitway	Router: BitStream 6832	IPv6 Ready Logo Phase 1
7	Jia Xun Fei Hong	IPv6 IDS: FH-IDS N100	IPv6 Ready Logo Phase 2 Core
8	ZTE	Router: ZXR10 GER	IPv6 Ready Logo Phase 2 Core

9	Huawei	Router: NetEngine 40E	IPv6 Ready Logo Phase 2 Core
10	Infinite	Router: InfiniteSwitch 8810R	IPv6 Ready Logo Phase 1

4. The test teams

4.1. TAHI



TAHI Project is the joint effort formed with the objective of developing and providing the verification technology for IPv6. It is founded at Oct. 1998.

The objectives are hereinafter.

1. We research and develop conformance tests and interoperability tests for IPv6.
2. Support implementers concerned with IPv6 in quality side.
3. Deployment of implementations conforming to RFC.

To achieve the objectives, TAHI Project opens the result and fruits of development freely.

Any implementers concerned with IPv6 can utilize them.

TAHI Project has organized world wide scale IPv6 interoperability test event eight times.

And TAHI Project has had a partnership with other test event like ETSI IPv6 Plugtests and Connectathon.

Now TAHI Project is playing a central role in IPv6 Logo Committee which is operating IPv6 Ready Logo Program in technical side.

See more at www.tahi.org

4.2. IRISA



IRISA is a research institute in which Inria (the French National Institute for Research in Computer Science and Control), CNRS (the French National Center for Scientific Research), The University of Rennes I and INSA (the National Institute of Applied Science, an engineering school in Rennes) are partners.

IRISA's activities are at the heart of Information and Communication Science and Technology (ICST) and contribute to achieve scientific and technological breakthroughs in telecommunications, multimedia information processing, software engineering, medicine and particularly bioinformatics.

IRISA participates in many technology transfert activities with major industrial partners, and this trend is likely to increase the coming years related to the participation in numerous European projects of the 6th IST framework program. These researches are recognized worldwide; international collaborations are developed with several research labs in the United States, Europe and Asia and IRISA develops a strong policy in the organization of famous international scientific conferences.

IRISA is also closely involved in academic training through teaching in universities and engineering schools and hosts more than 150 Ph-D students in its research teams.

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IRISA's Armor team is dedicated to Computer Networks (Internet protocols and architectures, wireless, performance evaluation, security, traffic engineering, pricing, QoS, multicast, etc) and Conformance and Interoperability Testing.

The Armor team has a critical activity in the deployment of IPv6 and is involved in several IPv6 related programs (test generation, methodology and tools, interoperability events, the IPv6 Ready Logo program, standardization, participation to working-groups of the IETF, training, etc.).

Since 2000, our engineers bring expertise to ETSI Plugtest service and take part since 2001 in the annual sessions of interoperability organized by Japanese project TAHI.

See more at <http://www.irisa.fr/tipi/>

4.3. ETSI STF 276

The ETSI STF276 a project of the Technical Committee MTS (Methods for Testing and Specifications)

