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Abstract:

This document gives an overview on the current status of IPv6 deployment in Europe and the rest of the world.

The goal of this document is to give a snapshot of activities that have been initiated by the IPv6 Task Force, driven by the IPv6 Task Force Steering Committee and other related initiatives.

Keywords:

Europe, International IPv6 Task Forces, IPv6, IPv6 Deployment, IPv6 Status, IPv6 Task Force, IPv6 Task Force Steering Committee, National IPv6 Task Forces.

Revision History

The following table describes the main changes done in the document since its creation.

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Executive Summary

This document outlines a summary overview of the IPv6 strategic initiatives and actions designed and rolled out by the European IPv6 Task Force (IPv6TF) and the IPv6 Task Force Steering Committee (IPv6 TF-SC), and the key achievements thereof during the short project lifetime.

The efforts and achievements of the EU National IPv6 Task Forces, along with the international IPv6 Task Forces are summarized, as well.

Several significant initiatives and achievements can be reported:

- The EU IPv6 Task Force SC has been directly involved in several global and strategic ground-breaking political goodwill, infrastructure, services and application platform initiatives, such as the adoption of the US DoD mandating IPv6-ready products in procurements as of October 2003, the Chinese IPv6 6TNET and Council to achieve adoption by the Chinese Government by announcing the large-scale CNGI project, the Global IPv6 Ready interoperability initiative and the Japanese IPv6 Appli-Contest 2003.
- The IPv6 Task Force Steering Committee and members of the IPv6 Task Forces have disseminated the status of the IPv6 initiatives and projects in Europe in over 50 conferences, workshops and other events. The inauguration events of the IPv6 National Task Forces have fostered national interest and gained press attention specifically in countries where the national Task Forces remained active.
- The EU IPv6 Task Force membership grew from approximately 70 individuals at the Brussels meeting of the European IPv6 Task Force in 2003 to more than 500 companies (approximately 600 individuals), so the National Task Force activity has gathered a significant momentum in recent months.
- Most European countries now have an IPv6 Task Force established; as new nations join the European Union, it will be important to embrace them in national TF activities.
- The international related activities and equivalent bodies have adopted the EU IPv6 TF model accelerating cooperation and partnership at several levels, facilitating smooth conclusion of key agreements among Asia Pacific and Europe.
- Special actions and press releases regarding the cooperation with CEA (Consumer Electronics Association) and CENELEC (European Committee for Electrotechnical Standardization).
- Strategic events with high impact politically and economically have been orchestrated in Europe and the rest of the world, including the Global IPv6 Service Launch Event which a number of IPv6 applications demonstrated, and showed how IPv6 deployment has advanced to production status in networks including the key worldwide national research networks
- A renewed call for actions has been published by the European Task Force.
- The dissemination level of this work has achieved a large-scale university dimension, as the number of engineers trained worldwide on IPv6 is over 10,000 yearly and increasing. Access to the web site shows tremendous hits in the millions with over 12.500 unique visitors.

- Over 70 companies worldwide have applied and received the IPv6 Ready Logo enabling quality products to be offered to the market for quality deployment of IPv6 networks and design of IPv6-ready applications. Task Force members have been active in the definition of the IPv6 Ready Logo programme.
- Joint cooperation agreement with RIPE and the rest of the RIRs for the cooperative support of the global IPv6 deployment.
- The European Task Forces have held joint open meetings with the European IST IPv6 Cluster, allowing commercial and research interests to be exchanged. The IST web site has published over 600 IPv6 news stories in the past 9 months, including the results and achievements of the Task Forces.

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1. INTRODUCTION

This deliverable (D4, Final Project Report), provides a summary of the work done by the IPv6 Task Force Steering Committee and the European IPv6 Task Force, together with the National IPv6 Task Forces and other similar international activities.

It also provides a snapshot of the IPv6 deployment status, including future expected trends.

2. THE EUROPEAN IPV6 TASK FORCE SCENE

The European IPv6 Task Force was launched in April 23rd, 2001, as the result of an open call to the industry by the European Enterprise Commissioner, Erkki Liikanen.

Four Working Groups were established, which in January 2002 generated their final reports:

- Internet Infrastructure
  - http://www.europe.ipv6tf.org/PublicDocuments/IPv6TF-Infra.pdf
- Mobile Wireless
  - http://www.europe.ipv6tf.org/PublicDocuments/IPv6TF-Mobilewireless.pdf
- Next Generation Applications
  - http://www.europe.ipv6tf.org/PublicDocuments/IPv6TF-Apps.pdf
- Trials Framework
  - http://www.europe.ipv6tf.org/PublicDocuments/IPv6TF-Trials.pdf

A summary and conclusions document, the "Main IPv6 Task Force Report" (http://www.europe.ipv6tf.org/PublicDocuments/IPv6TF-Report.pdf), was drafted by the editorial team, and then submitted for the consideration of the European Commission.

The Communication from the European Commission to the Council and the European Parliament, "Next Generation Internet – Priorities for action in migration to the new Internet protocol IPv6" (http://www.europe.ipv6tf.org/PublicDocuments/com2002_0096en01.pdf) was generated as direct consequence of the IPv6 Task Force Main Report, and delivered on February 2002.

Furthermore, the Barcelona European Council, under the Spanish Presidency, in March 2002, in the Presidency Conclusions (http://www.europe.ipv6tf.org/PublicDocuments/consejo_europeo-barcelona.pdf) considered IPv6 as one of the foundations for European competivity, which was further stressed, together with broadband and 3G, in the e-Europe 2005 plan approved in the Seville meeting, in June 2002.

One of the actions called upon was the continuation of the work of the European IPv6 Task Force, in its 2nd phase, and the setup of equivalent initiatives at national levels. The conclusion of the current IPv6 Task Force Steering Committee project (in May 2004) marks the end of the 2nd phase, with the 3rd phase beginning at the time of writing with a renewed Steering Committee project.

The IPv6 Task Force Steering Committee project undertook this mission to continue the initial work, succeeding in Phase 2 in the creation of the European National IPv6 Task Forces, from September 2002 up to May 2004.

The volunteer work of the members of the National IPv6 Task Forces in Europe, together with the IPv6 Task Force Steering Committee project partners, and the broad and extensive international cooperation from all around the world, have been very important to help kick-off the broad IPv6 deployment, which is starting to happen now at all the industrial levels.

IPv6 is no longer a utopia, it is here, and is slowly waking up in all the business fields, with a slow but firm progress, and the national, international and regional initiatives have been key for this progress.

2.1 The European IPv6 National Task Forces

The following National IPv6 Task Forces have been created during the project life time:

- Spain (May 2002).
- Finland (August 2002).
- France (September 2002).
- Luxembourg (November 2002).
- United Kingdom (January 2003).
- Portugal (February 2003).
- Switzerland (April 2003).
- Germany (April 2003).
- Denmark (May 2003).
- Sweden (May 2003).
- Belgium (June 2003).
- Italy (October 2003).
- Austria (March 2004).
- Ireland (April 2004).

Several other countries including Netherlands, Norway, Poland, Greece, Slovakia and Russia, at least, will follow in the next few months.

2.2 IPv6 Task Force Coordination

Actions have been performed aiming at the enhanced coordination and continuation of the work performed within the IPv6 Task Force 2nd phase.

With the assistance of the Commission the TF-SC invited participation of representatives of not yet represented economic and industrial sectors likely to be impacted by IPv6, including representatives of national or regional IPv6 Councils and appropriate representatives from candidate countries.

The TF-SC has worked together with equivalent international and national initiatives, with important achievements towards the establishment of a Global IPv6 Task Force effort.

2.2.1 Background

A clear differentiation between the European IPv6 players is essential. The following shall clarify the relationship of the European IPv6 Task Force (IPv6TF), the European IPv6 Task Force Steering Committee (IPv6TF-SC), the national IPv6 Task Forces and national IPv6 Task Force Steering Committees, the IPv6 Cluster and the European IPv6 projects.

The European IPv6 Task Force is a team of 70 members or so, that primarily interact via a dedicated mailing list, but which have also met a number of times at Task Force plenaries around Europe. It was originally intended that the IPv6 Task Force should monitor and implement the actions arising from the 1st Phase. The Task Force members (and not the Steering committee) was foreseen to do this during the project, as defined in the IPv6TF-SC project preliminaries, with the assistance of the TF-SC, i.e. the action items refer to the IPv6 Task Force. A complication of the Task Force was that only few people were actively contributing during the

first phase, and thus the burden of work was falling on the TF-SC, when this was not originally planned.

The funded part of the IPv6 Task Force, the project, with very limited resources, is the Steering Committee of European IPv6 Task Force (IPv6TF-SC). Several of the project members have voluntarily led working groups in the 1st Phase of the IPv6 Task Force. The original idea of the project was to provide some financial support for the SC members to continue their work.

While the original idea was to continue most work with the Task Force, the approach was slightly shifted in favor of activating more people on the national level. The IPv6TF-SC members have put a significant effort to spread the word about the European IPv6 activities and Task Force and to help initiate the national/regional Task Forces. The regional Task Forces have regional Task Force Steering Committee and these do currently help with the IPv6TF-SC work. The plan is to closely coordinate the next steps with the national IPv6 Task Forces. Since they are also not funded, the workload they can take is limited as well and a great lot depends on their enthusiasm and good will. This takes quite some effort, but the visible results are encouraging, there is some press coverage, a network of experts and ideas for common work. The idea is that this will result in some common action, direction and more deployment of IPv6.

The dialogue between the European IPv6 Task Force, the EU and national IPv6 Task Force Steering Committees and European IPv6 projects is beneficial to gain a higher momentum than single initiatives. The following figure depicts the level of interaction between the national Task Forces, the EU TF-SC and the European IPv6 projects.

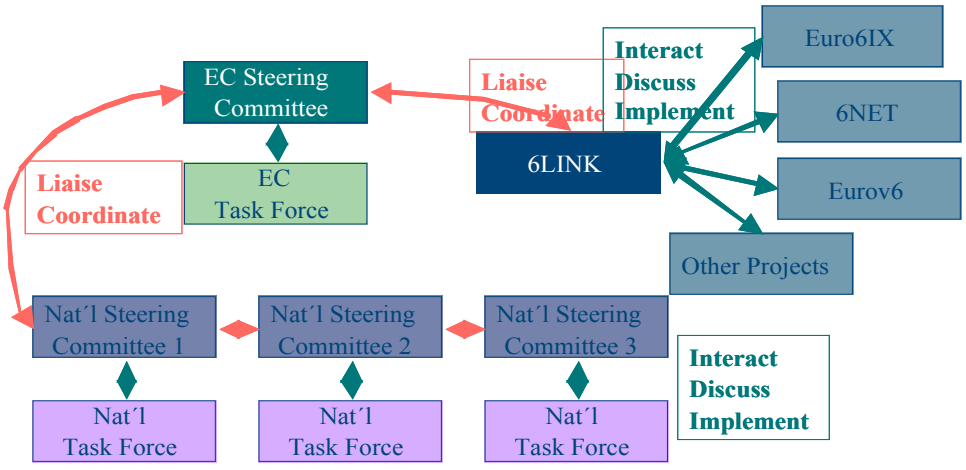

Figure 2-1: Levels of Interaction between the Task Forces, SC and Projects

The IST IPv6 Cluster (and the supporting project, 6LINK) is a different European activity, providing for active exchange of knowledge in the European IST IPv6 research projects, looking for synergies, preventing overlaps and helping discover open issues. There is a direct interaction with the IST IPv6 Cluster, and additionally several of the partners in the IPv6TF-SC are active members of 6LINK and therefore there is also additional coordination through the member companies. The IST IPv6 research projects typically include both academic and industrial partners (SMEs and large companies), with universities funded 100% and commercial organizations funded 50% by the Commission.

The same goes for the large IPv6 projects. The companies participating in the IPv6-TF-SC project actively are also active project members of many of the European IPv6 projects. BT, Consulintel, DT and University of Southampton (Soton-ECS) are members in Euro6IX; UoS is

also member of 6NET; other current and past projects include Moby Dick, 6INIT, 6WINIT, where several of the IPv6TF-SC partners companies participated. A complete list of projects can be found at the IST IPv6 Cluster web site (http://www.ist-ipv6.org).

The following figure depicts the membership relationships between the various European IPv6 activities and the EU IPv6 TF-SC.

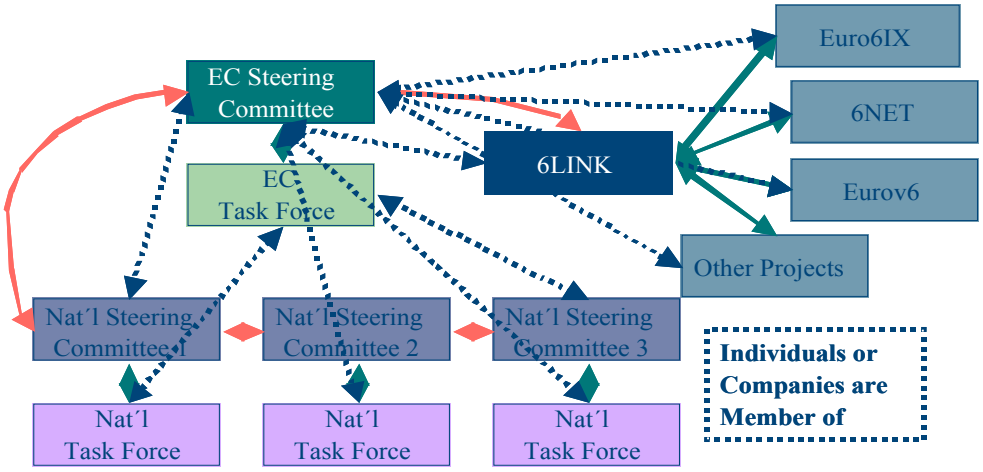

Figure 2-2: Membership Relationship between the IPv6TF-SC and other Activities

2.2.2 Coordination Results

The work with Phase 1 and Phase 2 of the IPv6 Task Force has now been actively pursued during the creation of the regional IPv6 Task Forces; some members of the IPv6 Task Force in fact are active in their regional and national Task Forces. This is however, a constant ongoing process in terms of activating networks of experts from the IPv6 Task Force on every possible occasion for further discussion of the next steps.

Through the national IPv6 Task Forces the membership grew from approximately 70 individuals at the Brussels meeting of the European IPv6 Task Force in 2003 to more than 400 companies (approximately 500 individuals), so the European national Task Force activity has gathered a significant momentum in recent months. The level of interest can also bee seen in the growth of visitor counts to the key European IPv6 web sites (including the European TF web site and the IST IPv6 Cluster web site, the latter having trebled its readership in the past 9 months). The list of member individuals and companies can be found on the National TF web pages or through the contacts for each national IPv6 Task Force.

In addition, more than 1,000 individuals representing over 500 companies/entities are being involved worldwide in regional Task Forces or similar initiatives.

2.3 Key Results of the IPv6 National Task Forces

2.3.1 Approach and Mission of the National Task Forces

The various national task forces have used similar approaches. So far, most of the national Task Forces have a good mix of industry and academic support. They have mission statements that aim to address the introduction of IPv6 in the country or region. Most of the Task Force members have contact to governmental agencies, although there are few examples where there is

an active support (not financial) from a ministry (positive examples are Spain and France). Other governmental agencies have been supportive in words or are not fully aware of the IPv6 Task Force activities. A main problem is that the current economic situation reduces the possibilities to get funding support for awareness-initiatives like that of the IPv6 Task Force. In such cases the Task Forces may seek to piggyback other funding, e.g. broadband initiatives.

Due to the voluntary character of the National IPv6 Task Force, the power of the task forces is dependant on the available workload of the members. But all national IPv6TF aim at the awareness for and deployment of IPv6 and therefore the cohesion between the national Task Forces is quite good. One of the aims of the European IPv6TF-SC has been to aggregate the plans of the national IPv6 Task Forces and to avoid duplication of work among the Task Forces.

2.3.2 Reaching a Critical Mass

The question about what is being done to attract more organizations/industries and especially the key movers into these national IPv6 Task Forces is a tough one. The possibilities to attract players depend heavily on the activities on the national Task Forces and their connections. Where there is a strong network and experts are available, the situation of the Task Force is usually better than where there are only technical people with few outreach possibilities. Some Task Forces have managed to get a fair level of press attention.

There are usually limitations in the outreach capabilities of the Task Forces, since they usually have no budget for dissemination activities and therefore the means to achieve and address a larger community are somewhat limited. None of the Task Force with their limited means could claim to target all industries and this does not seem to be an important goal (given the limitation). Some Task Forces have instead looked for qualitative members that are willing to contribute, rather than have a large number of silent members.

