www.euro6ix.net

Title:	Document Version:
Deliverable D5.3 **Report on Liaison between 6NET and Euro6IX**	0.14

Project Number:	Project Acronym:	Project Title:
IST-2001-32161	Euro6IX	European IPv6 Internet Exchanges Backbone

Contractual Delivery Date:	Actual Delivery Date:	Deliverable Type* - Security**:
30/06/2002	17/07/2002	R – PU

* Type: P - Prototype, R - Report, D - Demonstrator, O - Other
** Security Class: PU- Public, PP – Restricted to other programme participants (including the Commission), RE – Restricted to a group defined by the consortium (including the Commission), CO – Confidential, only for members of the consortium (including the Commission)

Responsible:	Organization:	Contributing WP:
Tim Chown	University of Southampton	WP5

Authors (organizations):

Wilfried Woeber (ACOnet), Jordi Palet (Consulintel), Martin Potts (Martel Consulting), Kevin Meynell (TERENA), Olaf Bonness (T-Nova), Peter Kirstein (UCL), Piers O'Hanlon (UCL), Antonio Gómez Skarmeta (UMU), Gregorio Martinez (UMU)

Abstract:

The two projects 6NET and Euro6IX both focus on large-scale IPv6 deployment, but for different market segments, research/academic and commercial. They work closely together and exchange information freely (as witnessed by this common Deliverable).

This Deliverable describes areas in which they have identified some potential common activities. It also includes the minutes of two joint workshops that have been held (March, Madrid and June, Limerick). Tentative plans for future joint events (workshops and trials) are given.

Keywords:

6NET, Euro6IX, IPv6, Liaison, Public Trials, Workshops

Revision History

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

Revision	Date	Description	Author (Organization)
v0.1	03/06/2002	Document creation	Tim Chown (UoS) Jordi Palet (Consulintel)
v0.2	20/03/2002	Included results from IETF meeting	Tim Chown (UoS) Jordi Palet (Consulintel)
v0.3	05/06/2002	Major update, moved to new template	Tim Chown (UoS)
v0.4	06/06/2002	Included notes and responsibilities engaged during Limerick meeting	Jordi Palet (Consulintel)
v0.4a	12/06/2002	Base text added for 6NET activities, Executive Summary started, minutes from the 1st joint meeting (Madrid) summarised, some additional common themes added.	Martin Potts (Martel)
v0.5	25/06/2002	Further text and integration of comments from contributors (Martin Potts, Antonio Gómez Skarmeta)	Tim Chown (UoS)
v0.6	26/06/2002	Tidying up layout, making clear what final contributions are required.	Tim Chown (UoS)
v0.7	27/06/2002	Inclusion of feedback	Tim Chown (UoS)
v0.8	05/07/2002	Addition of further inputs and comments.	Tim Chown (UoS)
v0.9	07/07/2002	Split proposed activities to those that are currently planned and those that are “potential future collaboration”.	Tim Chown (UoS)
v0.10	07/07/2002	General overview and compliance with template	Jordi Palet (Consulintel)
v0.11	14/07/2002	Addition of final contributions (VPN, security) Some grammatical tidying up	Tim Chown (UoS) Peter Kirstein (UCL)
v0.12	15/07/2002	Some text added relative to sponsors in the joint Madrid meeting, NMS, porting, clarifications about the Spain events, mention of showcase connectivity with Japan, latest information about the NTT link and the TEIN link, AUP, VPN/MPLS, multi6, multihoming, transition, access. Final Review and style compliance	Jordi Palet (Consulintel)
v0.13	17/07/2002	Reviewed by PSC, logos added	Jordi Palet (Consulintel)
v0.14	22/09/2002	Minor updates	Jordi Palet (Consulintel)

Executive Summary

The 6NET and Euro6IX projects both focus on large-scale IPv6 deployment, but for different market segments. 6NET is deploying an IPv6 infrastructure in an academic research environment, with a high-capacity native IPv6 backbone spanning many countries. Euro6IX is deploying a number of pre-commercial IPv6 exchange points (IX's), with relatively lower connectivity speeds between the IX's.

The projects work closely together and exchange information freely (as witnessed by this common Deliverable).

This Deliverable describes areas in which they have identified some potential common activities.