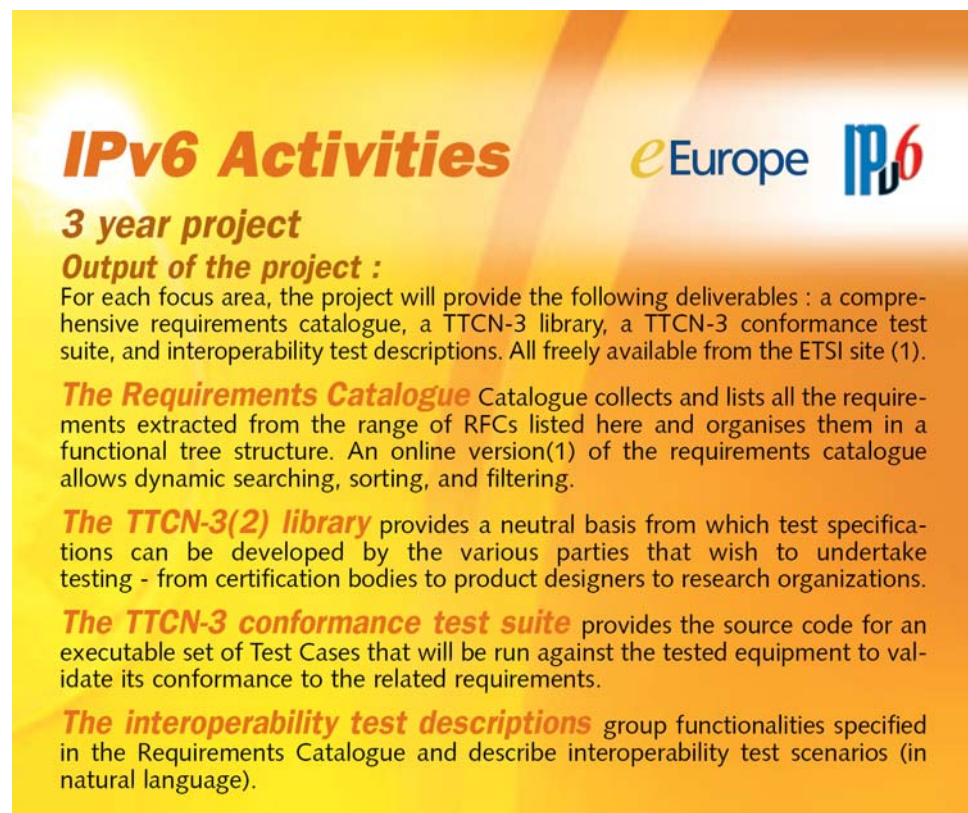


The ETSI TC Committee MTS

As Standards and interoperability become crucial factors in market success, the way that standards are written becomes increasingly important. ETSI's aim is always to produce documents that are clear and easy - easy to understand and easy to use. TC MTS (Methods for Testing and Specification) provides the frameworks and methodologies necessary to enable the other ETSI Technical Bodies to achieve this goal.

MTS meetings are attended by experts from the major telecommunications companies of Europe. Most large international telecoms businesses operate their own competence centres or at least have dedicated staff responsible for testing and specification. These organizations make decisions about which specification languages to use, how to use them and how they are to be supported by various tools. They come to MTS meetings to ensure that ETSI develops complementary guidelines for the use of these languages within standards.

Within the MTS work programme, the ETSI Specialist Task force 276 (STF276) project will provide a publicly available test development framework as well as interoperability test packages for four key areas of IPv6: core protocol, security, mobility and transitioning (IPv4 to IPv6). The approach will be based on flexibility and extensibility to facilitate testing of IPv6 products for interoperability in many contexts including development, procurement and certification schemes. This is an ETSI TC MTS project, co-funded by ETSI and the EC/EFTA. It will take into account ETSI needs such as those of 3GPP and TC TISPAN. The work will be done in a close relationship with the IPv6 Ready testing and certification program of the IPv6 Forum.



IPv6 Activities eEurope IPv6

3 year project

Output of the project :
For each focus area, the project will provide the following deliverables : a comprehensive requirements catalogue, a TTCN-3 library, a TTCN-3 conformance test suite, and interoperability test descriptions. All freely available from the ETSI site (1).

The Requirements Catalogue Catalogue collects and lists all the requirements extracted from the range of RFCs listed here and organises them in a functional tree structure. An online version(1) of the requirements catalogue allows dynamic searching, sorting, and filtering.

The TTCN-3(2) library provides a neutral basis from which test specifications can be developed by the various parties that wish to undertake testing - from certification bodies to product designers to research organizations.

The TTCN-3 conformance test suite provides the source code for an executable set of Test Cases that will be run against the tested equipment to validate its conformance to the related requirements.