2.3.3 Targeting the EU Enlargement Countries

So far now, the main focus has been to reach out for larger economic countries and countries where there were good opportunities for activities to be successful. The means there is still a need to address countries where there is no recognizable IPv6 activity. Resources to achieve this are very limited for the IPv6TF-SC at this stage. Further resource support would be required to engage these nations.

Initial activities have been started, though it is a slow process.

3. KEY FINDINGS FROM THE IPV6 NATIONAL TASK FORCES

After this initial "kick-off" period and after achieving a reasonable critical mass and representation, the European IPv6 Task Force started to reap the benefits of its initiatives by collecting the key findings from the field, combining country-specific results to identify common successes and common areas that need concerted action to resolve.

3.1 Achievements

Most of the National IPv6 Task Forces have achieved a certain level of:

- Awareness and working meetings.
- Different focused working groups.
- Local web site, ftp, mail exploders and archives.
- Press releases and articles.
- Participation from key industry, education, research and government groups.
- National Research and Education Networks connected to GÉANT with IPv6 (frequently natively), and offering IPv6 services to their community.
- Trials in different business sectors.

In some cases, Internet Exchanges (IX) have incorporated IPv6, or started to consider doing so. So far, only a couple of countries have deployed IPv6 services at the national NIC (e.g. in France with AFNIC), though many plan to do so.

Only a few ISPs, in some countries, have started to offer IPv6 services, but several have concrete plans to start deploying. We expect these to reach a broader base of customers during 2005.

3.2 Challenges

There is a consensus about the following challenges for the success of this mission:

- Lack of official commitment from governments.
- Lack of strategic recognition of the importance of IPv6.
- Lack of new IPv6-ready applications.
- Lack of concrete business models.
- Lack of customer demand (customers/consumers want services not protocols).
- Lack of European Industrial leaders.
- Lack of simpler and clearer technical answers.
- Lack of funding for the local National Task Forces activities.
- Lack of funding for IPv6 take-off in the ISPs and industry in general.
- Lack of benchmarking of the real IPv6 deployment status and the bigger picture.

It is also interesting to note that in several countries most of the achievements have not been well disseminated and recognized by the media. For example, at least in one country several public and private entities have confirmed that they are mandating IPv6 in their new procurements policies, but this has gone unnoticed and not been advertised publicly. In many cases, organizations do not wish to make their future technology plans public; the outlook and policy of such companies will vary. One major router vendor only announced IPv6 in its roadmap three

months ahead of releasing it in production code, while in contrast another had made open beta code available for many months. Of course now, all major router vendors have IPv6 support in production code, but this example shows how product announcements may hide true progress in application and service support in the coming months.

Though government support has been provided in most of the countries to kick-off the National IPv6 Task Forces, there is in general a lack of real commitment (or funding) from the government to set the pace. There are relatively simple technical solutions available to enable IPv6 in common web server platforms (e.g. current versions of Apache and IIS on Windows Server 2003), but none of the EC or European governmental web sites have been enabled up to now. Anyway, some work on this direction is already on-going in several European entities and results are expected in a few months. One problem here is that such sites are often outsourced, and thus changes in technology can take significant time. The outsourcing issue is a wider one, affecting many government and public sector organizations (including schools and health services).

3.3 Next Steps

In general, there is a unanimous agreement to push forward with the following activities:

- Continue and strengthen the work and cooperation of the National and EU IPv6 Task Forces, defining National and European recommendations.
- Focus on IPv6 deployment and application opportunities.
- Continue the awareness and dissemination activities, communicating on best practices.
- Update the national Task Force web sites and create an EU IPv6 web portal.
- Promote the creation of a centre of excellence, which can be an independent reference point for those wishing to design, build, develop or deploy IPv6 products.
- Convince the public and private organizations to demonstrate their commitment, demanding IPv6 in any procurement.
- Arrange for key public web sites to be accessible with IPv6.
- Gather more potential industrial actors (SMEs, integrators, ISPs, WISPs, etc.).
- Work on “business case” examples.
- Study a detailed deployment roadmap.

3.4 IPv6 Deployment Status in Europe and Required Actions

As a result of the October 2003 meeting in Milan and the work and initiatives undertaken by the European and National IPv6 Task Forces in Europe during the first half of the 2nd phase, a deployment status and updated call for action have been released, including a press release (http://www.eu.ipv6tf.org/PublicDocuments/ipv6tf_phase2_v5.pdf).

This report makes comprehensive recommendations for EU Member State governments, for the European Commission and for industry.

The collective initial findings of the 2nd phase of the European Union IPv6 Task Force are detailed in this report and in the minutes of the Milan meeting including the following key messages:

- The critical mass needed for IPv6 adoption in Europe and the member states has been garnered, though in a slow process, which needs further strengthening through increased active participation of key industry players and involvement of the new European countries to design a comprehensive European IPv6 roadmap.
- Global cooperation, including Research & Development, policy-making and real life deployment, should be strengthened to pave the way to a global scale deployment of IPv6 and equitable access to knowledge, avoiding the creation of isolated Internets and allowing a rhythmic adoption at a global scale.
- The National IPv6 Task Forces are still in the formation phase (with many with less than one year of activity) with a relative degree of success engaging their governments in the dialogue and recruiting volunteer experts to formulate objectives and action plans. The "volunteer model" delivers on a best effort basis. A dedicated or funded model would be more suitable for such an important, large-scale undertaking.
- The actual level of IPv6 deployment is still imperceptible, especially when compared with Asia Pacific and the expected growth in other areas (including North America).
- A number of barriers and hurdles towards IPv6 deployment have been detected, namely deployment business models, return on investment models, CEO/CTO unawareness and some political showstoppers. The creation of a new panel of experts, led by the IPv6 Task Forces, winning stakeholders from the public and private sector, including SMEs, will allow in depth investigation of these barriers and the generation of new recommendations and case studies.
- Similarly, a number of technical barriers had been identified, and it is necessary to address these, while driving forward technology in a networked world that will increasingly rely on IPv6 as an enabler. The creation of a research-led center of IPv6 expertise or excellence would address this requirement. Such a center should combine a technology-driven focus with the needs determined by the IPv6 panel of experts, and both should liaise in this mission.
- The adoption of IPv6 by governments, universities, schools and the European Commission, where it make sense (e.g. deployment on web sites), will generate confidence in the minds of end-users (as is happening with the DoD announcement in the US), and a possible trigger for business cases.
- Public and private sector procurements should require IPv6 capabilities for future-proof investment.
- Top-level national NICs should accelerate their support of IPv6.
- IPv6 deployment progress should be benchmarked in order to monitor its success.
- The achievements and progress of the Task Forces must be widely disseminated by means of an extended IPv6 Task Force portal.
- It is of paramount importance to take all required actions aiming at the continuation of the work performed by the "European IPv6 Task Force" and renew its mandate for the third phase with an enlarged team including the national IPv6 Task Forces and selected key industry players (ISPs, ASPs, vendors) with a "funded model". The third phase, beginning Summer 2004, should focus on tangible success in the short-term deployment in wired and wireless broadband access and strategic innovative revenue-generating applications (consumer electronics, end-two-end security, e-vehicle, etc.) and in the longer term strategic objectives (e-Infrastructure, GRID, 4G, Ambient technology,…).

While IPv6 deployment should be market led, the European IPv6 Task Force encourages the consideration of the recommendations contained in this report because of their critical importance towards the achievements of the eEurope 2005 goals (including "broadband for all", security and Ambient Intelligence) and the future development of Internet technology in Europe.

The European Commission is called upon to submit the results of the work of the 2nd phase of the IPv6 Task Force, contained in this document, to the European Council.

The complete "IPv6 Deployment Status in Europe and Required Actions" document is available at http://www.eu.ipv6tf.org/PublicDocuments/status_and_required_v1.8.pdf.

The press has widely spread this message, including articles and interviews to some of the key actors (http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=187).

3.5 Global IPv6 Service Launch Event

One of the key events that have been organized in cooperation with the IPv6 Task Force, was the Global IPv6 Service Launch Event, in Brussels on 15-16th of January 2004 (http://www.global-ipv6.net).

The event was funded and hosted by the European Commission together with the 6NET and Euro6IX projects, with some contributions from other projects, including GÉANT.

It was targeted to policy-makers, leading experts and managers from Research, Industry and Business active in the area of IPv6 and research networking from around the world.

The event included several end-user oriented demonstrations, a press conference, appearances in EuroNews (http://stream1.euronews.net:8080/ramgen/mag/hitech-ipv6-en.rm?usehostname) and a virtual inauguration ceremony to celebrate the availability of Global IPv6 connectivity.

A picture gallery is available, together with streaming of the complete event (which was streamed live over both IPv4 and IPv6).

Figure 3-1: Global IPv6 Service Launch Event Logo

The Global IPv6 Service Launch Event had the following objectives:

- Highlight the importance and impact of IPv6.
- Publicize the advanced capabilities of the large IPv6 test-beds, GÉANT and the national research and education networks with regard to their IPv6 deployment.
- Promote international coordination and collaboration.
- Emphasize the international dimension of research expanding from regional into global cooperation.
- Further develop a global perspective on research networking.

- Inform leading edge and influential users about the achievements of the large European IPv6 tests-beds and GÉANT and how they can benefit from them.
- Promote the new possibilities available with IPv6.

Representatives of the Informatics Directorate (Telecommunications and Network) of the European Commission were present, in order to prepare for the internal adoption of IPv6, with the support of the IPv6 TF-SC.

Several members of the IPv6 TF-SC participated in the event committee and in several related activities, including the preparation of the final report, which included the following summary:

> On January 15-16, 2004, the European Commission hosted the Global IPv6 Service Launch event in Brussels. The event formally heralded the availability of world-wide native IPv6 connectivity spanning IPv6-enabled research networks around the globe, including networks such as GÈANT in Europe, Abilene in the United States, CA*net4 in Canada and WIDE in Japan.
>
> The two-day event saw presentations from key players from the worldwide research networks, from industry and from the political arena. This document summarises the talks given by the speakers, and documents the launch ceremony and parallel IPv6 technology demonstrations.
>
> The focal point of the event was the launch ceremony held on the evening of the 15th January. Eight representatives of the worldwide research networks were each invited to speak briefly on the importance of IPv6 from their perspective. European Commissioner Erkki Liikanen added his view:
>
> "Today we are here to celebrate the arrival of IPv6 and its integration into Europe's key research infrastructure. IPv6 is part of the next generation of Internet technology. It will improve the performance of the Internet and it will enable the Internet to be integrated into a wide range of devices and services in our homes, businesses and while on the move. Some of these are demonstrated at this event - from household appliances to the IPv6 enabled vehicles.
>
> The introduction of IPv6, alongside unrestricted access to broadband, is of great importance. Together they will help to offer citizen's wider access to an advanced Information Society. They will deliver improvements in economic growth, competitiveness, and productivity through the provision of a whole new generation of services and applications, including 3G.
>
> Possible applications and services that this new technology promises to usher in are limited only by the imagination and many applications are currently under development now. If you consider that every device in the world is individually addressable, then this opens up limitless possibilities."

Figure 3-2: Commissioner Erkki Liikanen at the Global IPv6 Service Launch ceremony

In parallel to the presentations, a demonstration area was set up which showcased the results of a number of IST and other research projects where IPv6 has been the base technology for deployment. The demonstrations included examples of collaborative work undertaken with international partners around the world, illustrating the potential for a global perspective on research networking.

In terms of its goals, the Launch Event was considered a success. It managed to demonstrate future potential for IPv6 services and applications, highlighting the results achieved in research to date and the capabilities of the international research networks to offer a production quality IPv6 service to universities and research institutions.

The complete "Report on the Global IPv6 Service Launch Event", is available at http://www.eu.ipv6tf.org/PublicDocuments/ipv6-global-service-launch-03.pdf.

During the press conference, European Commissioner Erkki Liikanen, stated:

- Today we are here to celebrate the arrival of IPv6 and its integration into Europe's key research infrastructure.
- IPv6 is part of the next generation of Internet technology. It will improve the performance of the Internet and it will enable the Internet to be integrated into a wide range of devices and services in our homes, businesses and while on the move. Some of these are demonstrated at this event - from household appliances to the IPv6 enabled vehicles.
- The introduction of IPv6, alongside unrestricted access to broadband, is of great importance. Together they will help to offer citizens wider access to an advanced Information Society. They will deliver improvements in economic growth, competitiveness, and productivity through the provision of a whole new generation of services and applications, including 3G.
- Possible applications and services that this new technology promises to usher in are limited only by the imagination and many applications are currently under development now. If you consider that every device in the world is individually addressable, then this opens up limitless possibilities.

Take as one example road and traffic systems. Your in-built navigation system would do more than direct you to your destination based solely on global positioning and a set of passive digital maps, it would interact far more intelligently with the environment and could find routes dynamically based on information it receives back from other IPv6-enabled devices - for example enabling you to find the quickest or most efficient route taking into account heavily congested/blocked roads. Traffic signalling would become more intelligent and be able to respond instantaneously to the different patterns of traffic flow throughout the day. Road safety would benefit too. Drivers could be forewarned of accidents on the motorway or of slow-moving traffic and sensors of vehicles involved in collisions could automatically notify the emergency services.

Home appliances are another area which springs immediately to mind. Appliances enabled with IPv6 could be controlled remotely via a PC or even a hand-held 3G device giving home-owners total control of their homes from anywhere in the world. DVD players could be developed which would download or stream films from the Internet and alarm sensors could be manufactured cheaply which would automatically detect problems and forewarn the relevant services preventing unnecessary loss of life or damage to homes.

IPv6 also opens up enormous potential too for the end-user. With fast data connections and IPv6 at their fingertips, end-users will find they have the wherewithal to become tomorrow's data providers, opening up untold possibilities for end-user industries.

- The Union’s commitment to IPv6 started with the creation of a European IPv6 Task Force in 2001. Since then the European Commission has provided policy orientations which have been taken up at the highest political level.
- These efforts have been well rewarded. GÉANT, the European Research Networks backbone, is now IPv6-enabled and is today the world's largest IPv6 research network.
- GÉANT offers the greatest geographical coverage of any network of its kind in the world (from Iceland to the Caucasus). GÉANT has a dual role of providing an infrastructure to support the advanced communication needs of the scientific community (such as IPv6), as well as providing an infrastructure for research on state-of-the-art communication technologies itself.
- The GÉANT network is being continually upgraded, and currently has a total trunk capacity of 185 Gigabits per second (more than twice as powerful than any other research network in the world). In addition, the network provides 14.5 Gigabits per second of international connectivity to North America and Japan. Further links, to the Latin American and Mediterranean regions, are being implemented by the EU-projects ALICE and EUMEDconnect respectively and will become operational within the next few months. These regional backbone networks will be IPv6-enabled as well.
- During these two days we are celebrating the world's first global native IPv6 research network which is an important first step towards an IPv6-based commercial Internet. This event therefore underlines the fact that IPv6 is here and beginning to make its presence felt.

4. NON-EUROPEAN INITIATIVES

Here we summarize the statuses and initiatives of IPv6 TFs around the world. All these regions were represented at the IPv6 Global Service Launch Event in Brussels in January 2004.

4.1 Asia Pacific

The Asia Pacific IPv6 Task Force (http://www.ap.ipv6tf.org) was launched as a consequence of the IPv6 Summer Retreat meeting in Seoul (23rd August 2003), with the participation and cooperation of IPv6 TF-SC members.

In the region the most active countries are Japan, Korea, India, Taiwan, China and Malaysia. All of them have different related activities and initiatives.

In Japan the e-Japan Priority Policy Program that was established in March 2001 is very relevant. The Program states that it will realize an Internet environment equipped with IPv6 by 2005 where everyone can receive, share and transmit diverse information securely, promptly and easily, regardless of location. With current ongoing cooperation with non-governmental organizations, the Japanese IPv6 Promotion Council is determined to contribute in the most effective manner.

The Japanese IPv6 Promotion Council was the first entity in the world that achieved the corresponding government embracement of IPv6. In fact, the history of this group is a continuous history of achievements.

They organized the 1st IPv6 Application Contest in 2003, and the IPv6 Task Force was invited to participate. The 2nd Appli-Contest was launched in May 2004.

The award delivery ceremony was organized in a joint ceremony simultaneously in Madrid and Tokyo, during the Madrid 2003 Global IPv6 Summit.

Members of the EC IPv6 TF attended and presented at the EuroIndia 2004 event in New Delhi. A number of new contacts and potential collaborations have been seeded as a result of this activity, including a new proposal for dissemination of the work of IST IPv6 projects to Indian academic and commercial organizations.