It also includes:

- The minutes of two joint workshops that have been held (March: Madrid and June: Limerick). Plans for future joint events (workshops and trials) are given.
- Potential plans for interconnectivity between the projects, and shared external connectivity (including to the Far East and Internet 2).
- General areas of potential collaboration, identifying the activities in each project where these activities are carried out, and the people/organizations who may liaise between the projects.
- Specific trials and scenarios for collaboration, focusing on areas where trials can be established and run between one or more partners on each project.

We expect the plans presented in this document to evolve as the projects proceed. This document is a starting point for collaboration, both between the projects and beyond.

We expect the collaboration results to date, and future plans, to be reviewed at the next joint 6NET-Euro6IX workshop.

Table of Contents

Table of Figures

Introduction

In the IST Fifth Framework programme, two large-scale IPv6 research and deployment projects were funded by the European Commission, namely 6NET and Euro6IX.

The projects have differing focuses, 6NET on a high-capacity IPv6 research and academia infrastructure, Euro6IX on pre-commercial IPv6 Internet exchange points. Yet despite the differing nature of the projects, they have many commonalities. This Deliverable attempts to document these, and propose future areas of collaboration between the projects.

Both projects are scheduled to run until December 2004.

1. JOINT ACTIVITIES OVERVIEW

Figure 1-1 presents an overview of the potential joint activities between the projects, and lists the people (and organizations) who have volunteered to liaise to further that collaboration.

	6NET		Euro6IX	
	Activity	**Responsible**	**Activity**	**Responsible**
Initial collaboration areas				
Joint workshops and trials	A7.3	K. Meynell (TERENA), B. Ciscato (Cisco)	A5.3	J. Palet (Consulintel)
Interconnectivity (includes AUP)	A1.3	D. Sutherland (DANTE), B. Tuy (RENATER)	WP2	C. Ralli (TID)
Multicast	A3.4	W. Biemolt (SURFnet)	A4.1	A. Skarmeta (UMU)
VPN	A4.3	P. Kirstein (UCL)	A4.1	G. Martinez (UMU)
Mobile IPv6	A4.1	M. Dunmore (ULanc)	A4.1	A. Skarmeta (UMU)
Applications and porting	WP5	J. St. Blancat (IBM)	A4.2	J. Quemada (UPM)
Multimedia	WP5	J. St. Blancat (IBM)	A4.2	J. Quemada (UPM)
Multihoming	A4.5	C. Edwards (ULanc)	A4.1	O. Bonness (T-Nova)
Security	WP3	W. Woeber (ACOnet)	A4.1	G. Martinez (UMU)
Future collaboration areas				
Transition strategies	WP2	T. Chown (UoS)	-	C. Ralli (TID)
Network management and monitoring	WP6	B. Tuy (RENATER)	A3.3	C. Ralli (TID)
Access technologies	-	M. Dunmore (ULanc)	WP3	C. Ralli (TID)

Figure 1-1: 6NET-Euro6IX Joint Activity Areas

The activities are described in more detail in subsequent sections in this document.

At this stage some activities have clearer collaboration plans than others. It may be the case that not all activities will be able to collaborate, but through regular meetings and discussion we will seek to maximize the potential for joint activities where practical.

Note some activities are not specific research items in projects, i.e. access technologies in 6NET and IPv4-IPv6 transition in Euro6IX. It is quite probable that either project may utilize technologies, or deploy technologies, which they are not reporting on within the project. Thus Euro6IX will use transition techniques, even though the project has no specific activity for transition.

2. WORKSHOPS, DISSEMINATION AND PUBLIC TRIALS

6NET and Euro6IX had a contractual commitment to organise one joint Workshop, to be held on or before Month 6. In fact, two joint Workshops took place before the end of M6; a closed meeting in Madrid (March) and an open plenary workshop in Limerick (June). Overview reports from these sessions are presented in this section, together with future workshop and event plans. The Madrid meeting was open to possible Euro6IX sponsors, and indeed, a few of them participated.

2.1 Euro6IX-6NET Workshop, Madrid, March 2002

Over forty people attended this closed meeting, held in parallel with the Global IPv6 Summit in Madrid (organized by Consulintel on behalf of the IPv6 Forum, see http://www.ipv6-es.com). The aim was to explore areas of synergy between the projects and to start the process of preparing the joint Deliverable from the two projects (due in Month 6) that will describe the particular topics where close collaboration will take place.

Reduced versions of the Descriptions of Work of both projects (containing essentially just the technical aspects) were prepared and exchanged in advance of the meeting, in order to facilitate the knowledge among the projects and improve the debate.