The interoperability test descriptions group functionalities specified in the Requirements Catalogue and describe interoperability test scenarios (in natural language).

The project has the following objectives:

- to produce publicly available (standardised) IPv6 interoperability test specifications;
- to reduce the cost of testing and test development through the standardisation of an IPv6 test development framework and TTCN-3 library;
- to contribute to the implementation of the eEurope 2005 Action Plan;
- to strengthen the European influence in the IPv6 Ready certification program;
- to actively support and involve stakeholders in the standardisation of IPv6 test specifications and the IPv6 certification process;
- to contribute to the rollout of reliable and interoperable IPv6 network products

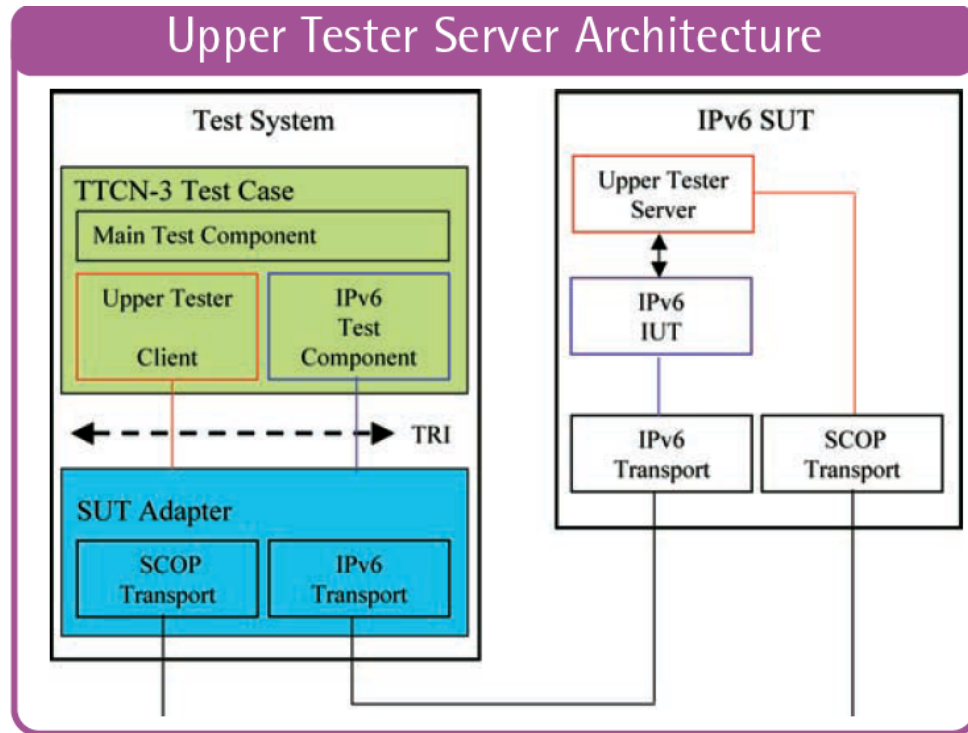
The use of TTCN3 by ETSI and then for the IPv6

What is TTCN-3? (see www.ttcn3.org)

- • Internationally standardized testing language
- • Look and feel of a regular programming language
- • Provides Full Test Execution Control



- • Dynamic concurrent testing configurations
- • Data templates with powerful matching mechanisms
- • Test verdict mechanisms
- • Test suite parameterisation and test case selection mechanisms
- • Independent of execution environment due to separate test system interface standards
- • Wide range of applications from mobile (radio) communications to Internet to software
- • Good book: “An Introduction to TTCN-3”,
<http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0470012242.html>