4.2 North America

The NAv6TF (http://www.na.ipv6tf.org) is an open group, accepting members from all geographies (not just North America), and all members of the NAv6TF represent themselves as individuals, not their companies.

The EC IPv6 Task Force helped in the creation of the North American IPv6 Task Force to focus on the adoption of IPv6 to the US government and the Department of Defense.

The following actions were undertaken:

- Meeting with Richard Clarke, Chair of the US Cybersecurity initiative Oct 17, 2002 in Boston. Latif Ladid (EC IPv6 TF chairman) presented the impact of IPv6 on security and privacy (see http://www.nav6tf.org/slides/repository.html IPv6 Security & Privacy - Latif Ladid [pdf] (posted 10/30/02))

- Meeting with Howard Schmidt, co-chair of the US Cybersecurity initiative Nov 8th, 2002 in Washington. Latif Ladid presented the draft of the NAv6TF's Response to U.S. National Security. V2.0 of the final versions are listed here (http://www.nav6tf.org/slides/repository.html).

This action has led to the inclusion of IPv6 in the final recommendations document: The National Strategy to Secure Cyberspace, which led to the decision of the DoD to announce adoption of IPv6-capable products. "The National Strategy to Secure Cyberspace is part of our overall effort to protect the Nation. It is an implementing component of the National Strategy for Homeland Security and is complemented by a National Strategy for the Physical Protection of Critical Infrastructures and Key Assets. The purpose of this document is to engage and empower Americans to secure the portions of cyberspace that they own, operate, control, or with which they interact. Securing cyberspace is a difficult strategic challenge that requires coordinated and focused effort from our entire society, the federal government, state and local governments, the private sector, and the American people" (see http://www.whitehouse.gov/pcipb/).

In June 13th, 2003, the DoD announced their strategy towards gradually implementing IPv6, requesting that all the acquisitions after September 30th 2003 should be IPv6-Ready. The complete deployment will be done by 2007. The EC IPv6 TF was represented in discussions with the DoD at the US IPv6 Summit event in June 2003.

A North American IPv6 Backbone Network Pilot, Moonv6 (http://www.moonv6.org), has been deployed. The Moonv6 project is a collaborative effort between the North American IPv6 Task Force (NAv6TF), the University of New Hampshire - InterOperability Laboratory (UNH-IOL), the Joint Interoperability Testing Command (JITC) and various other DoD agencies, and Internet2. Taking place across the US at multiple locations, the Moonv6 project represents the most aggressive collaborative IPv6 interoperability and application demonstration event in the North American market to date.

In October 2003, the Commerce Department announced the launch of a federal government task force to study how deployment of a new industry-developed version of the Internet Protocol, known as IPv6, will affect competitiveness, security and the needs of Internet users (http://www.ntia.doc.gov/ntiahome/press/2003/IPv6_10142003.html).

In January 2004, the Task Force released a Request for Comments on the costs and benefits of a transition from IPv4 to IPv6.

In cooperation with the NAv6TF and the IPv6 TF-SC, a workshop on Consumer Electronics was organized in Las Vegas, at CES (Consumer Electronics show), in January 2004.

4.3 Africa

At the time being only Tunisia has initiated IPv6 activities, including local conferences, with the cooperation of the IPv6 Task Force.

There has been strong official cooperation with the "Agence Tunisienne D'Internet" (http://www.ati.tn). A web site with IPv6 information is available at http://www.ipv6net.tn.

There is also some work towards participation in WSIS 2005.

A conference organized by ICANN had also a strong IPv6 component (http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=155).

4.4 Middle East

There have been some initial activities with SaudiNIC and Saudi Aramco, in order to prepare the introduction of IPv6 in Saudi Arabia, with some piloting already started (http://www.ipv6.net.sa).

The possibility of organizing a local conference is being investigated.

4.5 Latin America and Caribbean

Coincidently with the 6th LACNIC meeting, in Montevideo (Uruguay), 29th of March to 1st April 2004 the FLIP-6 (First Latin American IPv6 Forum) was organized, with the support and participation of the IPv6 TF-SC.

Several relevant organizations supported this meeting, as a precursor to the implementation of the IPv6 Task Force in Latin America and the Caribbean.

The aim of this Forum was to encourage and promote the adoption of the IPv6 protocol within the region covered by LACNIC through the exchange of experiences relating to this subject.

The Forum targeted a wide group of participants, including professionals working within the academic and commercial areas, university networks, ISPs, NAP operators, ccTLDs, etc.

The event web site is available at http://lacnic.net/en/flip6.html.

Subsequent meetings are being organized already.

In addition, a few countries started already related activities, with Cuba, Mexico and Brazil being the most advanced, but also strong R&D activities are being organized in most of the countries.

5. TOWARDS A EUROPEAN IPV6 ROADMAP

5.1 Overview

The European IPv6 Task Force is aiming to draw up a roadmap for the major development steps for the deployment of IPv6 in Europe.

Currently a rough outline for the roadmap exists. The roadmap needs to be refined and major developments and trends need to be outlined for the next three years. This activity is not only driven by the European IPv6 Task Force and the European IPv6 Task Force Steering Committee, but also by the national and regional IPv6 Task Forces.

The Task Force Steering Committee has taken the approach to raise support for IPv6 implementation on the regional/national level. Those regional/national activities are creating a stronger link between the development of a common view on the necessary steps for the introduction of IPv6 and concrete activities in each country and company. The task of the EU TF-SC is to aggregate all activities for more impact. The following figure depicts this idea.

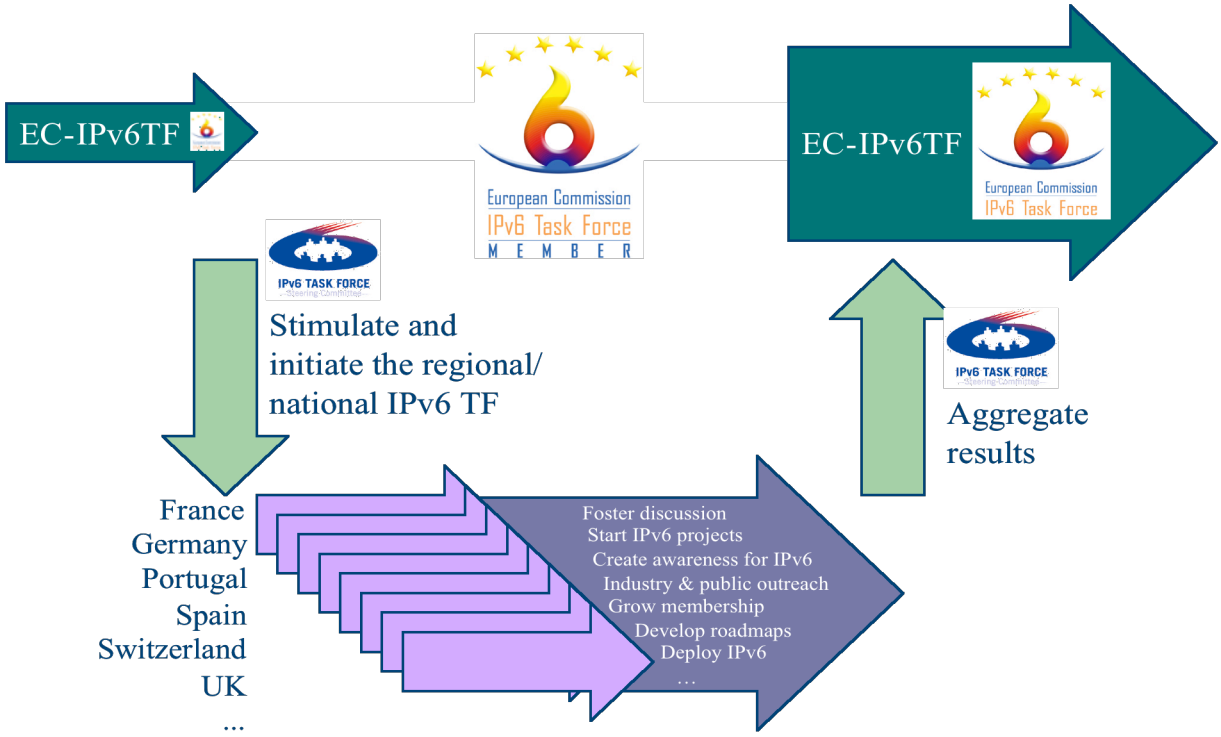

Figure 5-1: Gaining Momentum through National IPv6 Task Forces

This process and discussion is currently ongoing, so the roadmap depicted here reflects a work in progress. The roadmap will be updated and hardened during Phase 3 of the IPv6TF-SC starting in Summer 2004.

5.2 The Current Roadmap

From the TF-SC perspective, the next steps on the roadmap for the remainder of 2004 and early 2005 include:

- Initiate further European regional IPv6 Task Forces. The introduction of TFs in the new European Union nations will need special consideration (and additional resources).
- Merge regional IPv6 TF action plans to enhance the European roadmap.
- Aggregate national initiatives at the European Level for maximum impact.
- Review and prioritize action items of IPv6TF Phase 1 and Phase 2.
- Exploit the major results of the IST IPv6 research projects in conjunction with the IST IPv6 Cluster (the Cluster is currently funded until Spring 2005; some form of continuation of the Cluster's function will be required throughout 2005).
- Create briefing white papers on particular topics including:
    - Open or missing IPv6 issues to include the issues (and solutions) into a roadmap.
    - IPv6 Privacy (this has been completed by the IPv6 TF-SC's consultation with the Article 29 Working Party and the Euro6IX project).
    - DNS (including reverse DNS, IPv6 transport root servers, secure DNS).
    - IPsec, PKI.
    - Measuring IPv6/Benchmarking IPv6 deployment progress.
- Assist the IST IPv6 Cluster in determining that FP6 projects consider and use IPv6 wherever possible. This should include "flagship" projects such as EGEE, which as yet do not see IPv6 as important.
- Foster collaboration in IPv6 activities between Europe, Asia Pacific and North America, including connectivity for initiatives between the regions (e.g. Moonv6 to Euro6IX and 6NET).
- Goal: Develop recommendations in standardization and towards the EC as an initiative in the scope of IST Framework 6 (FP6). For example, one recommendation might be to investigate possibilities and options for a small, focused (Virtual) European Centre of Excellence for IPv6, as a reference point for industry and commercial organizations, where such expertise may complement the IPv6 TFs and IST IPv6 Cluster (and project) activities.

The following sections summarize this roadmap together with the progress and achievements of the IPv6 Task Force and the IPv6 TF-SC project.

The future steps of the IPv6 deployment in Europe are somehow vague in terms of timeframe, since they actually depend on a number of constrains and developments that could only be estimated from the today's perspective.

Furthermore the IPv6 Task Force Phase 3 will deal with those prognostics in a more detailed fashion, taking care of the IPv6 European roadmap update.

The following figure depicts the main achievements of the work done in the IPv6 Task Force since initiated and the vision of the expected progress for the IPv6 Task Force Phase 3 and the European deployment of IPv6.

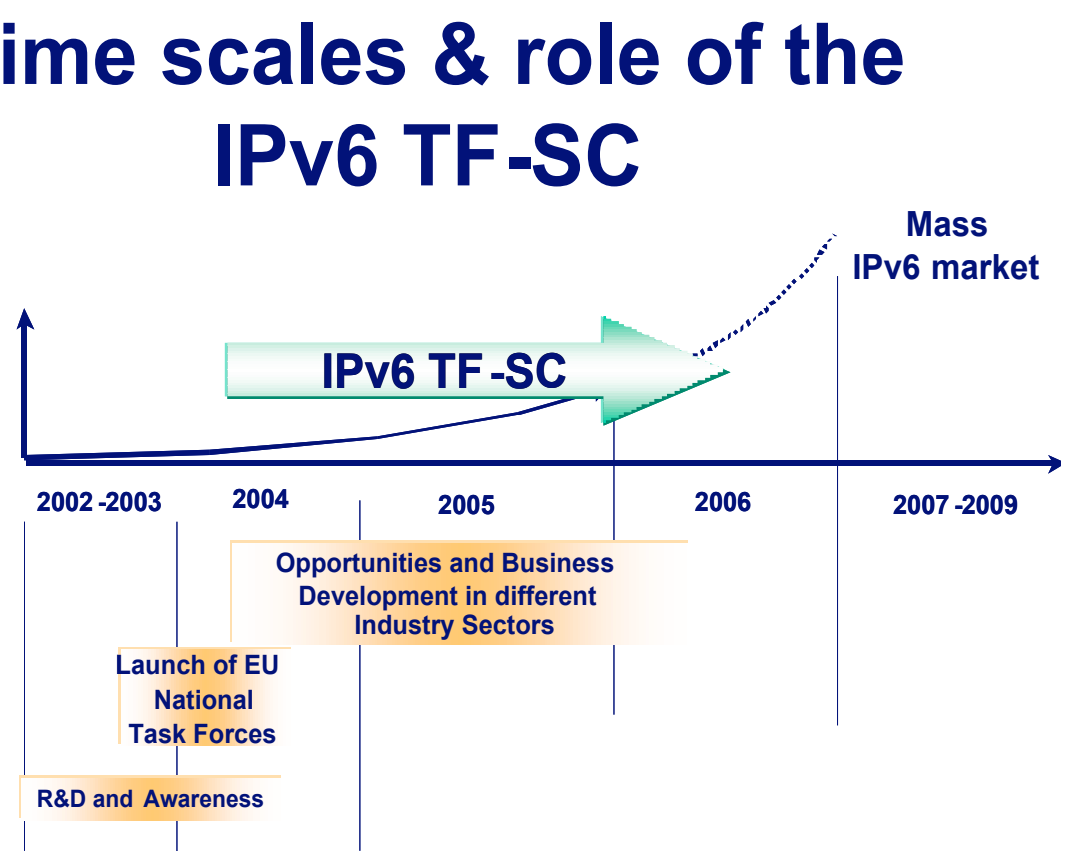

Figure 5-2: Future IPv6 Expected Timeframe

5.2.1 Roadmap for Deployment of IPv6 in Selected Industry Sectors

5.2.1.1 Overview

The following picture gives an overview on the expected deployment of IPv6 in various industry sectors. It starts with an overview on the expected private and industry sectors that we expect to be affected first.

Members of the IPv6TF-SC are involved in scenario description and analysis in the IETF for enterprise, unmanaged, ISP and 3G network deployment of IPv6. IST IPv6 projects are being proactive in such standards contributions, as a better understanding is gained on potential priorities and timeframes for deployment from a technical perspective. Political and commercial uptake of the IETF technology is still required. The IST IPv6 projects are also heavily involved in IPv6 application development and porting, again giving insight for the IPv6 TF-SC on potential adoption. The task in hand is to turn potential into reality. The first signs of that reality are now emerging, initially in the Asia-Pacific region (e.g. IPv6-capable printer hardware).

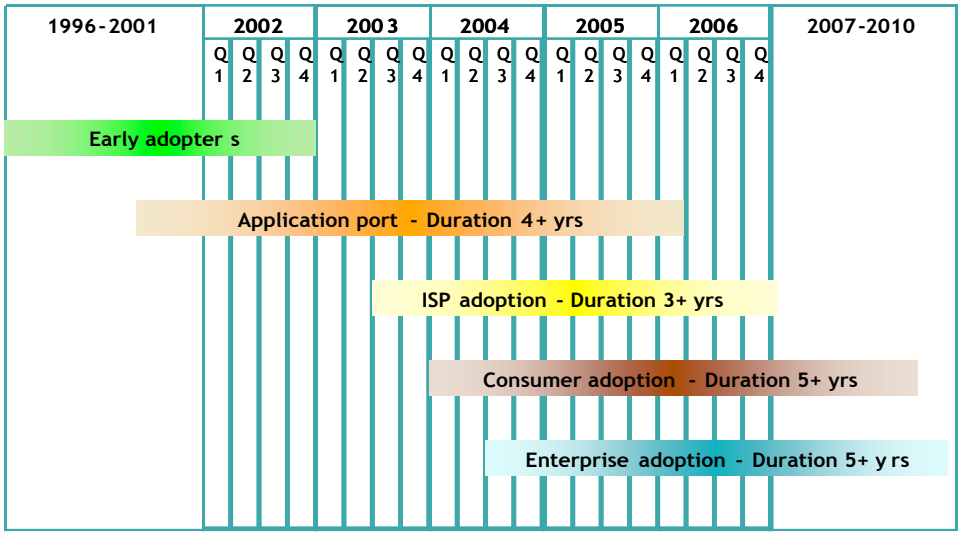

Figure 5-3: IPv6 Rollout

5.2.1.2 IT-Rollout for IPv6

The following picture provides an overview on expected steps in organizations and companies that are starting to integrate IPv6 into their IT planning. The initial plans would generally assume a transition to dual-stack deployment (addition of IPv6 capability) rather than an immediate migration to IPv6 only operation (which is the long-term goal). IPv6 only networking may emerge earlier in places where IPv4 global address space is not so readily available, e.g. in many areas of the Asia Pacific, or African or Latin American regions.