It was clear from the brief presentations of the two projects that whilst both had distinctly different aims, target users and many unique topics of research, there were a number of themes that were addressed in both projects (see below).

2.1.1 Infrastructure and Connectivity

There was general consensus that the two projects should interconnect (and at more than one location). The following locations were identified as candidates for the interconnection:

- UK: UCL presented a scenario encompassing:
  - UoS (UK6x) - BT Tower (UCL) - Adastral Park (Euro6IX)
  - ULCC (to UoS and GÉANT) - UCL CS - UCL EE
  - [Ed note: The physical infrastructure for this is now largely in place as of M6.]
- France: RENATER reported that nodes of both networks are present in the same building in Paris.
- Germany: DFN identified two possibilities, DFN - T-Nova (FhG-Fokus – Deutsche Telekom), or in Frankfurt.
- Italy: INFN-GARR suggested Torino (Polytechnic Torino - TI lab).

2.1.2 Research Activities

The following joint collaboration areas were discussed.

1. MM Conferencing / IP multicast

Multicast mechanisms range from the design of the network topology, to a service provided by edge devices (keywords: PIMv2, RPs, SSM, MLD for IPv6, inter-domain multicast, KAME stack). Certain applications that will be used in both projects (e.g. ISABEL) have specific demands for Multicasting.

Multicasting will first be implemented within each project individually, before considering a combined 6NET-Euro6IX scenario.

2. Security

Euro6IX is addressing security in two ways:

- Security of the basic infrastructure.
- Experiments with security at a “lower level”.

There is already some collaboration between UCL (6NET) and UMU (Euro6IX) on this topic.

3. Virtual Private Networks

Experiments will be made in both projects with different approaches for providing VPNs. To some extent, the work on VPNs is related with the previous topic of Security, since the VPNs will include features related to Security Policy, PKI and AAA.

4. Access

The access network (in particular DSL technology, but also ISDN, PSTN modems and wireless) is a major interest for Euro6IX. The only common item with 6NET is wireless (6NET/WP4).

5. Network Management and Monitoring

One of the first priorities in 6NET is to define the network management architecture, and to select the tools (a first catalogue has been identified).

Euro6IX expressed an interest to consider using the same tools as 6NET.

Euro6IX is also working in several network management tools, which will be provided also to 6NET when available.

6. Applications and Porting

There are many ways of porting IPv4 applications to IPv6, and there was some interest to produce a joint “best practice” guide. Euro6IX already has a proposal (based on work in a previous project).

A common mail exploder has been setup by 6NET in order to follow this work area.

7. Mobility

IPv6 Mobility is a common topic in both projects, but it was determined that it was too early to decide on the precise collaboration.

8. AUP

6NET is planning to use a similar AUP to that used by the NRENs and DANTE in GÉANT. This places the responsibility for the AUP on the partners that control the NREN PoPs. Once accepted by any one of these nodes, all nodes automatically accept the traffic. Whilst no one accepts commercial traffic, the scheme allows for partners/countries to have different policies.

Euro6IX could envisage that their AUP might migrate towards the acceptance of commercial traffic towards the later stages of the project, as the network becomes more reliable and incorporates the necessary management features. Euro6IX has more flexibility than 6NET regarding carrying commercial traffic, as the Commission is not paying anything towards the connectivity.

[Ed note: The 6NET AUP has been published on the 6NET web site as of M6]

2.1.3 Any Other Issues

The logistics of following up all the ideas for collaboration were discussed. The consensus was that, at this stage, the goal was primarily to identify the areas for collaboration. Once the areas were more precise, then smaller interest groups would naturally form around these topics, and that would be the appropriate time to identify the players, and build appropriate e-mail groups. Part of the responsibility of these groups would be to provide input for the corresponding chapters of the joint Deliverable.

2.2 Euro6IX-6NET Workshop, Limerick, June 2002

The full minutes and notes from this workshop are available from the 6NET project as Deliverable D7.3.

The Joint 6NET/Euro6IX Workshop was held on 5 June 2002 in conjunction with the TERENA Networking Conference in Limerick, Ireland. The objective was to publicise the 6NET and Euro6IX project activities, as well as discuss IPv6 developments elsewhere. It also provided an opportunity for feedback from the European research networking community.

In contrast to the meeting in Madrid, where the 6NET and Euro6IX partners discussed potential collaboration activities, the style of this workshop was plenary, with the audience able to listen to topical presentations on important IPv6 research and development issues.