TTCN-3 Result Visualisation

The screenshot displays the TTCN-3 Execution Management window for a test named 'TC_COR_Prototype_04'. It features several panes: 'Management View' on the left showing the test structure, 'Dump View' and 'Test Data View' in the center showing test data tables, and a 'Properties View' on the bottom left. The 'Test Data View' contains two tables, 'Expected TTCN-3 Template' and 'Data', both listing fields like 'record', 'IPv6Header', 'version', 'trafficClass', 'flowLabel', 'payloadLength', 'nextHeader', 'hopLimit', 'sourceAddress', 'destinationAddress', 'icmpType', 'icmpCode', 'checksum', and 'data'. The 'Data' table shows specific values for these fields. At the bottom, a 'TTCN-3 Graphical Logging' pane shows a sequence diagram with messages like 'send SyncCmd', 'recv SyncCmd', 'recv EchoReply', and 'recv RouterAdvertisement'. A console window at the bottom right shows log messages, including a warning about an unexpected IP message received.

4.4. NICI

Taiwan's NICI IPv6 Standard and Testing Lab(STL) is to help carry Taiwan's NICI IPv6



Steering Committee's goals to promote the IPv6 technologies, push the IPv6 development projects and help transform Taiwan into a highly advanced IPv6 society. STL is now providing IPv6 Ready Logo Phase I and Phase II conformance and interoperability testing services to the public after its launching ceremony on 2003/07/01 in Taiwan. Through working with the Taiwan's IPv6 equipment manufactures and vendors, STL has accumulated IPv6 testing expertise and know-hows to reduce the testing time and help TW's IPv6 Ready Logo applicants to have easier and quicker 32's Phase I and 2's Phase II Logos certification process

To further provide verification for those IPv6 equipments' network management capabilities that might include fault management, configuration management, performance management and maybe more advanced accounting and security management after their network layer functions are IPv6 Ready Logo certified, STL is working to ensure network management functions are tested as add-on features for managing these IPv6-capable intelligent nodes in the Internet by developing SNMP(Simple Network Management Protocol, SNMP), the most commonly used network management protocol, to verify and assure the IPv6 network management functionality of these IPv6-capable equipments.

NICI IPv6 STL has also developed IPv6 MIBs conformance test suit to provide RFC 2465 IPv6 MIB and RFC 2466 ICMPv6 MIB verification functions since 2004/11/9 and has been providing this IPv6 MIBs conformance test tool (<http://210.242.96.195/>) to the world IPv6 world community.

Now NICI IPv6 STL is experimentally releasing its “SNMP Test Specification Draft (v0.1.0) and is asking comments for this SNMP Test Specification. Free download is available at

http://interop.ipv6.org.tw/pdf/IPv6_Ready_Test_Specification_SNMPv0.1.0.pdf.

Further SNMP test specification will follow the IETF's updates closely to provide SNMP testing capability to the IPv6 community.

STL mission is to serve Taiwan local IPv6 related equipment vendors or manufactures, academia and other non-profit organizations. Non-Taiwan vendors are also welcomed. STL is currently at the promotion stage. No fee is needed to apply for the test services. Free technical consultation is also provided.

For details and download the application form, please visit NICI IPv6 SITL website at <http://interop.ipv6.org.tw> . Email the filled application to interop@cht.com.tw, or call 1-886-03-4245638 for setting up a test appointment.

5. The Organizers

5.1. BII

BII Group developed based on Beijing Internet Institute which is the first private research institute focusing on IT and Telecom in China from the origins in 1995. BII began to dedicate to IPv6 as an active Promoter and Developer from 1999, and became a leading IT Consulting and Solution company in this IPv6 Age.



In IT Consulting Business filed, BII undertakes its mission through convergence by strategic communication channels and integrating wealthy knowledge of government and industries, local market understanding and breakthrough creativity. BII has initiated and implemented series of international events such as summits and forums which generated great influence within the industry worldwide. BII helps partners establish branches and provide correspondent value-added consulting service concerning on operation in China and marketing strategy. BII possesses abundant international, domestic resources and professional team.

BII develops certification and testing business with international partners from 2002, succeeded in expanding influence in professional fields and experts' communication. By now, all the major Chinese telecommunication manufactures have obtained IPv6 related certifications through BII's professional technical support and consulting.