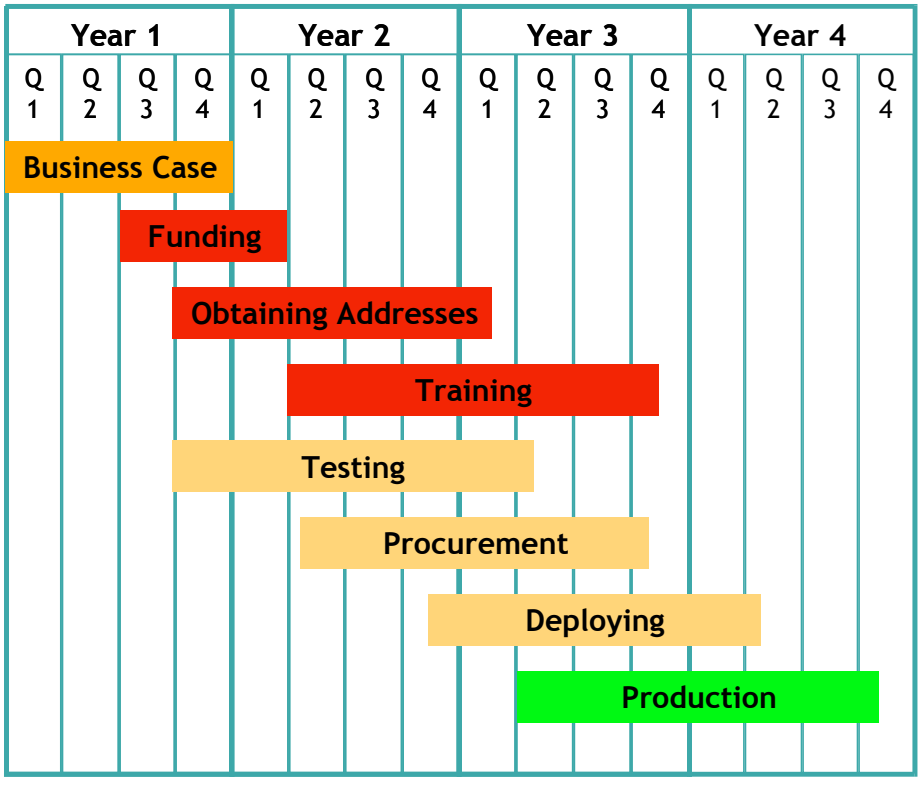

Figure 5-4: IPv6 Deployment

5.2.1.3 Internet Service Providers (ISP)

One of the main problems currently is that many of the ISPs currently are hesitating to invest in major new activities due to the current economic situation in general. New business is welcome, of course, but IPv6 currently does not automatically imply a new big business. Indeed, deploying a dual-stack IPv4-IPv6 infrastructure may imply a short-term increase in costs (managing both protocols) until operations become streamlined and new IPv6 functionality can be leveraged.

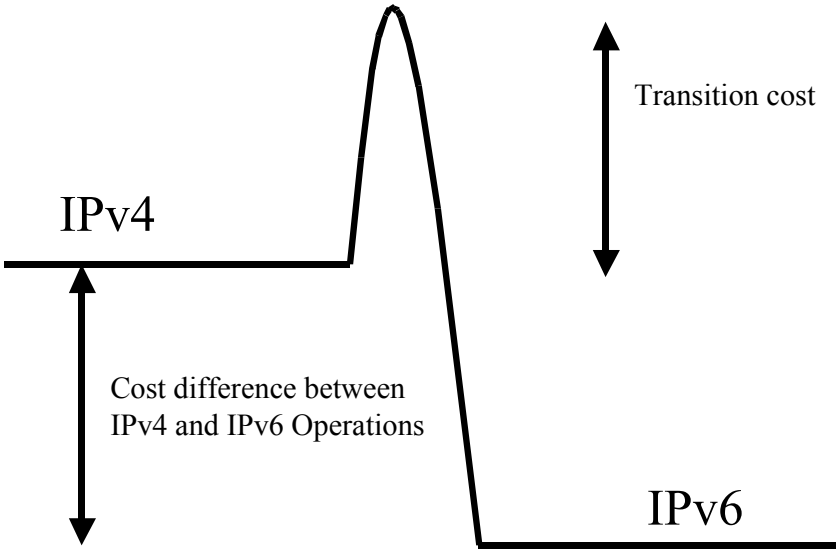

Figure 5-5: IPv6 Transition Cost (depiction following Chown, Doyle, Ladid, et. al.[1])

The best way to overcome this dilemma is through creating customer awareness so that they are motivated enough to request their ISP for IPv6 service. Particularly (large) business customers requesting IPv6, asking to move some parts or all of their networks or VPNs to support IPv6 would be a big incentive for ISPs to start providing services and products beyond customer projects. This would lead to more investments in IPv6 on the provider side. This would also be of benefit for private customers. Not many private customers, though a growing number, are currently asking for IPv6. In comparison their impact seems to be less than a large network contract with a big customer.

Many major ISPs are prepared internally to do a rollout of IPv6, once a business decision is made. A business decision currently largely depends on customer requests. First customer requests are apparently handled as a project business. Massive customer requests would lead to an acceleration of internal decisions and a quicker IPv6 rollout. It is expected that over the coming 24 months IPv6 demand from customers will grow to a level, where few ISPs will be able not to offer IPv6 services in Europe. This situation seems to hold true for Backbone networks as well as for access and broadband access networks.

IPv6 capability is now present in all major router vendor implementations. A natural procurement cycle will lead to the deployment of IPv6 capability at very low additional cost in terms of acquisition, though additional costs exist in terms of management of the network, and areas including training.

Thus another point that could bring the ISPs to the decision of implementing IPv6 service is simply the rising number of supported IPv6 features within the actual router implementations that meet the special ISPs requirements. Especially the support of IPv6 for broadband access as

[1] *http://www.ipv6forum.com/navbar/papers/IPv6-an-Internet-Evolution.pdf*

well as the IPv6 transport possibilities over an IPv4 (MPLS) based provider backbones (without service degradation for IPv4) are a big step towards an IPv6 enabled carrier scale provider infrastructure.

The encouraging exception in IPv6 deployment can be observed within the academic networks, where no business case is required for deployment of IPv6. Here, IPv6 is seen as the "right thing to do" for the benefit of researchers and students alike. As a result, at the time of writing GÉANT (the pan-European IPv6 research network interconnecting all the NRENs) is dual-stack IPv6 and 18 of the NRENs have connected natively to this service, most of them having their own dual-stack service. The 6NET project accelerated significantly the deployment of IPv6 in these networks (from a planned end-of-2004 to reality in the early part of 2003). The academic deployment has been important for validating the production deployment of IPv6 for commercial ISPs. In some cases, academic deployment leads to IPv6 technology awareness and adoption in commercial ISPs, e.g. where regional networks are outsourced to commercial ISPs, who then deploy IPv6 for the academic network using technologies like 6PE.

In a similar way, the US DoD did not require a business case for IPv6, rather it knew that IPv6 was the tool to do the job for their personnel, including the military forces. As a side effect, the scale of the US DoD market for procurement of IP-enabled products creates a business case for vendors and developers in itself.

Besides that the necessity of supporting IPv6 within the global military communication radiates to the other Defense Departments of NATO, so that the requests from these big customers can trigger their ISPs to offer IPv6 services faster than expected.

A few ISPs in Spain and France have already started to provide some initial commercial services, most probably as a result of the Spanish and French IPv6 Task Forces activities and the major push done in these countries, including a strong government involvement. Other European ISPs are also involved in their national Task Forces and investigate in internal as well as EU triggered research programs their own IPv6 implementation strategies.

Regarding the lack of a business case in terms of short-term revenue, it is necessary to consider that the "business cases" are here already here in terms of an obligation to fulfill missions.

For academic research, the mission is to educate, to train, to produce engineers, PhDs as well as operators, technical, marketing, commercial people. Their "business case" is to provide efficient tools for Research Education, for the benefit of the economy. This is a key driver for universities to deploy IPv6, perhaps initially in their Computer Science departments, and then to the wider campus. Such a deployment scenario is being built within the IETF through the work of 6NET and Euro6IX project partners, some of whom are also IPv6 TF-SC members.

Today we have mostly succeeded in demonstrating the validity and robustness of deployment of IPv6 on backbones, but so far very few large universities or research organizations are running an IPv6 operational network. Consequently, one of the priorities should be not only to have connected labs working on the technology, but deploying IPv6 pervasively in European universities, where new IPv6 applications and services can then be built.

The same is true for military businesses. They need to deploy more efficient networks to fulfill their missions and to be cost effective with technologies. The DoD moved from ISO to IP because of the availability of products. The business model was clear: Low cost and product availability.

Where early adopter ISPs are moving to IPv6, it is often because they have people who know the technology and because they see IPv6 as a necessity and an opportunity. Early deployment experience can lead to potential market advantage in the long term.

Encouraging to the ISPs is the statement from NTT/Verio, one of the earlier large-scale adopters, regarding the cost of IPv6 in their network. Cody Christman, Verio's Director of Product Engineering indicated that the deployment costs are extremely low. IPv6 has been on their roadmap for years, and therefore the transition to IPv6 has been a consideration in all normal hardware and software upgrade cycles since that time. Some resources have been enlisted to perform testing related to IPv6, but testing is always performed on new hardware and OS releases. NTT/VERIO's transition to a dual-stack backbone will normally require some software and hardware upgrades, but the costs for those are already factored in as part of an overall maintenance strategy to maintain the highest-possible network performance. As a result, it is difficult to quantify the specific costs for the deployment independently of an ongoing maintenance strategy.

Is interesting to note that the same stance is being facilitated by several other telcos and ISPs, even in Europe, which are deploying IPv6. Basically, they indicate that the upgrade is (relatively) almost zero cost, except for the education and training of the maintenance personnel, and the requirements for network management of IPv6 services. Also it is observed that the maintenance of IPv6 networks is usually 30-35% cheaper than equivalent IPv4 networks, according to what is being indicated by early adopters in big telco-networks.

5.2.1.4 3GPP/UMTS

While 3GPP networks were initially perceived as one of the prime motivators of IPv6, and indeed was part of the standard (3GPP release 5), there was a pushback from some of the operators and vendors to allow the usage of IPv4.

The release 5 of the 3GPP standard mandates the usage of IPv6 (and only IPv6) for the IMS (IP Multimedia Subsystem). However, at the end of 2003, a few operators stated that they would much prefer to be able to use also IPv4 for IMS. It seems that the main motivation for that request was the lack of a complete set of all the equipment pieces required for this deployment (supporting IMS with IPv6, which was not available from most of the manufacturers).

Today we can state, after several talks with different mobile operators, that this pushback is not longer going to be a hurdle, because during 2004 the equipment started to be ready and they have also indicated that they don't want to pass by the pain of deploying IMS with IPv4 and private addresses, which will definitively generate some interoperability problems, not only within their own networks, but also when roaming from one network to another, or even just when calls need to work across different operator's networks.

The other problem was also that the deployment of UMTS itself was delayed and somehow being endangered because the extremely high cost of the licenses. But this situation seems to be now clearer and the deployment started already during 2004.

The conclusion is that UMTS will be deployed with IPv6, with a small delay from the initial planning, and is only a question of which applications will take advantage of IMS, in order to predict the utilization rate and the market grow. This will for sure have an impact in the deployment of IPv6 across the rest of the non-mobile networks, considering the need to interoperate and make sure that those services and applications become transparent regardless the type of network and terminals being used.

5.2.1.5 VoIP

One frequently asked question is about actual or future "killer IPv6 applications" and whether VoIP is a good example.

Many countries around the world are aggressively rolling out various always-on broadband access mechanisms aimed at the domestic and SME market. Many of these always-on access mechanisms are based on cable modem or xDSL type technologies. With the current IPv4 address allocation rules adopted by the Internet Registries around the world the number and type of IPv4 addresses allocated to these always on connections range from (best to worst):

- A few static IPv4 globally routable IPv4 addresses.
- One static globally routable IPv4 address.
- One dynamic globally routable IPv4 address.
- One private IPv4 address – access to the global Internet is only via NAT.

The vast majority being of the middle two types i.e. one static or dynamic globally routable address, with multiple addresses often being available only at an additional, premium price. The result is that end users are installing NAT devices on their premises to enable multiple devices to be connected to the broadband always on access (which of course then hampers the ability to run services end-to-end between two such NATed networks). In fact there is a complete range of small cheap xDSL modems/routers that have NAT and a variety of interfaces (Wi-Fi, USB hub, etc.) built in.

Many of the xDSL providers are also the old incumbent telcos that still have a large proportion of their revenue streams from the existing PSTN. The telcos are however facing a problem that the existing PSTN exchanges are in need of replacement/upgrades but with lifetimes of 20+ years are reluctant to invest money in the PSTN when there is a generally accepted view that voice traffic will migrate from the PSTN to IP technology. Deutsche Telekom, for instance, announced in January 2004 that by 2020 all telephone traffic will run over IP.

Telcos around Europe that also have an increasing always-on xDSL network are therefore facing a problem. On the one hand they do not want to invest in the PSTN. But on the other hand they cannot easily migrate voice to the emerging xDSL networks. This is because of the way IP addresses have been allocated, resulting in many users deploying their own NAT devices, which would cause significant problems for a VoIP service. This is because while it is quite possible to connect *out* from a NAT network, it is considerably harder, if in some cases not impossible in a realistically manageable way, to connect *in* to a NAT network, especially with multiple services running within it.

The answer, of course, is IPv6. IPv6 over xDSL allows multiple globally routable addresses per access network and hence all the problems of NAT are overcome. It is also logical to use SIP as the controlling protocol and then considerable synergies with the 3GPP Release 5 specification are achieved. In practice this would allow true seamless services between the fixed and mobile environments. The use of IPv6 also allows Mobile IPv6 to be used and hence inter-domain roaming to be possible i.e. fixed to Wi-Fi, etc.

The type of voice service offered over IP would not be a direct replacement of the PSTN service but could be a much richer offering as presence, multimedia, multi party etc services could also be offered.

The "price" for the removal of NAT is that the "security by obscurity" principle of NATs is also removed, and thus with all devices globally addressable security has to be introduced in gateway

devices (firewalls in xDSL routers) or in devices (e.g. personal firewalls). However, the advantage in end-to-end service should be seen to significantly outweigh the perceived advantage that NAT offers. Indeed, IPv6 has the property of being resilient to network port scanning, because an IPv6 subnet has 2^{64} potential IPv6 addresses (not just the one or at most 256 addresses a typical IPv4 host or subnet would contain in a SOHO environment).

In summary it would seem that technically VoIPv6 has much to offer; gets around the NAT problem, has synergy with the 3G (or the 802.11 Wireless LAN) environment, enables mobility and additionally allows adjunct services to be offered. It also has a business model of saving investment in the PSTN and providing additional revenue streams on the current predominately flat rate xDSL access offerings.

Whether SIP-based VoIP is an "IPv6 killer application" remains to be seen. It may certainly prove to be a strong candidate, especially where available in IPv6-enabled WiFi hotspots.

The potential advantage for Mobile IPv6 as a key feature in 3G and Beyond Networks also has yet to be fully explored; with it, IPv6could find a dominating position in the future telecoms environment (e.g by enabling direct peer-to-peer communication between two roaming hosts in a WLAN hotspot by removal of the triangular routing of IPv4 MIP).

Nevertheless, there exist still some open issues with VoIPv6 (e.g. interworking between IPv4 and IPv6 VoIP systems in a carrier scale environment), but those should be solved within the near future (a number of IST IPv6 projects are working in this area) so that VoIP will develop to a communication scenario that motivates ISPs for implementing and offering IPv6.

5.2.1.6 Broadband PLC

Power Line Communications (PLC) allows transmission of data over power lines. PLC is the network with the most enabling infrastructure already in place in the world: Power line is ubiquitous.

IPv6 provides a package of enhancements to the Internet compared to the capabilities of the existing IPv4 protocol sustained by the Network Address Translation (NAT). NAT has unfortunately created new barriers during the massive and unexpected growth of the Internet with the consequence of breaking the initial end-to-end communications concept.