Presentations were made on the following topics by members of the 6NET and Euro6IX projects, and by some invited guests:

- 6NET
- Euro6IX
- European Initiatives on IPv6 - Future Perspectives
- IPv6 Standards Update

- Security Services on IPv6 Networks: PKIv6 and IPv6-VPNs
- ISABELv6
- Internet2 IPv6 Update
- User Projects Expectation from IPv6 Backbone Network
- IPv6 Multimedia Adaptive Applications in the Framework of the MIND Project
- IPv6 Services in LONG Network
- Security Architectures for Mobile IPv6
- IPv6 in the IST @Hom Project
- 6WiN: IPv6 in DFN
- IPv6 and the Internet Applications Suite

The workshop concluded with a 45-minute session where the audience was invited to put questions to a panel of speakers. This proved extremely productive with many topics of interest being covered.

The presentations from this event are available online in PDF format:

http://www.6net.org/events/joint-workshop and http://www.euro6ix.com/new_6net.htm

At least two planned presentations, one on IPv6 Transition Strategies, were unfortunately cancelled due to travel problems caused by the Aer Lingus strike.

2.3 Future Joint Euro6IX-6NET Workshops and Public Trials

Future joint collaborations (after M6) in the Descriptions of Work of the two projects state that 6NET has a contractual requirement to organise three Open Workshops (M18, M30, M36), and that Euro6IX has a contractual requirement to make three public trials (M18, M30 and M36). In principle, the projects have agreed to co-ordinate these events, and for this reason the dates had been aligned, in order that both projects can benefit from a larger attendance.

Opportunities for locations for these events and for additional joint workshops and trials have been identified as follows:

2002:

Joint collaboration meeting, 3-6 September, Brussels

- A one-day collaborative meeting may be held either side of the 6NET plenary meeting in September 2002. An alternative is to hold such a meeting in series with the Euro6IX plenary, which is at a similar time (23-24 September).

IST Event, 4-6 November, Copenhagen:

- Consulintel, Euro6IX technical coordinator, has worked with the EC to secure the WLAN (IPv4 and IPv6) and IPv6 connectivity to this event. 6NET can provide the IST event, including Euro6IX, with broadband native IPv6 connectivity to the GÉANT PoP in Copenhagen (NORDUnet) from all other sites represented by NRENs or Universities in the project, and then connectivity to Euro6IX network. It is understood that wireline connectivity is available from Copenhagen to the conference centre, and that wireless connectivity is available in-house, as a legacy of previous events that have been held there. The EC has already confirmed that they will pay the fee for the usage of the wireless devices in the venue. In addition, Euro6IX has a booth confirmed for IST2002, 6NET does not have a booth, but is discussing shared activities with Euro6IX, and a possible IPv6 Clustering initiative for the event.

European Research Meeting, 10-12 November, Brussels

- A joint meeting or workshop may be possible at this event. Consulintel, already applied for an IPv6 session.

2003:

IPv6 Summit, May, Madrid:

- Following the successful organisation of the 2001 and 2002 IPv6 Summits in Madrid by the Euro6IX Co-ordinating partner Consulintel, the event will be repeated in 2003 (May/June). There will therefore be another joint 6NET-Euro6IX Workshop on this occasion, together with a Euro6IX public trial. It is being investigated if there can also be some collaboration with ETSI for an IPv6 “Plugtest”, which may involve the need to use Euro6IX and 6NET connectivity.

IETF Meeting, July, Vienna:

- Given that the University of Vienna is a partner in 6NET, this can be a good opportunity to host a 6NET Open Workshop and a Euro6IX trial.

TERENA Networking Conference:

- This is an event that attracts a high number of participants from precisely the community that can contribute effectively to the topics being investigated and implemented in the two projects. It is an ideal opportunity to combine with a 6NET Open Workshop, and offers facilities for making a Euro6IX trial.

IST2003 Event

- It is probable that both projects will attend this event in late 2003.

2004:

IETF & Global IPv6 Summit, March, July or November, Madrid or Barcelona.

- This is currently being negotiated with the IETF, so cannot be confirmed, however an IPv6 Forum event is likely to proceed at this time anyway. If the IETF event is confirmed in Spain, it will be held, most probably, the week after the IPv6 Summit.

TERENA Networking Conference

- This is an event that attracts a high number of participants from precisely the community that can contribute effectively to the topics being investigated and implemented in the 2 projects. It is an ideal opportunity to combine with a 6NET Open Workshop, and offers facilities for making a Euro6IX trial.