In IT Solution Business field, BII is a pioneer company to develop and operate IPv6 network and application in China from 2002. So far BII won lots prize and bid in both government funded projects and business, because our very powerful R&D resources. BII is an ISO 9001 company of Computer Network System Integration, and Computer Software Design, Development, Manufacture and Service.

BII's Partners and Clients include Government, International associations and multinational companies. They are distributed in America, Europe and Asia. BII has built strong relationship with ICANN, IPv6 Forum, ITU, IETF, IEEE, ETSI, APNIC,

WiMAX Forum, China Telecom, China Netcom, Lenovo, ZTE, HuaBili, Intel, Microsoft, NTT, Hitachi, Samsung and AT&T since its foundation. Each partner gives BII a high appraisal.

With powerful R&D, confidence and rich experience, BII is capable to help clients to develop business in China, and BII like to cooperate with our partners to jointly develop new technologies, products, services, explore new business in China and World Wide, too.

5.2. The European Telecommunication Standard Institute (ETSI)

5.2.1. The ETSI Organisation



The European Telecommunications Standards Institute (ETSI) is an independent, non-profit organization, whose mission is to produce telecommunications standards for today and for the future.

Based in Sophia Antipolis (France), the European Telecommunications Standards Institute (ETSI) is officially responsible for standardization of Information and Communication Technologies (ICT) within Europe. These technologies include telecommunications, broadcasting and related areas such as intelligent transportation and medical electronics.

ETSI unites 688 members from 55 countries inside and outside Europe, including manufacturers, network operators, administrations, service providers, research bodies and users - in fact, all the key players in the ICT arena.

ETSI plays a major role in developing a wide range of standards and other technical documentation as Europe's contribution to world-wide ICT standardization. This activity is supplemented by interoperability testing services and other specialisms. ETSI's prime objective is to support global harmonization by providing a forum in which all the key players can contribute actively. ETSI is officially recognized by the European Commission and the EFTA secretariat.

ETSI's Members determine the Institute's work programme, allocate resources and approve its deliverables. As a result, ETSI's activities are closely aligned with market needs and there is wide acceptance of its products.

ETSI's standards are built on consensus.

Standardization in a changing world

The Information Society offers huge potential to enrich everyone's lives. We can communicate with the other side of the world almost as easily as we speak to our next-door neighbour. Our children take for granted what their PC or mobile phone will do. New technology is affecting our work, our rest and our play.

But with new opportunities come challenges. Technology makes things quicker, easier, better. But it is also more complex. Achieving the Information Society involves practical action by a wide range of players. Data exchange around the world, using different platforms, with different practices, different languages and character sets, requires a neutral tool for all parties to communicate. Standardization carves a path through this complexity.

The Benefits of Standardization

Standardization:

- ✓ enables interoperability
- ✓ encourages innovation, fosters enterprise and opens up new markets

- ✓ creates trust and confidence in products
- ✓ expands the market, brings down costs and increases competition

helps prevent the duplication of effort

Standardization is an essential requirement for the open exchange of information; without it, the network simply will not work.

There are two major caveats, however, without which standardization could impede rather than accelerate progress:

- ✓ standards must be produced at a speed that is consistent with market demand,
- ✓ standards must consider all interested parties, or they will not be widely acceptable.

5.2.2. Plugtests™, The ETSI Interoperability Service

The Plugtests™ service history dates back to 1999. Plugtests™ was created within



ETSI (European Telecommunications Standards Institute), a not for profit organization, with the purpose of organizing interoperability events. By incorporating Plugtests™ in its standardization activities, ETSI is complementing its support to conformance testing activities [e.g. use of formal specification techniques (SDL, TTCN)] and providing fast feedback into the standards process, enhancing the quality of the final deliverable.