But nevertheless, this massive IPv4 deployment happened mainly in rich countries, creating a digitally divided society. IPv6, together with other technologies, like PLC, are key in order to restore the situation and alleviate the digital divide pain, enabling more people, entire countries to access information, knowledge which in turn will allow them to take part in the global economy, benefit and possibly create new knowledge.

New access technologies, like PLC, that have already been evaluated for a number of years, have failed to support the initial Internet paradigm. These new technologies have now a new opportunity with IPv6, because IPv6 will facilitate their deployment.

That seems the case for Power Line Communications (PLC). PLC has been around since the 30's but was never seriously thought of as a medium for communication due to its low speed, low functionality and high deployment cost. However, new modulation techniques have enabled this medium to become a realistic and practical means of communication.

Over the last years, new technology designs have led to integrated chips and modems that have been introduced into the market, providing high speeds over the power lines infrastructure at reasonable if not low cost.

Although several broadband PLC technologies have been successfully developed, a standard in this area does not exist yet. Some vendors provide "low-speed" (up to 2 Mbps) data rates using single-carrier technologies (GMSK, CDMA). Some technologies are based on multicarrier modulations (OFDM) and offer higher data rate, starting with a 45 Mbps OFDM PLC chipset, which is the highest data rate available at this time.

On December 2002, at least one PLC technology vendor announced that during the second half of 2003, a new generation of broadband PLC technology providing 200 Mbps of physical layer data rate would be available as a commercial product. That technology is now reality, and is being exploited in the IST project 6POWER (http://www.6power.org).

A complete document describing this technology, and how IPv6 can improve the deployment status for both technologies and simultaneously facilitate the addressing of the digital divide, has been published by ISOC, as part of the ISOC members' briefing series; this can be found at http://www.isoc.org/briefings/013.

Several ongoing activities are being addressed to allow the take-off and further cooperation between these technologies, with the cooperation of the IPv6 Task Force.

As a result of 6POWER's work, several utilities have started to provide a commercial service, including extending some of the IPv6 related trials. See:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=156.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=216.
- http://www.silicon.com/comment/0,39024711,10005886,00.htm.
- http://www.vnunet.es/Actualidad/Noticias/Comunicaciones/Internet/20031027015.
- http://www.denverpost.com/Stories/0,1413,36~33~1972967,00.html.
- http://www.computing-spain.com/Actualidad/Noticias/Comunicaciones/Internet/20031027016.

5.2.1.7 Digital Video Broadcasting (DVB)

The Digital Video Broadcasting Project (DVB) is an industry-led consortium of over 300 broadcasters, manufacturers, network operators, software developers, regulatory bodies and other organizations in over 35 countries committed to designing global standards for the global delivery of digital television and data services. DVB technology has become an integral part of global broadcasting, setting the global standard for satellite, cable and terrestrial transmissions and equipment. DVB standards are available from ETSI.

The move towards interactive services and the convergence at application and service level as well as convergence in networks as increased even further the future importance of the Internet Protocol (IPv4 now, and IPv6 in the future)

The steps taken include awareness creation, presenting the benefits with respect to home networking, coexistence and interoperability with IPv4 and guidelines for dual-stack networking. The first steps have already been taken, and this is actually a key activity of some of the Task Force members.

An example of this was the release in January 2004, by data planet international AG (dpi AG), of the world's first IPv6/DVB encapsulator including support for Ultra light encapsulation (ULE) - especially designed to fulfill the needs of existing and upcoming IPv6 based DVB platforms (see http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=344). This has been possible as a direct consequence of several European projects working on this topic, with the participation of IPv6 Task Force members. Current activities include further standardization work in IETF (IPDVB WG).

5.2.1.8 Home Networking

Looking at the current situation one can conclude that most computers using generic operating systems (e.g. Linux or Windows XP) have IPv6 available as a production protocol. For consumer devices based on embedded operating systems (even for broadband modems and home routers) IPv6 is not yet common in the commercially available devices. However, new embedded systems developers are releasing IPv6 capable code, e.g. Symbian, WindRiver, Elmic Systems and the Microsoft CE .NET. Elmic Systems also have an implementation of the final version of Mobile IPv6 (which was given RFC status early in 2004).

We are still in the stage that only knowledgeable early adopters can set-up an IPv6 home network. An important step will be when broadband modems and routers (wired as well as wireless) can be configured to use IPv6 in the home and support tunneling on IPv4 to IPv6 services. While some ISPs offer IPv6 services the access networks are still on IPv4. For the consumer world these solutions should be easy to install and to manage, e.g. through adaptive appliances and auto-configuration. The ideal goal is to have native IPv6 services to end customers. In the meantime methods for (tunneled) access over existing IPv4 infrastructure are desirable. IPv6TF-SC members are involved in standardizing these methods in the IETF through IST research project work.

Current consumer applications are based on sessions where the connection is initiated from within the home. However, many applications (such as VoIP, remote monitoring, web cam access or video calls) would benefit from connections being initiated from the outside *into* the home. This would be impossible or at least difficult in situations where NAT is used. IPv6 creates an opportunity for new classes of application, it is possible not only to reach external services but also applications and services can be reached from outside (e.g. from mobile handsets), or - under proper control (easy-to-use security mechanisms are required) - by others.

The usage of Wi-Fi, Bluetooth, together with new technologies like PLC, will facilitate home automation, possibly via OSGi gateways, already being developed by a few IST projects. Consequently this will increase the deployment of home networks and home appliances with embedded IPv6 features, even small GRIDs, Personal Area Networks, and at the end facilitate the enabling of the Ambient Intelligence concept, described in the next section.

Besides that the v6ops working group of the IETF is working to speed up the introduction and support of IPv6 in home networking, offering recommendations about how IPv6 could best be implemented in unmanaged and home network scenarios.

Some early announcements about IPv6-based commercial services and products related to this have already been made by several entities, including European companies.

5.2.1.9 Ambient Intelligence

Ambient Intelligence (AmI) has been described as a vision of the Information Society where the emphasis is on greater user-friendliness, more efficient services support, user-empowerment, and support for human interactions, where people are surrounded by intelligent intuitive interfaces embedded in the environment. Since we are talking here about the Information Society as a whole we should realize that this has an impact on telecom, home appliances, business and industrial applications, healthcare and vehicles.

To make this possible Ambient Intelligence depends on seamless networking. There will be a need to be a large number and variety of devices, within spaces and as part of the electronic outfit, communicating with each other and with services. For this communication a variety of networks (wired as well as wireless) will be used, which will need to operate seamlessly as one logical network for the applications and the users. Different devices would roam across multiple networks. Interleaving such networks is a challenging task, but can be made easier by avoiding use of private IP addressing (common in IPv4 with NAT) by adopting IPv6.

The needs expressed above stress again the requirement for the address space, autoconfiguration (plug and play), ad-hoc networking, security, and mobility aspects offered by IPv6. Steps have to be taken in several domains such as infra-structures covering wide area, local area and personal networks, devices and services (e.g. location and situational awareness, identity management, etc).

5.2.1.10 Smart Tags

RF-ID is one of the new application areas that are being investigated in terms of opportunities for adoption with IPv6.

There are several ongoing activities on this field and Nokia Japan have already exhibited a technical demonstration model of a name-card sized PDA that supports Wireless LAN and includes an RF-ID reader. It realizes an easy-to-use security system by configuring the network setting of the PDA using information obtained from the RF-ID tag the user is wearing.

A bracelet with a built-in RF-ID tag identifies the user. Each RF-ID tag contains a unique IPv6 address and a pre-shared key for IPsec. The PDA reads the information and automatically reconfigures its own address to prepare for the new IPsec session. See:

- http://www.ipv6style.jp/en/apps/20030318/index.shtml.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=117.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=368.

It is important to note here that RFID is simply a technology to identify something, by attachment of an RFID tag. IPv6 becomes important where either the device tagged has IP connectivity, or the reader for the tag needs to have global IP connectivity.

5.2.1.11 Security

There are many aspects to IPv6 and security.

Some early commercial IPv6 firewall products are now available, e.g. from 6WIND, Cisco (basic ACLs), Nokia, Checkpoint and NetScreen among others, but their functionality is currently limited (e.g. in not allowing scanning of certain IPv6 headers, or not having stateful operation modes). Microsoft already offers a personal firewall in XP SP1.

A new challenge lies in enabling IPv6 access for peer-to-peer applications where firewalls would otherwise be blocking the traffic. Such end-to-end usage may currently be prevented by a site's security policy (or may involve the use of NAT as a "security" measure). Current policies tend to be site-to-site or device-to-site, rather than device-to-device.

The new SEINIT IST FP6 project has a broad brief to study IPv6 and security and to publish new frameworks appropriate for an IPv6 environment. This project should be a reference point for IPv6 security issues.

The Euro6IX IST project is working on deployment of an IPv6 PKI and IPv6 VPNs.

Euro6IX has also started a new interesting activity regarding new distributed security models for IPv6, considering the end-to-end paradigm with the enterprises and individuals interest, with a requirements draft already submitted to the IETF.

One open topic is the availability of commercial IPv6-enabled IDS (Intrusion Detection Systems) tools. Euro6IX and 6NET are among the projects working in this area.

5.2.2 Challenges for IPv6 Deployment

The aim of the EC IPv6 Task Force and the IPv6TF-SC is to ensure the smooth and timely introduction of IPv6 in Europe. To achieve this aim the IPv6 Task Force is putting in place a number of initiatives to overcome the barriers and hurdles – real or perceived, technical or political – in deploying IPv6 in Europe.

The following overview was requested at the January 2003 London IPv6 Task Force meeting and is a compilation, in no particular order, of the barriers to or challenges for IPv6 deployment highlighted by the IPv6 community. This list is being updated regularly.

Standards

Stable standards are required to encourage companies to develop equipment and enable interoperability.

The November 2003 IETF meeting continued the discussion on IPv6 Site Local unicast addressing. It has now been agreed that such addressing will be deprecated, to be replaced by an alternative called IPv6 Globally Unique Local addresses that resolves the issues of address ambiguity (although address leakage, as with IPv4, will remain an issue). The meeting also agreed a roadmap to propose new solutions for IPv6 multihoming, which also remains an open issue, but with some clear progress perspectives envisaged. The IETF multi6 WG is now reconvened and is working on new multihoming architectures.

The MIPv6 and DHCPv6 standards are now both full RFCs, after a long standardization process. This marks an important point for implementers, as we now see RFC-compliant code emerging from vendors who were previously (understandably) cautious to implement based on an unfinished draft (e.g. 6WIND, Cisco, Elmic).

Nevertheless there still exist some gaps within several standard documents that lead to interoperability issues between heterogeneous IPv6 equipment of different vendors (e.g. explicit 0-Label in 6PE). These gaps have to be identified and fixed and interoperability tests (like the ETSI IPv6 Plugtests and others related to the IPv6 Ready logo program). The number of such gaps is falling quickly, as can be expected through operational and Plugtests experience.

IPv6 access

There has been much research and development in the IP core area but the most widely used IPv6 access to these emerging IPv6 cores is via IPv6-in-IPv4 tunneling services, e.g. 6to4, tunnel brokers, Protocol-41 forwarding, Teredo). More IPv6 research and development in the IPv6 edge needs to be undertaken so that there is a range of interoperable and stable commercially available equipment. The end goal is native deployment, rather than tunnels to edge users.

Members of the TF-SC are working on an IETF I-D on issues for the deployment of tunneled services to small end sites (including the tradeoffs of managed and unmanaged solutions), even through NAT devices.

Several well known router vendors (6WIND, Cisco, Hitachi, Juniper, etc) have already recognized that for instance broadband IPv6 access via DSL could be one of the driving forces that motivate an ISP to offer IPv6 services. Hence corresponding implementations have become available.

New low cost IPv6-enabled access devices are quickly coming into the market.

User/Network interface

There are currently a plethora of standards that apply to the user/network interface area, but to achieve mass and interoperable deployment between user equipment and various network offerings an industry agreed user/network best practices guide needs to be established. This would allow equipment manufacturers, network providers and users to manufacture, install and purchase equipment with the knowledge that it will fully interoperate with their existing environment.

The end goal is to have secure, easy-to-use systems that an average home user can use, including simple security mechanisms and configuration

DNS

There are many issues with DNS and IPv6, especially when interworking and DNSsec are also considered. These will be more fully elaborated in a separate IPv6 TF document but further investigation is required to ensure that the current DNS system does not degrade with the introduction of IPv6. From the standardization side, this task is covered by the dnsop WG of the IETF, with the regular participation of IPv6 TF-SC members.

The basic IPv6 DNS service (using AAAA DNS records) works, however, but current usage relies on deployment being dual-stack, or via a dual-stack local resolver, e.g. there is currently no mechanism except for DHCPv6 for an IPv6 host to discover a local IPv6 resolver address using IPv6 transport – is a stateless solution also required?

Zero configuration

IP configuration is still reserved for the technically aware. To meet the expectations that every home will have many IP aware devices we must have a complete and robust zero configuration or ‘plug-and-play’ architecture. More research and development is required in this area to allow a device purchased in the supermarket to be taken home and gain IP connectivity with the user having zero knowledge of IP.

New devices with zero-configuration features are already now in the market, for example IPv6 capable cameras and printers.

Security

Much has been discussed about the inclusion of IPsec as a mandatory part of a "full implementation" of IPv6, however, at the moment, not many IPv6 stacks include IPsec. Inclusion of IPsec needs to be encouraged and solutions found to the automatic distribution of keys in the circumstance that a widely available PKI solution is unlikely to happen. Security in its widest sense needs further investigations in all areas e.g. is it possible to use the authentication mechanism (AH) to replace parts of PPP, what are the real concerns on privacy – does security help or hinder.

The DoD adoption of IPv6 is likely to accelerate activity in this area.

Network management

Products in this area are scarce, vendors need to be encouraged to develop IPv6-enabled solutions and new methodologies that IPv6 may facilitate need to be researched. Support for IPv6 in MIBs is currently generally lacking as is IPv6 transport for SNMP. Without a proper IPv6 management capability only a few and small providers will implement IPv6 and be able to operate their IPv6 networks. A range of IPv6 network management and monitoring tools have been developed abd/or deployed by members of the 6NET, 6QM and Euro6IX IST projects.

The management of transition tools and systems will also be important as the transition occurs.

Some of the most popular Network Management Systems and Operating System Support tools are becoming IPv6 ready.

IP version-neutral applications

Nearly all current applications use IPv4, but many are starting to be ported to IPv6. However, in some instances, porting IPv4 applications to be capable of working with IPv4 and IPv6 can be difficult; the complexity depends on issues such as how cleanly the IPv4 application was implemented, in terms of network abstraction and data structures used. Developing an IP version neutral application from scratch is much more straightforward.

There is now an IETF I-D on application porting, as well as a good guide from the LONG project, as well as two new standards documents for application porting within the GGF (written by an IPv6 TF-SC member through the 6NET project). The guide is now being updated by the Euro6IX IST project.

Consumer devices

Currently there are very few IPv6 capable consumer electronic devices; those that are available are predominately Japanese and oriented to the Far Eastern market (e.g. Canon, Panasonic, Matsutshita and Sony). Is it just a matter of time? Or can European industry be stimulated in producing conventional devices that are IPv6 capable and by "looking outside of the box" can IPv6 with its inherent capabilities enable new markets? This is almost a chicken and egg problem: no devices because there is no user-ready IPv6 network, so as yet no clear advantages for development. Japanese IPv6 products are not generally available for import to Europe.

There are already some applications available that suffer from NAT and would benefit from IPv6 e.g. VoIP and conferencing applications but operators and access providers do not seem to be interested in deploying a service in advance of the applications being ready and user demand being there. Mobility of wearable devices across different residential networks would be a clear advantage.

The problem is: IPv6 on its own will not be required by end users, rather it is functionality of appliances and applications that will be the discriminator Users want functionality, not IPv6. This means functionality at low cost, easy to use. IPv6 is the way to implement those requirements. IPv6 is an embedded technology, so is not visible (nor should it be), though WiFi is not visible and users are requesting WiFi. A good example of IPv6 integration is given by Microsoft with its Three Degrees: A new type of application (P2P); to run it you need IPv6, but the user doesn't' know (the Teredo transition/tunneling mechanism is used as a part of Windows XP for the application).

Awareness

IPv6 is gaining momentum but considerable training of conventional IPv4 engineers needs to be undertaken and awareness increased in industries that currently do not use IP but to which IPv6 could bring benefits. One of the problems is that there are not that many industries that are as well organized as the mobile telephone industry (in terms of realizing and understanding the IP futures). Contact needs to be established with the car manufacturers, broadcasting world, ISP organizations etc.