IST2004 Event

- This is likely to be the last major event before both projects end, so could be a good location for the "M36" workshop in late 2004 and the Euro6IX public trial, simultaneously.

2.4 Joint Dissemination Activities

There will be many occasions where speakers from either project are presenting the results of work on their project. It seems appropriate that such speakers can present, at least briefly, an overview of the other project while doing so. To facilitate this, a standard set of slides should be exchanged between the projects. Such speakers can also mention other IST IPv6 initiatives, such as the IPv6 Cluster (managed by the 6LINK project).

It may be the case that other IST projects use the 6NET or Euro6IX infrastructure in their work (see the next section). Such projects should at least briefly describe the project that provides such infrastructure in any presentations they give.

Both projects will seek to make joint press release documents where appropriate, to maximize their impact.

Both projects will feed results and news to 6LINK for the periodic IPv6 Cluster Newsletter.

2.5 Relationships to Other (IST) Projects

There are other IST projects that can work to mutual benefit with 6NET and Euro6IX in dissemination and joint studies. These include:

- 6LINK, which manages the IPv6 Cluster activity. As major IST IPv6 projects, both Euro6IX and 6NET will feed reports into 6LINK, and attend the Cluster activities (members of both projects are also involved in the 6LINK project). 6LINK has three-year project duration, finishing in February 2005.
- IPv6 Task Force Steering Committee, which drives the EU IPv6 Task Force, which in turn is discussing issues that affect the deployment of IPv6 in Europe, and recommending measures to assist that process. Clearly both projects have a role to play in that process, from operational experience gained.

- NGN-LAB, which provides an international distributed IPv6 test bed facility based on two interconnected sites; in Brussels (Eurodemo) and Basel (MCLab). Issues addressed include QoS (DiffServ, Flow Label), security, wireless (WLAN, GPRS), transition strategies, applications (including ISABEL, VideoLAN, Darwin, vic, rat), and interoperability. The project concentrates on integrating and demonstrating early implementations. The sites are used to host other projects for their testing and validation.
- Eurov6, which will be a "European IPv6 Showcase" project, has officially commenced in July 2002. Plans for cooperation with this project can be discussed once the project is underway. At least 3 demo rooms will be setup, some using 6NET, and others Euro6IX, including connectivity to the Japanese showcase.

3. COMMON CONNECTIVITY ISSUES FOR EURO6IX AND 6NET

In this section we detail and discuss the connectivity issues for both projects.

3.1 General Connectivity

As new network architectures and technologies, algorithms and protocols emerge, these must be tested, in order to enable the selection of the appropriate technology to fulfil the demand from users for higher bandwidths, QoS, and (from operators) for more structured network interconnection schemes. Interoperability must be proven in large-scale realistic environments, evolution scenarios must be checked, specifications must be validated and applications and services must be trialled, as a forerunner to any commercial deployment, and to ensure that earlier investments are not wasted.

3.1.1 6NET

The 6NET interconnectivity policies are described in Deliverable D1.3, under Activity A1.3. The 6NET backbone network will be connected to access routers of the national IPv6 test/pilot networks operated by the NREN partners (e.g. RENATER in France, UKERNA in the UK, DFN in Germany). These NRENs will be the points of access to the backbone. It is anticipated that university partners would connect via the national PoPs, using IPv6 address space allocated from their own NREN.

3.1.2 Euro6IX

Euro6IX is a co-ordinated initiative of major European Telecom companies, equipment manufacturers, solutions/software providers, and research laboratories with the objective to research appropriate architecture, design, develop, deploy and validate the first Pan-European pre-commercial IPv6 Internet Exchanges Network, connecting several regional and strategic neutral IPv6 Internet Exchange points across Europe.

ISPs wishing to conduct pre-commercial trials will be able, subject to AUP, to connect to one or more of the national IPv6 exchange points (e.g. the LON6IX in the UK, or MAD6IX in Spain).

3.1.3 Proposed Joint Activities

An organization or (IST) project wishing to conduct IPv6 trials may connect to either of the 6NET or Euro6IX project infrastructure, subject to AUP.

Interconnections can be made to the Euro6IX IXs in the countries of these partners, or via the 6NET NREN national PoPs. Alternatively, it may be possible to connect via the site network of one of the project partners.

Organisations connecting in this way may, again subject to AUP, be able to utilize the international links of the projects, e.g. via the current TEIN network to Korea and thence Japan, or to the US via the 6TAP.