The ETSI Plugtests™ Service is a professional unit of ETSI specializing in running interoperability test events for a wide range of telecommunications, Internet, broadcasting and multimedia converging standards. Events have been organised ranging from 30 to 500 engineers on sites from 100 - 3000 m2 (300 - 10,000 square feet). Plugtests events are open to all companies, organizations, working and study groups implementing a standard

Plugtests's customers are:

- Operators, Vendors or Equipment manufacturers
 - who are about to place their product on the market
 - who want to be sure of the interoperability of their products
 - who feel comfortable with the technologies but still want to improve their know-how

- Standardization bodies (ETSI, IETF, ITU, etc.) or any forum or interest group
 - that are developing an important standard or specification
 - that want to check the coherence of the specifications implemented
 - that need to check progress in using their specification
 - that want to let their members get useful feedback for quickly and efficiently adapting or improving their specifications

What's a "Plugtests™ Event"?

Plugtests refer to events where engineers get together to test the interoperability of their implementations between each other.

- Plugtests are part of the standardization process
- - The implementations tested are prototypes
- - The events are open to every developer
- - They are usually short duration events (1-5 days)
- - They take place within the time frame of the standards drafting

What is the goal of a Plugtests Event?

Interoperability. This is what standards are all about. Plugtests increase the probability of achieving interoperability by debugging the standard and companies' implementations at an early stage.

What happens during a Plugtests event?

Plugtests are for engineers who are implementing a standard. They are not for people who just want to see what the competition is working on.

Plugtests are also not trade shows. So care needs to be taken that only engineers with implementations come.

It seems that pretty sensitive information may be revealed at Plugtests. Doesn't this risk outweigh the benefits?

The fact that companies do go to these events demonstrates that, at least for those, risk outweighs benefits. We put this question to the participants. On a scale of 1 (risks outweigh benefits) to 5 (benefits outweigh risks), the total average score out of about 70 events is 4.2.

Frequently, equipment manufacturers are running non-publicized tests with friendly competitors, or are in field trials with operators. So why should they care to come to Plugtests?

Plugtests take place earlier in time, while the standard is still in the making. They don't make field trials superfluous.

Aren't interoperability events benefiting only small companies?

No. The question assumes – wrongly – that a small company has an implementation which is inferior to that of a big company.

Aren't Plugtests benefiting only non-experienced companies, i.e. companies that are just starting to implement the standard, over experienced companies?

That's precisely the reason why the time-window for such event is rather short, i.e. only as long as the standard is still in the making. As soon as there is a general understanding on how to interpret a standard, there is no more incentive for the experienced player to participate in Plugtests and give newcomers lessons for free.

Is a Plugtests Event only for equipment manufacturers?

Most of the participants are equipment manufacturers (vendors). But often operators are experimenting with the standard as well, writing their own implementations to get a better understanding of the standard and of potential problems, and so do participate.

Are Plugtests something new?

No. Plugtests have been around for many years, though less in the telecommunications world. They are also known as "PlugFests", "Interoperability event", "Group tests".

5.2.3. The ETSI Protocol and Tests Competence Centre (PTCC)

The ultimate aim of standardisation is to enable interoperability of ITC products, ideally on a global scale. ETSI members have long-recognized that well-defined, unambiguous and validated standards, together with testing, are crucial elements in achieving that goal.



The **ETSI Protocol and Testing Competence Centre** is a unique resource available to ETSI Technical Bodies for the application of leading-edge specification, validation and testing techniques in ETSI deliverables. The task of the PTCC is to help the ETSI membership produce the very best standards and products possible.

The PTCC works closely with the [ETSI Plugtests Service](#). Interoperability events organised by this service are a pragmatic and cost-effective means to validate standards and products.

A Good Standard Means Cheaper Production Costs

A well-specified standard is easier to understand and easier and cheaper to implement. It is less open to mis-interpretation, which increases the likelihood that different products based on the same standards will interwork seamlessly in the real world.