Host and router OS support

Many operating systems have commercially support IPv6 functionality included. Full support in the most popular end host operating system would stimulate demand. The situation with Linux, BSD, Windows XP/Server 2003, Solaris, Mac OS/X, HP/UX and other products is promising. As it is with most router vendors including 6WIND, Alcatel, Cisco, Juniper, Hitachi and others. Basic functionality is there, but support for advanced features such as IPsec, DHCPv6 and MIPv6 is variable.

Support for RT kernels for embedded systems is another issue, if one wants to develop consumer devices. Products from Symbian, QNX, WindRiver and Elmic Systems already include IPv6 for embedded systems; Windows CE .NET and Mobile 2003 are also available for such systems.

Transition

Considerable effort has already been expended on transition and interworking technologies; there is however still a considerable amount of confusion, mainly due to the huge variety of proposed solutions. Clear guidelines need to be produced and discussed on what are the best options in a number for circumstances. There is also some interoperability of interworking mechanisms work that needs to be performed to recommend which of the plethora of interworking technologies are compatible with each other within a particular network domain.

Members of the TF-SC are contributing to a number of the IETF activities in four scenario areas (ISP, home unmanaged network, 3GPP and enterprise) including analyses of those areas. This work should lead to clarification of the key transition mechanisms, and where and when they should be used.

Business case

What is the business case (main incentives) for companies to invest in IPv6 when the current economic climate is forcing people to save costs? A clear list of economic advantages of IPv6 needs to be articulated.

Some of the claimed advantages of IPv6: Mobile IPv6, Multicast, Plug and Play and even NAT avoidance, have not been quantified.

But it is important to mention as well the potential risks of not implementing IPv6, including the opportunity cost.

Technical case

In a similar fashion to the business case a clear technical guide to deployment is needed. These needs to cover what the most imminent steps are for IT people to consider over the next 2-3 years.

The 6NET IST project has produced a number of technical IPv6 technology cookbooks, as early guidance in this area (e.g. for management, DNS, transition, multicast).

5.2.3 Development of IPv6 in the World

While IPv6 in Europe is only slowly gaining momentum, IPv6 is continuing to gain rapid interest in the Asia Pacific region. Due to restraints in the growth of IPv4 address space, the limitations of IPv4 put a growing limitation of the growth of the Internet in the important Asia Pacific economies, in particular in China, Taiwan, Korea and Japan.

In the Americas, the interest in IPv6 is growing slowly but steadily. Recent reports suggest that IPv6 will start to take up so rapidly, that there is the danger of a divide in the of Internet users: Those with IPv4 and those with IPv6. It is therefore essential to assure that the growth in IPv6 is happening all over the Internet with comparable speeds.

The following picture gives an overview on the development of major IPv6 initiatives worldwide.

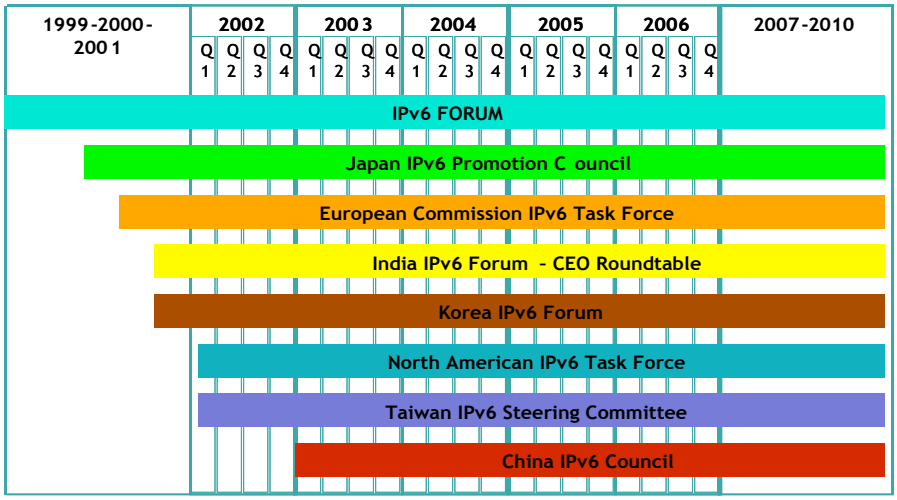

Figure 5-6: Major IPv6 Activities Worldwide

The following picture gives an overview on the current status of IPv6 deployment in major economies worldwide.

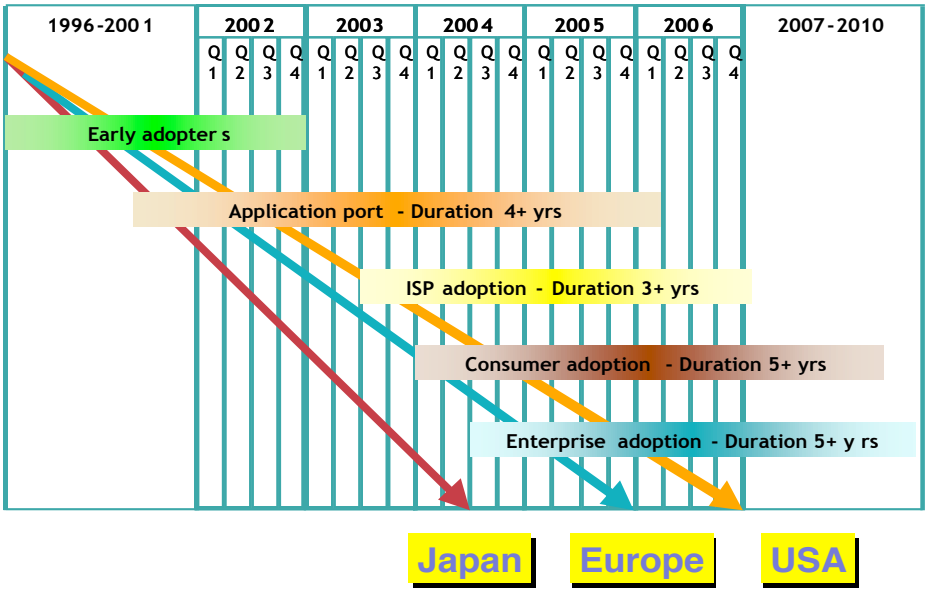

Figure 5-7: IPv6 in Japan, Europe and USA

The Japanese lead in IPv6 technology is marked. Indeed, the Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) of Japan, working towards "New, Japan-Inspired IT Society" (FY2004 IT Policy Principles), indicates that their IPv6 expertise is one of their competitive advantages, key for realization of a ubiquitous network society. Consequently MPHPT will address advancement of the Internet, including promotion of IPv6.

Furthermore, on September 8, 2003, the second China-Japan-Korea IT Ministerial Meeting was held at Shilla Hotel, Cheju, Republic of Korea. Attendees from Japan included Mr. Katayam Toranosuke, Minister for Public Management, Home Affairs, Posts and Telecommunications; Vice-Minister Nabekura Shin'ichi; Mr. Oku, Director of International Cooperation Division, and others; from China, Mr. Wang Xudong, Minister of Information Industry; Mr. Qu, Deputy Director-General of Foreign Affairs Department, and others; and from Korea, Dr. Chin Dae-Je, Minister of Information and Communication; Dr. Yang, Director-General of International Cooperation Bureau and others.

During the Ministerial Meeting part, acknowledging that ICT is an indispensable infrastructure in order to develop Asia and enhance mutual ties, and that the cooperation among the three countries accelerates the deployment of broadband platforms through Asia, the three ministers exchanged opinions on wide-ranging topics including development and cooperation through establishment of new cooperation models for the ICT field. Upon conclusion of the meeting, toward further development of the ICT field, the three ministers agreed that the three countries should promote cooperation in the seven information and communications areas, such as 3G and the next-generation (4G) mobile communications systems, the next-generation Internet (IPv6) and information security; the three ministers then signed the Arrangement.

This meeting continued with the Japan-China ICT Ministers Bilateral Meeting among Minister Katayama and Minister Wang of MII, China, which exchanged opinions on bilateral cooperation in the ICT field. It included the strengthening of cooperation under the scheme of Japan-China ICT partnership, cooperation on IPv6 and introduction of 3G into China. Regarding Next-generation Internet (IPv6), the goals include: Exchange of information and joint hosting of seminars for the promotion of IPv6, cooperation in R&D and standardization of IPv6, development and promotion of IPv6 application services, exchange of policies and experts on IPv6, establishment of a Working Group in order to promote the abovementioned cooperation.

As a consequence, several companies from those countries increased their cooperation on these fields.

Related links:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=75.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=190.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=198.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=200.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=213.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=221.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=274.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=275.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=277.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=278.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=279.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=313.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=328.

One more immediate result of this cooperation is the cooperation among Japan and China in order to jointly test 4G networks. Related links:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=199.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=204.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=211.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=212.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=214.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=218.

In addition, in November 2003, the South Korean Ministry of Information and Communication (MIC) unveiled the plan to foster Broadband convergence Network (BcN) infrastructure, indicating that for BcN to be successful, it must provide a high quality of service, security, and sufficient Internet protocol (IP) addresses using IPv6 (see http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=190).

In the same direction, coincidently with the Global IPv6 Service Launch Event, in one of the first cross-continent agreements, the EU agreed to work with South Korea to develop applications for IPv6:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=303.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=310.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=320.

6. IPv6 Deployment Status Report

6.1 Overview

The IPv6 Task Force Steering Committee has been monitoring how the recommendations of the 1st phase have been implemented. In the next, 3rd, TF-SC Phase, the recommendations of the 2nd phase will similarly be followed and tracked.

The following sections provide an overview of the tracking of Phase 1 recommendations. Each section outlines a quick status of the detailed action item. At the end of each section, a summary provides an overview on the major achievements and the major open issues to be addressed by the relevant addressees of the IPv6 Task Force Phase 1 recommendations.

It should be noted that the European IPv6 TF-SC has put a focus on creation and fostering of national TFs to undertake the recommendations at a regional level, and to act as a collator of regional experiences to be fed back into the national levels for maximum effectiveness and impact. As described earlier in this document, most key European countries now have a national IPv6 TF established.

6.2 EC Recommendations: EU Member States

6.2.1 Status of the Implementation of the Recommendations

1. Provide support towards the IPv6 enabling of the networks and services associated with the public sector (e.g. e-government, e-learning and e-health services), including educational institutions. Moreover, IPv6 should be considered in application procurements.

   Status

   Not addressed so far on a large scale, although there are single initiatives. In France a Healthcare Initiative is being started, initiated through the French National IPv6 Task Force.

   The UK e-GIF programme's draft document has recommended IPv6-enabled products for government and public sector procurements where cost-effective to do so (see www.govtalk.gov.uk).

   Several Spanish public entities and government bodies already implemented IPv6 requirements in their tenders, though not public awareness has been raised.

   Besides that several activities have been undertaken by TF SC members in order to encourage the German Bundeswehr on their way to IPv6.

2. Establish and launch educational programmes on IPv6 tools, techniques and applications, so as to create the required base of IPv6 skills and knowledge.

   Status

   Not addressed so far in a large scale.

   A Spanish funded project, 6SOS (http://www.6sos.org), is addressing this goal, and organized the event "Deploying IPv6" (http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=358).

   The 6NET IST project has some educational activities in the final phase of its project plan, which will reach out to academic sites.

3. Promote the adoption of IPv6 through awareness raising campaigns and co-operative take-up activities, targeted at consumer organisations, small and medium size enterprises, Internet service providers (fixed or wireless) and operators.

   Status

   Addressed so far by some EU Member States governments. Namely worth mentioning is the French and the Spanish Ministry initiative. The IPv6 Task Force has contributed here with a bottom up approach by creating the National Task Forces to drive the awareness on a regional basis.

4. Continue to stimulate the widespread use of Internet across the European Union and encourage the transition towards IPv6 by avoiding fragmented approaches or mandatory deployment time-lines.

   Status

   Addressed in the NRENs and GÉANT, where IPv6 has been deployed during 2003, but not yet in the wider commercial ISP sector.

5. Strengthen the financial support towards national and regional research networks (NRENs), with a view to enhance their integration in European wide networks such as GEANT, and increase the operational experience on novel Internet services and applications based on the use of IPv6.

   Status

   GÉANT has been dual-stack native IPv6 at 10Gbit/s since early 2003, and now connects 18 NRENs natively, most of whom are also dual-stack. Only 5 NRENs have yet to start the introduction of IPv6 native services.

   GÉANT has native dual-stack connectivity to Abilene (Internet 2).

   Most deployments use Cisco or Juniper equipment. No reports of adverse effects on production IPv4 service have been reported.

   The NREN status in IPv6 activity happens in many levels:

   - National IPv6 NREN pilots, e.g. Bermuda project in the UK, G6 in France, JOIN in Germany.
     Participation by NRENs to European activities, e.g. to the TERENA TF-NGN IPv6 WG, covering all GÉANT partners. This group has done much IPv6 piloting and testing, see: http://www.terena.nl/tech/task-forces/tf-ngn/.
   - Also to RIPE IPv6 WG, which meets 3-4 times per year.
   - Participation in IST projects, especially 6NET.

   All NRENs now have production IPv6 address space under 2001::/16. Indeed GÉANT is no longer routing external 6Bone prefixes under 3ffe::/16, recognizing the IETF's decision to deprecate the 6Bone, and for the increased routing stability that such a step creates.

   The next challenge is stimulating IPv6 interest in the universities, and connecting them natively.

6. Provide the required incentives towards the development and testing of IPv6 products, tools, services and applications in the new economy sectors. In particular, IPv6 enabled broadband access to the home, to small and medium size enterprise and in public areas, is of key importance.

   Status

   Addressed so far by some EU Member States governments. Namely worth mentioning is the French and the Spanish Ministry initiative. The IPv6 Task Force has contributed here with a bottom up approach by creating the National Task Forces.

7. Take appropriate measures (such as the establishment of a National or Regional IPv6 Council) to carry out:

a. The assessment, at national or regional level, of current developments and degree of take-up of IPv6, as well as the formulation of guidelines and dissemination of best practices relating to the efficient transition towards IPv6.

Status

This is largely addressed. See section 2.1 in this document. The European IPv6 Task Force has played a significant role in the helping and facilitating the establishment of national IPv6 Task Forces. Besides Italy, most of the economically larger European Countries have IPv6 Task Forces.

b. The development of measures aiming at the alignment of IPv6 transition schedules favoring a cohesive IPv6 take-up.

Status

This is largely addressed. See section 2.1 in this document. The European IPv6 Task Force has played a significant role in the helping and facilitating the establishment of national IPv6 Task Forces. The IPv6 Task Forces aim to coordinate their work and their roadmaps. This is work in progress.

Some IST projects, e.g. 6NET, have a focus on transition and have produced guides or cookbooks in this area aimed at various deployment scenarios.

c. Encouraging the active participation of technology experts from industry in the work of European and International standards and specification bodies tasked with IPv6 matters.

Status

This is largely addressed. The European IPv6 Task Force and the national IPv6 Task Forces are actively aiming to widen their outreach, to include more people in the active development of IPv6. The TF-SC works closely with the IST IPv6 Cluster, in which standards issues are discussed. Both 6NET and Euro6IX are very active in IETF standardization.

6.2.2 Key Results

An active commitment by most EU Member States towards implementing plans for the introduction of IPv6 is not yet accomplished, although there are encouraging signals from some of the member states.

There are no single reasons for this that can be observed among all member states. The current economic situation can be recognized as part of the problem, as some contacts in the member states administrations consider the work of the national IPv6 Task Forces as relevant, but are unable to support them financially. Other reasons are that IPv6 is still not on the "radar screen" of officials or does not seem to have a high priority due to heavy investments in IPv4-only equipment.

However, there are encouraging examples. Those worth mentioning are France, Germany, Spain and the UK.

The IPv6 Task Force has contributed in most of the major economies in Europe by actively helping to facilitate the creation of national IPv6 Task Forces. Most members of the European IPv6 Task Force are active contributors to national IPv6 initiatives.

6.3 EC Recommendations: The Industry

6.3.1 Status of the Implementation of the Recommendations

1. Fully participate in the R&D activities to be supported in the context of the 6th Framework programme.

   Status

   This is fully addressed. The IPv6 Task Force, the IPv6 Task Force Steering Committee and the National IPv6 Task Forces have actively contributed for a large participation in IPv6 proposals in the FP6.

   However, very few IPv6-specific proposals have been funded to date in FP6. It is thus very important that those projects that are funded consider and use IPv6 (a notable example is EGEE, which does not yet have IPv6 on its agenda in a significant way).

2. Actively contribute towards the acceleration and alignment of ongoing IPv6 work within standards and specifications bodies.

   Status

   This is addressed. The European industry, in its own interest, in the FP5 and upcoming FP6 and in other R&D frameworks is quite actively participating in the international standardization and specification initiatives, e.g. the IETF, RIPE and ETSI.