Peering, transit agreements and routing policies between 6NET and Euro6IX should be determined as part of the project interconnection collaboration discussed below. Discussion of these issues is also present in 6NET Deliverable D1.3.

3.2 Connectivity Between the Projects

6NET and Euro6IX have plans currently for at most two interconnection points between the project infrastructures.

The current candidate linkage locations are:

France (Paris):

- Details to be provided by Bernard Tuy (RENATER)

Germany:

- Details to be provided by Jürgen Rauschenbach (DFN)

UK (UK6X):

- The UK connectivity initiative involves Peter Hovell (BT Exact), Peter Kirstein (UCL) and Rob Evans (UKERNA/JANET NOSC). There is a 100Mbit/s link running BGP between the UK6X and the JANET router in Telehouse, which in turn connects to the ULCC and the UK 6NET PoP. The UK6X is willing to provide transit between 6NET and Euro6IX partners, and agreement from 6NET to allow transit via the UK PoP to Euro6IX partners should be forthcoming soon. [There is also a direct link from BT Exact to UCL, but the UKERNA/ULCC route is preferred.]

We expect at least one, possibly two, connectivity points to be agreed soon.

We also expect some sharing of links by project partners, where it is mutually economic to do so. There are two such instances identified to date, though exact details are yet to be resolved:

6WIND

- 6WIND (in Euro6IX) already has an ATM IPv6 link to RENATER (in 6NET), which could be used for connectivity, but would like to experiment also with a second connection method (e.g. ADSL), which would also allow multihoming trials. It is quite possible that Euro6IX and 6NET will have a connection point in Paris, which would be advantageous.

UoS

- UoS is uniquely a member of both projects, and requires native IPv6 connectivity to London for both projects. UoS has budget within Euro6IX for such a link, and also has the prospect of support from UKERNA for native connectivity over SuperJANET hardware in Year 2, but has to resolve connectivity issues regionally and within London.

3.3 Shared International Links

Both projects will benefit from IPv6 connectivity to external (principally overseas) networks. It may be that some common links can be used for such connectivity, e.g. to:

- Japan (WIDE) and Korea via the Trans-Euroasia Network (TEIN).
- US (StarTap).

Consulintel is already investigating the potential for a 45 Mbps direct link to Japan, free of charge at least for the first year of use.

Is expected that the capacity of the TEIN link will be increased to 45 Mbps., or even more, in November 2002.

NTT is providing also a link between 6NET and Japan, and they agreed to allow its usage by other projects working with 6NET.

We hope that both projects can mutually benefit from joint links, and may be able to leverage their joint research weight as a means to secure mutually beneficial connectivity agreements.

3.4 Acceptable Use Policy (AUP)

In offering services to other projects (IST or otherwise) and ISPs, the AUPs will determine the nature of connectivity and transit offered.

3.4.1 6NET

To quote 6NET Deliverable D1.3: “In principle, the 6NET infrastructure is open for other IST projects to use, and this deliverable gives guidance on the procedures for interconnecting. The interconnection has to be approved by the 6NET PMC and be regulated on a case by case basis. The general rule is to be liberal to accept connection proposals to 6NET that might be mutually beneficial for IST projects”.

6NET has agreed to follow an AUP that is compatible with that used by GÉANT; this specifies the NRENs as being the only points of access to the backbone. The individual NRENs determine their price for the access, bearing in mind that they have minimal charging capabilities, and therefore price according to a flat rate, with the ability to restrict throughput up to the agreed limit. All NRENs accept to transit - or route to the final destination - all traffic accepted by the other NRENs. Such a policy does not explicitly exclude that commercial traffic could be carried, but such traffic is generally forbidden in the access agreement, and it would anyway be unwise for any business to depend upon such a research network for its data transport.

3.4.2 Euro6IX

The Euro6IX AUP has not yet at the time of writing been formally declared in a public deliverable, but will be based mainly in the actual contents of the Technical Annex: “Euro6IX will offer the use of its IPv6 test-bed network for non-commercial traffic of R+D projects or organizations”.

However, the general ethos of the project is to encourage ISPs and other interested parties to connect to an appropriate national IX point (e.g. LON6IX, MAD6IX) to participate in pre-commercial IPv6 trials.

The issues of transit and peering exports will be decided within the final AUP document that is right now under consideration.