Validated standards are better standards

Modelling and simulation techniques can be used to show that a standard is correct and consistent and that it really describes the functionality it is supposed to standardise. Powerful tools can bring standards to life at an early stage, often leading to faster development.

Wide Range of Application

Major PTCC achievements include assisting ETSI Technical Bodies in the development of test and/or protocol specifications for:

- ▶ Mobile terminals for GSM, 3G, DECT cordless phones
- ▶ VoIP-related protocols including IPV6, SIP, H.323
- ▶ Wireless LANs, including HiperLAN2, HiperAccess, HiperMAN/WiMAX
- ▶ APIs for Open Service Access (OSA)
- ▶ Intelligent Networks (INAP)
- ▶ ISDN, Broadband-ISDN, VB5 etc

Tested Products Interoperate!

High quality standardized test specifications for key protocols play a direct role in ensuring interoperability. The ETSI PTCC is a world leader in testing, and manages all the ETSI Specialist Task Forces dedicated to the production of ETSI test specifications. In an average year this means 15-20 STFs, involving 30-40 testing experts from the ETSI membership.

PTCC services include:

- ▶ Long-term expert support dedicated to specific TB needs
- ▶ Proof-checking services (for UML, MSC, ASN.1, SDL, TTCN)
- ▶ Advice on the use of specialized tools
- ▶ Introductory presentations, tutorials, workshops and seminars
- ▶ Registration of Object Identifiers and XML Identifiers
- ▶ Defining testing strategy
- ▶ Introductory training on testing methodology and TTCN (especially TTCN-3)
- ▶ Production of test suites

The PTCC has at its disposal sophisticated tools for development, checking, simulation, validation, testing and, in some cases, automatic test case generation.

5.3. The EU IST GO4IT Project



European Commission
Information Society and Media



The Go4IT project allows better exploitation of the large European investments made to develop state of the art telecommunication research infrastructures by providing to all user communities open and generic tools to test IPv6 protocol implementations. These tools will increase end-users trust and confidence in the new IPv6 equipment and infrastructures.

The better exploitation of the Research Infrastructure depends on the capacity first to raise the level of knowledge and preparation of users to move to IPv6, and secondly to enlarge the IPv6 community of users. These two challenges are the principal objectives of the GO4IT project.

The objectives

While there is important effort to pool all forces to provide the necessary standards to deploy global and interoperable services, standards are not enough if operational tool and services are not available to get the critical mass of adopters from users and industry players.

Interoperability standards are part of the solution but the existence of well-defined and validated testing tools and facilities is also crucial for achieving the goal of interoperability.

The Go4IT project intends to provide Research Infrastructure users, the IPv6 development and user communities with IPv6 oriented test tools, test suites and the related services based upon the standardised TTCN-3 methods. This environment will allow more efficient use of the existing infrastructures, raise user knowledge and confidence in these new technologies and boost their adoption. Users will be able to validate compliance and interoperability before deployment and follow-on testing on the large European Research Infrastructures. In addition, the test environment will be made available to the IPv6 community at large and to any other interested party.

The action plan

To achieve the targeted objectives, the Go4IT project is conducting a set of activities and services.

They are:

- To provide a roadmap to a free, open & generic test environment
- To develop open & generic test tools for IPv6 protocols
- To offer free test tools, test services such as plug&test events and related support
- To raise user communities awareness of testing and validation methodologies

International aspects

The Go4IT consortium comprises partners from Europe, Russia, China and Brazil. This international consortium allow:

- To communicate and disseminate in covered countries. As an example, Go4IT is going to organise an Ipv6 plug&test event and a parallel session during the Global Ipv6 summit to be held in Beijing from April, 9th to April, 14 2006.