3. Develop key guidelines permitting the efficient integration of IPv6 infrastructures and interoperability of IPv6 services and applications, notably in the context of 3G mobile communications.

   Status

   This is partially addressed. The Task Force has actively contacted a representative set of providers informally. It is observed that many of the major European telecommunication providers are actively working on plans to integrate IPv6 in their production networks. On the other hand, it can be observed that the current rollout of services is still rather slow. A major reason seem to be the lack of active customer demand (though the customers are unlikely to request IPv6, only applications and services that IPv6 could deliver).

   In the area of mobile operators, active work on IPv6 seems to be slow as well. Many operators seem to be occupied with the quick rollout of 3G services, where IPv6 is currently playing only a limited role (3GPP version 5 makes IPv6 mandatory for the IMS component, but this version is not widely implemented yet).

   In the area of IPv6 services and applications, adoption is rather slow. While many of the larger software companies (Microsoft, Apple, Sun, IBM, etc.) are actively working on IPv6, the rollout of application and services is still marginal. While there are positive examples of early deployment of IPv6, e.g. in the NRENs, deployment of IPv6 applications and services in the industry is progressing slowly, still.

   The Task Force is actively contributing in the 3GPP through Latif Ladid and Bosco Fernandes.

4. Support and fully participate in interoperability events organized, including those by ETSI.

   Status

   This is fully addressed. See the “IPv6 Ready initiative” in this document, which is organized by ETSI and other organizations.

   Two major events have already succeeded around this idea, one in Belgium and one in US (Moonv6).

   IPv6 has been an important part of the 1st PLT Plugtests organized by ETSI, under the guidance of the 6POWER expertise (http://www.ist-

ipv6.org/modules.php?op=modload&name=News&file=article&sid=183).

5. Address the multi-vendor interoperability issues impeding the wide-scale deployment of IP security and conduct extensive IP security trials.

   Status

   Not addressed so far. Security- and PKI-Infrastructures are a problem that goes to some extent beyond the problem of IPv6.

   A new FP6 IPv6 security project called SEINIT is just beginning, and will address this topic, with the participation of several of the TF members.

   A new work on IPv6 Distributed Security has been started in the IETF by the Euro6IX IST project. Euro6IX is also working on IPv6 PKI and VPNs.

6. Devote efforts towards the establishment of a European wide, vendor independent, training and education programme on IPv6 and ensure through timely and user friendly information, the collectively increase of IPv6 awareness.

   Status

   This has been addressed by the Task Force Steering Committee. Initiatives were taken, but without positive results. It was intended to setup an initiative in the FP5, but the initiative was not taken up by the EC. The Task Force will not actively pursue this issue, since approaches were made twice, unsuccessfully. Commercial Trainings by some companies are emerging (companies in the training field, manufacturers, e.g. Cisco, etc.), although vendor independent programs are still lacking behind.

7. Integrate IPv6 in their strategic plans and take early steps to obtain appropriate IPv6 address allocations.

   Status

   This is partially addressed. The Multihoming issue is still unresolved (it is a known open issue at the IETF), which is potentially a barrier for deployment at large enterprises who do not want to be tied to the address space of a single ISP.

   The Multi6 WG has now reconvened at the last two meetings of the IETF, and is considering new proposals. Progress is now being made but is still likely to be slow due to the complex nature of the issue.

6.3.2 Key Results

Progress in the industry is now gaining momentum. Many major companies are well aware of IPv6. Commercial rollout of services is lacking behind for various reasons. A common explanation pattern is the lack of customer demand for commercial IPv6 services (although customers will be unaware of IPv6, just aware of the application it may offer) and the current economic situation, which is in some areas preventing large or temporarily even any upfront investments in new technologies. It has been observed that there may be several cases of conflicting reports on the status of IPv6 within the same (large) commercial organization.

6.4 Commission

6.4.1 Status of the Implementation of the Recommendations

1. Increase and refocus EU support to RTD in the context of the 6th Framework programme in the following areas:

   a. IPv6 broadband fixed and wireless network infrastructures, and their interoperability aspects.

Status

This target is addressed in FP6.

b. Development of IPv6 tools, devices and network elements.

Status

Not addressed so far. Very few IPv6-specific projects have been funded in FP6.

c. Large scale testing of IPv6 based services and applications, across heterogeneous, fixed and wireless, access platforms.

Status

This target is addressed in FP5 already with GÉANT, 6NET and Euro6IX.

d. IPv6 enabled advanced infrastructures for Research (GÉANT and GRIDs).

Status

This target is addressed in FP6, although EGEE does not yet have IPv6 as an integral, pervasive project component.

e. IPv6 awareness, training and education.

Status

Not addressed so far. This has been addressed by the Task Force Steering Committee. Initiatives were taken, but without positive results. It was intended to setup an initiative in the FP5, but the initiative was not taken up by the EC. The Task Force will not actively pursue this issue, since approaches were made twice, unsuccessfully. Material is available in the Task Force if needed.

f. Production of a European Code Base for IPv6, including the development of IPv6 open source code.

Status

Not really addressed so far. There is a variety of open IPv6 source code available by European companies (e.g. IABG: IPsec implementation, HUT: mobile implementation, 6WIND etc.). Issues are the lack of IPv6 libraries, IPv6 applications etc., this could be addressed in a focused way.

A potential IST funding bid for an IPv6 stack was not presented because it was deemed too late for a new IPv6 open source stack (and informal discussion with the EC showed there was no appropriate instrument, i.e. an SSA is not appropriate for development work).

g. Launching a socio-economic and market study addressing the key potential impacts of the transition to IPv6, including on security, freedom of information privacy, user friendliness and easier management.

Status

This is work in progress: A market study is potentially too early. The study should be postponed, to be conducted late in 2004 by the Commission with support of the IPv6 Task Force. Some work on privacy is on going in Euro6IX. Benchmarking was proposed to be addressed by a new FP6 project (6MEMO), resubmitted in the second IST call of FP6 in October 2003. However, this proposal was not funded in the second call of FP6, so the issue still remains open.

2. Study the impact of the further evolution of the Internet including the new generation IPv6 protocol, on the fundamental right to privacy and data protection, so as to ensure that the required standards and specifications take these aspects into full consideration.

Status

The IPv6 TF-SC has addressed this. A communication between the EU Art. 29 WG has been established and a small common document has been prepared. Some work is done in cooperation with the Euro6IX project on this issue (http://www.ec.ipv6tf.org/PublicDocuments/030225IPv6TF-StatementArt29-03.pdf).

Euro6IX is continuing this work and future documents and joint activities with Art. 29 WG is expected in the next few months.

3. Renew the mandate of the "IPv6 Task Force" with an enlarged participation of all economic and industrial sectors likely to be impacted by IPv6, including, consumer organizations, research institutions, and independent data protection authorities as well as representatives of national or regional IPv6 Councils and appropriate representatives from candidate countries. In its renewed mandate the Task Force is requested to:

   a. Ensure a working liaison with standards and Internet governance bodies such as ISOC, IETF, ICANN, RIPE NCC, 3GPP, ETSI, IPv6 Forum, Eurescom, ETNO, UMTS Forum and GSM Europe.

   Status

   This item is addressed. There are direct links to ISOC, IETF, ICANN, RIPE NCC, 3GPP, ETSI, IPv6 Forum, Eurescom, UMTS Forum and GSM Europe via members of the IPv6 Task Force. The liaisons are established on collecting and exchanging information.

   In the UMTS Forum the Operators are only now showing keen interest for IPv6 and created a list of topic and issues to be studied within the Forum. 3GPP Release still holds to a firm mandatory implementation of IPv6 in the IP Multimedia Subsystem. GSM Europe has established Operator individual Groups to study IP and in particular IPv6. Also the impact of VoIP cannibalizing their current Circuit Switched Voice Revenues.

   The IETF and ISOC are fully supporting IPv6.

   RIPE and the rest of the RIRs signed a cooperation agreement with the IPv6 Task Forces.

   The IPv6 TF-SC has liaised with ICANN to follow-up the introduction of IPv6 in the root servers.

   ETSI, UNH and TAHI have successfully launched it's interoperability project and been extremely useful in creating the "IPv6 Ready" program, with the support of the TF-SC.

   b. Provide a regularly updated review and plan action ("the European IPv6 Roadmap") on the development and future perspectives of IPv6 in order to coordinate European efforts on IPv6,

   Status

   This is addressed and work in progress. This report is part of identifying gaps and determining actions needed.

   c. Establish collaboration arrangements and working relationships with similar initiatives being launched in other world regions.

   Status

   This is addressed and work in progress. A European delegation including IPv6TF-SC members had visited Japan. See the section of Non-European IPv6 Task Forces. The European IPv6 Task Force has played and is playing a helping role in supporting other Task Force, namely the NAv6TF.

   A new Asia Pacific IPv6 Task Force has been started with the cooperation of the IPv6 TF-SC.

A new IPv6 Task Force has been formed in the Latin American and Caribbean region, with the cooperation of the IPv6 TF-SC.

6.4.2 Key Results

The main activities have been put on the work of the Task Force itself and the liaison with other relevant parties. A paper has been prepared and some work has been put on data protection issues.

The national IPv6 Task Force have put some emphasis on the *e*Europe 2005 action plan, namely France has set up some initiatives in this direction. The Task Force member organizations are active participants in the major European IPv6 projects.

Currently there are few working groups operational. There is a Naming and Addressing Working Group ("Nomad") actively contributing in the French IPv6TF. The French IPv6TF plans a Business Model and Security Models Working group. The Spanish IPv6TF has produced some first results already published, which are available currently only through the Spanish IPv6 TF. Preliminary results include the detection, that there is a need to increase R&D on IPv6 related issues, that Dissemination & Training are necessary and essential components, ongoing work on standardization issues is important, that there is a need for new and more IPv6 applications, as well as IPv6 Services and IPv6 E2E Security models.

The lack of funding in IST for specific IPv6 proposals (e.g. IPv6 Monitoring and Measurement) has meant that the TF-SC has some gaps in the required tools to push IPv6 deployment. Indeed, very few IPv6-focused projects were funded in FP6 to date; thus the IPv6 potential of those projects that were funded needs to be realized. Flagship projects like EGEE must embrace IPv6; to date EGEE does not show significant signs of doing so.

7. LIAISON WITH STANDARDS

It is the task of the IPv6 Task Force to create the proper working and liaison environment to ensure that a working collaboration with standards and Internet governance/policy bodies takes place.

The members of the Task Force are active contributors in a large number of Internet standards and policy bodies, including the IETF and 3GPP. The members are promoting IPv6 deployment, and the collaboration amongst European IPv6 initiatives in these bodies.

The first steps towards DVB IP Infrastructure (DVB-IPI) have been taken, through the Philips representation. Furthermore, an ongoing debate between the DVB-T IP Data cast working Group and UMTSF/Siemens has been going on. At a recent, workshop held in Munich at the "Institut für Rundfunktechnik" it has become very obvious that IPv6 will be used for datacast channel and transport protocol. Current, DVB-T Handheld (H) with UMTS/GPRS trials are being carried out in some countries e.g. Germany (Berlin) and will be a future alternative for delivery of multimedia services.

In the Workshops of the IPv6 Task Force in London, January 17th 2003, in Berlin on April 30th 2003, and in Milan on 1st October 2003 and Brussels on 14th January 2004, several topics have been identified that need further attention. It is intended to provide more inputs on these topics in short memorandums. These memorandums will help to identify potentially additional actions to be taken in the R&D or standardization areas, among others.

One of the main standardization bodies that is already being directly addressed, and heavily involved in work with the IPv6 Task Force and the Steering Committee, is ETSI, involving once more, international cooperation, as described in the following sections.

Several deployment and interoperability activities related to IPv6 and SIP are taking place:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=142.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=253.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=255.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=256.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=352.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=365.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=380.

ETSI is also involved in a number of IPv6 MIPv6 interoperability activities:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=184.

The ITU is also considering IPv6 as crucial, and started to provide a Newslog service specific to IPv6 (http://www.itu.int/osg/spu/newslog/categories/ipv6), managed by the Strategy and Policy Unit. Besides this, in the October 2003 ITU Telecom World, IPv6 was one of the major technological issues highlighted by many Japanese exhibitors. In particular Panasonic, NTT and Toshiba are planning ahead for their IPv6 development and deployment.

7.1 The "IPv6 Ready" Logo Certification Program

An important activity has been initiated with the participation of ETSI, UNH, TAHI, members of the IPv6 TF-SC (Consulintel, LME and Soton-ECS), and several research institutions involved in IPv6 testing activities.

The IPv6 Forum plays a major role to bring together industrial actors, to develop and deploy the new generation of IP protocols. Contrary to IPv4, which started with a small closed group of implementers, the universality of IPv6 leads to a huge number of implementations. Interoperability has always been considered as a critical feature in the Internet community. Due to the large number of IPv6 implementations, it is important to give to the market a strong signal proving the interoperability degree of various products.

To avoid confusion in the mind of customers, a unique logo programme has been defined. The IPv6 logo will give confidence to users that IPv6 is currently operational. It will also be a clear indication that the technology will still be used in the future. To summarize, the logo programme will contribute to the feeling that IPv6 is available and ready to be used.

Figure 7-1: "IPv6 Ready" Logo

In January 2004, the 1st batch of "IPv6 Ready" products was announced:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=301.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=302.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=322.

The IPv6 Ready web site (http://www.ipv6ready.org) already contains a list of the first vendors and products to have been awarded with Phase I of the IPv6 Ready logo.

7.2 STF 236: IPv6 Testing

Consulintel is working with ETSI on the initiative Specialist Task Force 236, towards the delivery of a Technical Report on Pre-normative study for IPv6 testing (DTR/MTS-00083).

As IP-technology permeates more and more ETSI standards, there is a strong case for centralizing ETSI's IP testing activities. To this end the ETSI Board has approved the creation of an IP Testing group in TC MTS. This activity is well supported by other TBs who will make use of the output of this group.

The area of "IP Testing" is extremely broad covering items such as SIP, Mobile IPv6, ROHC (Header Compression), Interworking (e.g., SIP/H.323), IPv6 over IPv4 and security aspects. There are also questions of methodology, types of testing and the practical implementation of the tests that need to be taken into account.

The Internet community of service providers and equipment manufacturers has indicated that the testing of IPv6 is one of their highest priorities in order to support the "IPv6 Ready" certification programme. It is here that TC MTS believes effort should be spent. In order to use ETSI resources (both voluntary and funded contributions) it is necessary to provide a scope for this work and to develop both short-term and long-term plans. The purpose of this STF is therefore:

- To produce an overall plan for enabling test specifications suitable for "IPv6 Ready" testing, taking into consideration the schedule of producing test documentation in a timely manner, the effort required and other costs.
- To identify specific IPv6 protocols to be tested and to allocate priorities (taking special account of other ETSI TB needs and schedules).
- To identify which types of testing are relevant: Conformance testing only; interoperability testing only or both.
- To identify the level and nature of voluntary support available and to estimate the extent of funded support necessary.
- To consolidate Test Purposes from existing TPs for the IPv6 core protocol.

The outputs of the STF will be a TR including:

- TC-MTS Work Item proposals for the individual testing specifications.
- Workplan and ToRs for proposed STFs to carry out the testing specification tasks.
- A funding proposal to *e*Europe 2003-2005.

This work is also being liaised with several research and trial activities within different IST funded projects.

The complete terms of reference and other information of this working group are available at http://portal.etsi.org/STFs/MTS/STF236.asp.

See also http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=71.

A follow up initiative is being prepared.

7.3 Global IPv6 Showcase

A new initiative is being proposed to extend the actual achievements, for a Global IPv6 Showcase implementation, with the contribution of the Eurov6 project (http://www.eurov6.org).

Figure 7-2: Global IPv6 Showcase Logo

7.4 Key Results

The Internet Engineering Task Force (IETF), of course, does the standardization of IPv6. As far as operational matters are concerned, the Regional Internet Registries are involved, i.e. RIPE for Europe. The members of the IPv6TF-SC are active followers and contributors in the IETF and in RIPE and are following the developments. The necessary actions for technical progress are well known in the IETF community and the contribution of the IPv6TF-SC in the IETF so far was to a lower extent (but TF-SC members may be heavy IETF contributors through the projects they are in, e.g. 6NET and Euro6IX). Members of the IPv6TF-SC have actively endorsed the IPv6 Ready and the IPv6 Plugtests events organized by ETSI and others. At the Madrid 2003 Global IPv6 Summit, Consulintel has organized the first remote distributed Plugtests event (http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=18).