3.4.3 Proposed Joint Activities

The 6NET and Euro6IX projects are both available, subject to AUP constraints, to external projects and organizations for IPv6 connectivity and trials.

It is likely that both projects will liaise with existing IST projects to offer such connectivity between project partners. Potential liaisons already proposed include:

Euro6IX:

- 6POWER
- 6QM
- Eurov6
- LONG
- MIND

6NET:

- 6WINIT
- Android
- Eurov6

We expect others to be proposed, and the availability to extend into FP6.

It is quite possible, in fact very probable, that where IST projects include commercial and academic partners, that the commercial partners may most naturally use Euro6IX infrastructure, and the academic partners use 6NET infrastructure, the partners then communicating over IPv6 via the connection point(s) between the 6NET and Euo6IX projects. Also, it will depend on geographical coverage of the projects.

4. INITIAL COLLABORATION AREAS

In this section we describe the subject areas identified for early collaboration between the projects, beyond the workshop, trials and connectivity work described earlier.

In the following section, the identified future potential collaboration topics are listed.

4.1 Multicast

There is not yet much experience with any significant IPv6 multicast deployments in Europe. There have been some small-scale intra-domain tests with PIM-SM and MLD, in particular those led by RENATER, but no solution exists yet for inter-domain IPv6 multicast.

4.1.1 6NET

6NET (A3.4 in WP3 Basic Network Services) will design, implement and test both intra-domain and inter-domain IPv6 multicast. Interoperability with IPv4 multicast will be examined too. 6NET is committed to demonstrating a pan-European IPv6 multicast network, preferably with connections to the rest of the Internet.

The initial 6NET multicast deployment will use PIM-SM, establishing tunnels where required, and will also use PIM-SSM when available.

4.1.2 Euro6IX

One of the basic objectives of Euro6IX is to investigate how new services like multicast, that are in general still being studied in the research arena, or are being defined in standardization communities, can be supported in a real IPv6 network. Specifically in relation with multicast on Euro6IX, the main goal is to jointly study how IP multicast can be deployed in the network, specifying the service the network should offer and how the applications should use it. We will evaluate - analytically or using simulation - the scalability of the solution chosen and propose modifications or enhancements to appropriate standards to improve the service.

There are number of applications and services that will benefit from the use of multicast in IPv6, like information services, service discovery, alert services, event notification and e-education. Presently, multicast hasn't been successful, as it has been a retrospective patch in today’s IPv4 networks. IPv6 fully exploits multicast and will be key to enable these kinds of applications for broader use. In that sense multicast is still an open area of research in IPv6, with clear applications but subject to scalability problems. These problems require analysis.

Multicast activities in Euro6IX are covered within WP2 and WP3 from the network/services design and deployment, and in WP4 from the services and application point of view.

4.1.3 Proposed Joint Activities

As discussed in the Madrid joint workshop, multicasting will first be implemented within each project individually, before considering a combined 6NET-Euro6IX scenario.

Once established, we can then use this multicast infrastructure to hold joint meetings using multicast-enabled IPv6 conference tools such as the MICE tools (vic and rat) or ISABEL.

The main consequence that is obtained from the analysis of both projects is the highly complementary perspective of the approach. In that sense, the main objective of both projects is the analysis and validation of a variety of multicast scenarios on a native IPv6 network. In order to do that:

- Euro6IX goal is to study how IP multicast can be deployed in the network, specifying the service the network should offer and how the applications should use it. In that sense the perspective is the deployment of multicast services in backbone networks and then the use of applications and services within the network that take advantage of this technology.
- 6NET goal is to in the first place define a testing and implementation plan of IPv6 multicast where first each partner will run its own PIM-SM domain inside their organisation, and a subsequent part of the multicast work will be the interconnecting of the PIM-SM domains of the partners. Also issues like IPv6 multicast scope, IPv6 multicast address allocation and IPv4/IPv6 multicast interoperability will be investigated.

In that sense there is a clear possibility of collaboration by means of defining common scenarios of interconnectivity and interoperation of multicast protocols either in the context of:

- Intra-domain IPv6 multicast (MLD, PIM-SM).
- Inter-domain IPv6 multicast (BGMP, MBGP/MSDP, SSM) within a common connectivity provider like the case of 6NET.
- Inter-domain within a diverse connectivity provider like in Euro6IX.
- Within an IX approach like in Euro6IX.

And also defining common activities to share the:

- Tests of existing implementations, e.g. FreeBSD/KAME PIM-SM.
- Investigations of the multicast scope issues.