Project name:
Go4IT

Contract no.:
RI-026649

Start date:
1/11/2005

Duration:
30 months

Total budget:
1 273 705 €

Funding from the EC:
1 000 000 €

Total effort in person-month:
137 pm

Web site:
www.go4-it.org

Contact person:
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Project participants:

INNO	DE
ETSI	FR
INRIA	FR
CETECOM	SP
Fokus	DE
ISPRAS	RU
Jtest	FR
BII	CN
CATR	CN
BUPT	CN
IPT	BR

Key words:
Conformance testing
Ipv6 TTCN-3

- To gather users and market needs in these regions.

Service Activities

The Go4IT project intends to provide a set of services related to Ipv6 protocols testing.

1. Dedicated web portal
2. General documentation on test and validation approaches
3. Free executable test tools
4. Associated documentation
5. Synchronous and asynchronous users support

All these services will be progressively deployed during the year 2006.

Research Activities

First 6 months of the project have been dedicated to the definition of a roadmap toward an open and generic test environment, taking into account the users and market needs.

This will be concretised during the development phase that will target

1. Delivery of executable test suites
2. Delivery of the open and generic test environment

Networking Activities

The networking activities of the Go4IT project aim to increase the users awareness of test and validation approaches. This objective is ensured through

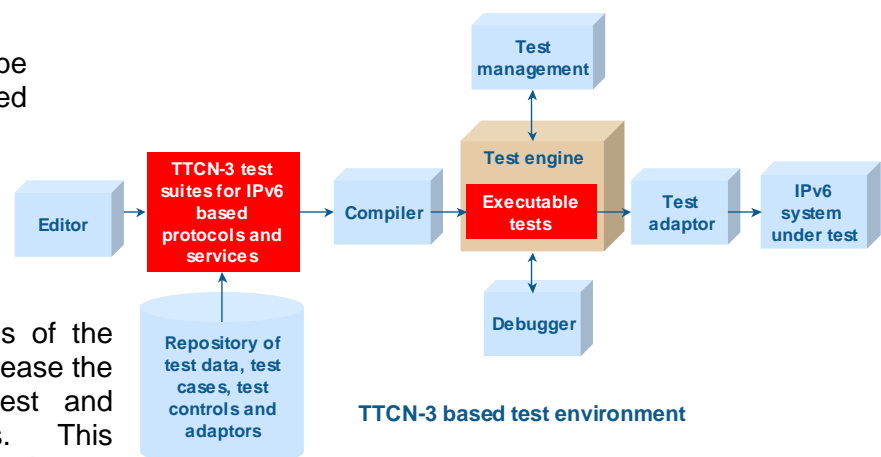
- The set-up of an open and collaborative web portal
- The organisation of Plug & Test events, bringing together Ipv6 vendors and researchers to test and verify the interoperability of their solutions
- The participation to conferences (Ipv6 global summit in Beijing, TUC3 conference in Berlin)
- The preparation of a users workshop to be held in 2007 in Russia

Community enlargement

To increase the impact and achievements of the Go4IT project, several levels of participation, from "being aware" right up to "active contribution", have been defined and open to communities

- **Be informed:** Share aims and results while accessing for free the full services offered by the Go4IT project and having the opportunity to give your feedback ... **Go4IT forum**
- **Contribute:** Get privileged access to private information and tools and participate in technical and dissemination activities ... **Go4IT factory**
- **Coordinate:** Ensure the project deliverables remain aligned to the overall objectives of Go4IT and the interests of individual contributors...**Go4IT consortium**

See more at www.go4-it.org



6. Conclusion

All vendors were happy to participate to the event and got the either the IPv6 Ready logo or the assistance and the test services they looked for.

This event was very successful and will likely be repeated on a regular basis in particular as the use and deployment of IPv6 will keep growing.

This event has also demonstrated the good cooperation worldwide between the Chinese partners and the other world wide ones. The GO4IT project is a 30 months project just started since November and therefore a solid cooperation is establish for the next coming years. It is expected that free test solutions will be soon become available through this project and then that would provide even bigger support to the industry in adopting, deploying or using IPv6.

7. Acknowledgement

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