A new event has been organized in Brussels, in cooperation with the Eurov6 project (http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=41 and http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=67).

The project partners participated actively in the decision, in the IETF framework, to close down the 6Bone on 6/6/2006, considering that at that time, the status of the production networks will be optimal. This decision has been promoted widely, with the result, for example, that GÉANT is generally no longer routing non-internal 6Bone prefixes on its network. The UK research network, JANET, is implementing a similar policy soon.

8. LIAISON WITH INDUSTRY AND RESEARCH

8.1 Achievements and Non-Achievements

So far IPv6 deployment in European industry has started slowly but consistently. Quite a number of industry sectors have started to become IPv6 aware. However, major success stories are still missing, although there are some good examples for IPv6 services, e.g. in France, Netherlands and Spain.

The following chart gives an overview on the availability of IPv6 in the IT Sector.

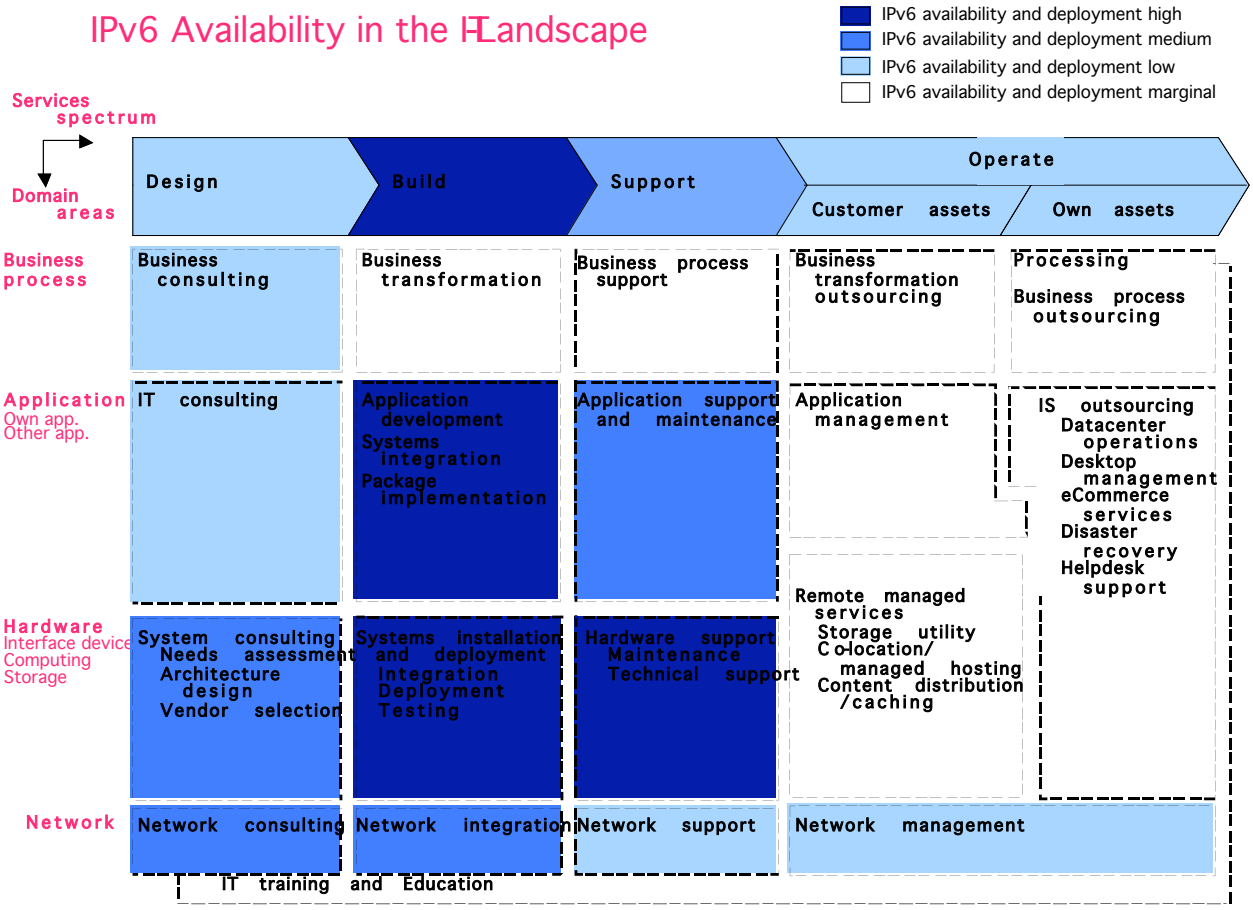

Figure 8-1: IPv6 availability in the IT landscape

The following chart provides a list (for reference only, not exhaustive) of manufacturers (Hardware and Software) and Service Providers, with an active involvement in IPv6 (an extended list is available at http://playground.sun.com/pub/ipng/html/ipng-implementations.html). The plans and roadmaps of these providers are known via personal contacts, conferences, and product presentations. The list of members of the national IPv6 Task Forces provides a good overview on the national IPv6 Task Force activities and its players.

Hardware
6WIND, Agilent, Alcatel, Allied Telesyn, ARtem, Bay Micro, Cisco, Conexant, dpi, Enterasys Networks, Ericsson, Extreme Networks, EZchip, Fortinet, Foundry Networks, Fujitsu, Hexago, Ixia,

Juniper, Matsushita, Nec, NetLogic Microsystems, NetScreen, Newport Networks, Motorola, Nokia, Nortel Networks, Paion, Polypix, Procket Networks, Renault, Samsung, Sony, Spirent, Sumitomo, Telco Systems, Teldat, Teradiant, Xcelerated, Xiran, Yamaha
Applications, Software, OSs
Accelerated Technology/Nucleus, Apple, Ariel Networks, BSD, Check Point, Consulintel, Elmic Systems, Enea/OSE, FreeBit, Firebird, Green Hills/Integrity, Hexago, HIfn, HP/UX/Tru64, IBM/AIX, Interpeak,InterWorking Labs, IP Infusion, Java, Linux, Matsushita, Mentat, Microsoft, MontaVista, Mozilla, NextHop Technologies, NFR Security, Novell, Opera, Panasonic, QNX, Radvision, SCO, SGI, Sun/Solaris, Symbian, TeamF1, Teja, Trolltech, Ubo System, WindRiver/VxWorks
Native IPv6 Service Providers
arsys, AsiaNetcom, Biglobe, Bersafe, British Telecom, Cegetel, Chita Medias Network, Colt, Deutsche Telekom, Dream Train Internet, France Telecom OpenTransit, Flag Telecom, FreeBit, Gitoyen, Global Crossing, HKNET, HiNet, HTnet, Hurricane Electric, IIJ, Japan Telecom, Japan Sustainable Community Center, Jens, KDDI/KDDI Lab, Level3, Matsushita Graphic Communication Systems, MCI, Media Exchange, Nerim, Nifty, NTT Australia, NTT Communications, NTT East, NTT Europe, NTT MCL, NTT MSC, NTTPC, Poweredcom, SpaceNet, Stealth Communications, STnet, Telecom Italia, Telefonica, Teleglobe, Telia, Tiscali, TIWS, Verio, vBNS+, XS4ALL
Internet Exchangers
6TAP, 6IIX, 6NGIX, AMS-IX, ASNet, Equinix, FICIX, Florida-MIX, FNIX6, INXS, JPIX, mad-iX, MCI MAE, NaMeX, NL-SIX, NSPIXP-6, NTT MCL IPv6 IX, NY6IX, PAIX, S-IX, Sphinx, TIX, TOP-IX, TREX, TWIX, UK6X, Wellington Internet Exchange, XchangePoint Europe

Figure 8-2: Known Commercial IPv6 Products/Services (partial selection only)

8.2 Key Results

So far, the main goal of the task force was to promote and support the creation of regional IPv6 Task Forces in Europe to establish liaisons with Industry and Research on a regional or national level. It is intended to advocate the establishment of these liaisons and links on a national level and to aggregate the players and link the national initiatives on a European level as soon as these links have been established.

The IPv6 Task Force Steering Committee intends to gather various industries European-wide in workshops and gatherings to gain momentum for the deployment and usage of industries on a European level. This ongoing process will continue after the completion of the TF-SC Phase 2 project with TF-SC Phase 3 from Summer 2004. Progress is continuously being reported, since these links and liaisons on a regional and national level are currently established through the national/regional IPv6 Task Forces.

IBM, one of the IPv6 Task Force members, released a position paper regarding IPv6. The document provides the "IBM vision for IPv6 in the era of e-business on demand" (see http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=70).

8.2.1 ISOC

The Task Forces are already working in cooperation with several ISOC chapters.

Several "member briefings" include contribution from the IPv6 Task Force members:

- IPv6 and the Future of the Internet (http://www.isoc.org/briefings/001).
- IPv6 Implementation (http://www.isoc.org/briefings/004).

- The Transition to IPv6 (http://www.isoc.org/briefings/006).
- IPv6 in the Home Makes Sense (http://www.isoc.org/briefings/007/index.html).
- Grid Computing (http://www.isoc.org/briefings/011).
- Establishment of global IPv6 address policies (http://www.isoc.org/briefings/012).
- Addressing the Digital Divide with IPv6-enabled Broadband Power Line Communications (http://www.isoc.org/briefings/013).
- IPv6: Necessary for Mobile and Wireless Internet (http://www.isoc.org/briefings/014).

The IPv6 Task Force has also organized a dedicated IPv6 session "The New Internet (IPv6)" at the next INET2004, May 10th, in Barcelona, organized in this occasion jointly with the Internet Global Conference 2004 (http://www.isoc.org/isoc/conferences/inet/04/tutorials.shtml).

8.2.2 GGF (Global Grid Forum)

With the cooperation of the IPv6 Task Force, the Global Grid Forum (GGF) has recently established an IPv6 WG. The WG met at GGF9, and its charter has been formalized. It is initially tasked with producing two documents. The first is a review of IPv4 dependencies in existing GGF specifications, the second is a set of guidelines for IP version-independence in future specifications. These drafts were finalized at GGF10 and are now GGF standards, and were authored by 6NET IST project participants.

There are several ongoing activities with IST R&D projects. More information is available at http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=208.

8.2.3 NPF (Network Processing Forum)

With the cooperation of IPv6 Task Force members and the Euro6IX project, the Network Processing Forum is providing IPv6 support in their latest specifications.

More information is available at:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=108.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=230.

8.2.4 CEA (Consumer Electronics Association)

The Consumer Electronics Association and the IPv6 Forum joined forces to promote the essential technologies necessary in deploying the IPv6 Internet protocol around the world.

As a first result of this agreement, in the January 2004 International Consumer Electronics Show, the IPv6 Task Forces organized a dedicated workshop "IPv6 Products and Services: Enabling Consumer Electronics with Next Gen Internet".

This event resulted in a high press impact, and was very well attended by key relevant organizations and individuals. A liaison was established with the Welcome to the Digital Home Working Group (DHWG, http://www.dhwg.org).

Related links:

- http://www.eu.ipv6tf.org/in/cea.htm.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=219.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=257.

8.2.5 CENELEC (European Committee for Electrotechnical Standardization)

The IPv6 Forum, with the collaboration of the IPv6 Task Force, agreed to forge a Liaison with CENELEC to drive Deployment of the Smart House.

"CENELEC within the ICT Standards Board (ICTSB) and in collaboration with the European Commission has been working for quite a long time on the Smart House initiative. Now that the concept is maturing and interest from the Consumer and Industry is rising, the challenge is more to help the convergence of the different initiatives in a structured and coherent way for the benefit of the European citizen. The role of Standardization is very important here, and IPv6 will facilitate the broad development of Home Networking", states Mrs. Elena de Santiago, Director General of CENELEC.

References:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=287.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=304.

9. SUMMARY AND CONCLUSIONS

9.1 Status of Project Goals

1 **Goal**

To perform all required actions aiming at the enhanced coordination and continuation of the work performed within the IPv6 Task Force 2nd phase.

The IPv6 TF-SC will set the Agenda and with the assistance of the Commission invite participation of representatives of not yet represented economic and industrial sectors likely to be impacted by IPv6, including representatives of national or regional IPv6 Councils and appropriate representatives from candidate countries.

Status

The IPv6 Task Force has primarily focused on the creation of national Task Forces so far. During this time, the work of the European IPv6 Task Force has focused on fostering and coordinating the national activities. Many colleagues from the European Task Force support the national IPv6 Task Force activities. It is intended to continue some of the work with the national IPv6 Task Forces, while the European Task Force will be invited for special occasions only.

2 **Goal**

The IPv6 Task Force provide a regularly updated review and plan action on the development and future perspectives of IPv6 in order to coordinate European efforts on IPv6.

The IPv6 Task Force Steering Committee will monitor how the recommendations are transformed implemented and remind those that need to take action where appropriate.

Status

An action plan and the status of the implementation of the recommendations is part of this document.

3 **Goal**

Create the proper working and liaison environment to ensure that a working collaboration with standards and Internet governance/policy bodies takes place.

Status

Through the members of the project, the liaisons have been and are being established.

4 **Goal**

Establish collaboration arrangements and working relationships with similar initiatives being launched in other world regions, industry and research.

Status

The relations with other IPv6 activities are listed in this document.

5 **Goal**

Organize regular IPv6 Task Force meetings (Plenary and/or Working Groups) with the assistance of the Commission.

Status

National Task Force meetings have been arranged with the help of the Commission. Further meetings are work in progress.

6 **Goal**

Foster dissemination and awareness activities, regarding the IPv6 Task Force work, and other related efforts and initiatives, including the operation of the IPv6 Task Force and the project web sites.

Status

The website has been created and is being operated by the project. The project members are actively participating in many events and are actively promoting the European IPv6 Activities as well as the work of the Task Force. Partner, collaborating projects such as the IST IPv6 Cluster (6LINK) have complementary IPv6 content on their sites.

9.2 Conclusions

The IPv6 Task Force Steering Committee took up its work as per the project goals. A focus was placed on national TF creation and fostering. Several gatherings have been organized and links and liaisons have been and are currently established with several bodies. The project is gaining momentum through the initiated national IPv6 Task Forces.

The Task Force intends to continue and intensify the work on the goals that are addressed so far.

Is remarkable the wide press coverage about IPv6 and the high number of new products and services supporting it worldwide.

Is also a remarkable achievement that worldwide there is a growing take-up of IPv6 in industry and governments, including its consideration in private and public tenders. First business "because is IPv6-Ready", can be already accounted.

The dissemination activities are a great success, including the Global IPv6 Service Launch event and the EuroNews appearance.

Very positive articles being published by specialized press:

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=361.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=347.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=339.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=338.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=312.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=258.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=271.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=276.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=284.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=289.

It should also be noted that there is some negative press, usually due to incomplete knowledge about IPv6 (education in the press remains a continuous task):

- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=377.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=300.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=291.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=295.
- http://www.ist-ipv6.org/modules.php?op=modload&name=News&file=article&sid=286.

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Asia Pacific IPv6 TF	http://www.ap.ipv6tf.org
Belgium IPv6 TF	http://www.be.ipv6tf.org
Brazil IPv6 TF	http://www.br.ipv6f.org
China IPv6 Council	http://www.cn.ipv6tf.org
Denmark IPv6 TF	http://www.dk.ipv6tf.org
EC IPv6 Task Force	http://www.ec.ipv6tf.org
ETSI STF236	http://portal.etsi.org/STFs/MTS/STF236.asp
French IPv6 TF	http://www.fr.ipv6tf.org
German IPv6 TF	http://www.de.ipv6tf.org
India IPv6 Forum	http://ipv6forum.org.in
IPv6 Cluster	http://www.ist-ipv6.org
IPv6 Forum and Steering Committee Taiwan	http://www.ipv6.org.tw/eng/index_E.shtml
IPv6 Forum Korea	http://www.ipv6.or.kr/english/index.new.htm
IPv6 Interest Group	http://ipv6forum.org.in/wg/6ig/6ig.htm
IPv6 Promotion Council Japan	http://www.v6pc.jp/en/index.html
IPv6 Task Force Steering Committee	http://www.ipv6tf-sc.org
IPv6 Task Forces Root Website	http://www.ipv6tf.org
Iranian IPv6 TF	http://www.ir.ipv6tf.org
Italian IPv6 TF	http://www.it.ipv6tf.org
Luxembourg IPv6 TF	http://www.lu.ipv6tf.org
North America IPv6 Task Force	http://www.na.ipv6tf.org
Portugal IPv6 TF	http://www.pt.ipv6tf.org
Spanish IPv6 TF	http://www.es.ipv6tf.org
Swiss IPv6 TF	http://www.swiss.ipv6tf.org
UK IPv6 TF	http://www.uk.ipv6tf.org