This list of heterogeneous environments and scenarios that could result from the collaboration of the two projects will certainly give an extensive evaluation of multicast technology.

In the context of applications there is a common interest in evaluating and running multicast applications, e.g. vic, rat, icecast, and also services that use multicast technologies. In that sense the experiments that are been done by UMU (Euro6IX) and UCL (6NET) could be an example of collaboration between the two projects. In this case within the IPv6 over IPv4 tunnel between UMU and UCL (which may later be replaced with a path over the joint infrastructure) “pim6dd” has been set up. FreeBSD "pimg6dd" it is used with tunnels to remote sites with similar routers. Given that dense mode PIM seems to be less popular in IPv6 usage, next it is planned to also use pim6sd (sparse mode PIM) for FreeBSD 4.5, including a special KAME patch plus some extra patches (see Figure 4-1).

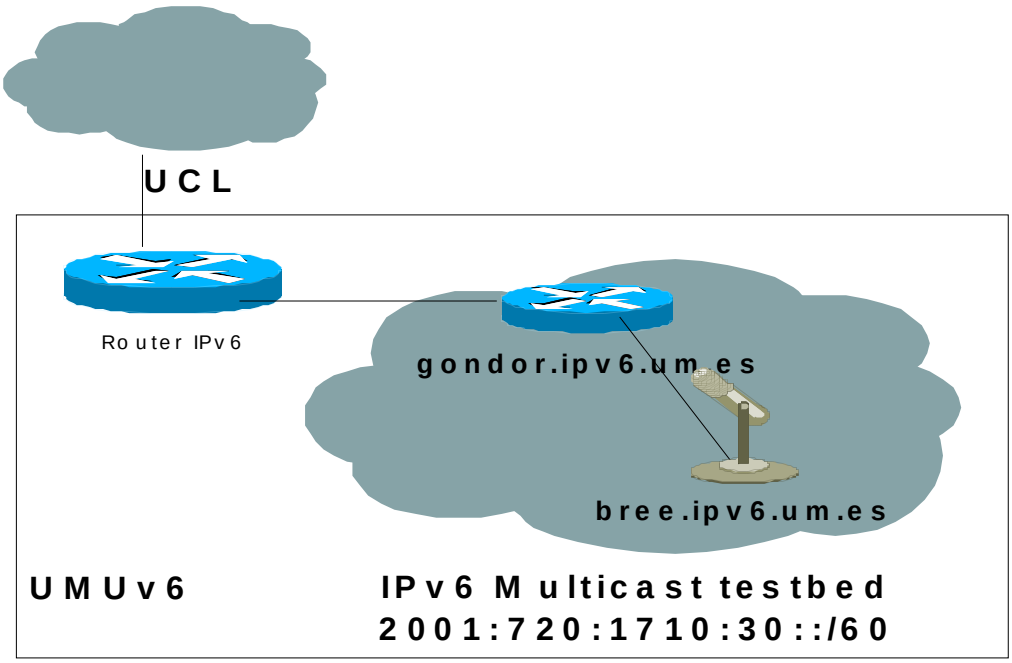

Figure 4-1: UCL-UMU IPv6 Multicast Experiment Topology

Over this multicast tunnel, multicast IPv6 sessions have been established testing the following tools:

- VICv6 (video).
- RATv6 (audio).
- SDRv6 (sessions management).
- Secure Conference Storev6 (web sessions management).

Next, we plan to evaluate different applications with multicast support, and possibilities like:

- ISABELv6.
- P2P applications.
- Games.

Such tests will help prepare selection of tools for wider use once the multicast infrastructure between the two networks is established.

4.2 Virtual Private Networks (VPNs)

VPN services are expected to be an important part of any IPv6 deployment, particularly for commercial services. However, certain scenarios, such as those in the medical research area, will also require VPN technology in academic and research networks.

4.2.1 6NET

Activity A4.3 in 6NET is responsible for work on VPNs.

6NET partners have experience of two types of dynamic VPNs: One is the set-up of VPNs using active networks as demonstrated in ANDROID [http://www.cs.ucl.ac.uk/research/android]; the second is the use of hierarchical active networks – as in the X-Bone used in the DARPA RADIOACTIVE [http://www.cs.ucl.ac.uk/research/radioactive] project. Porting of both of these to IPv6 is already underway.

The ANDROID (IST project) implementation will be extended in 6NET, and an IPv6-enabled Public Key Infrastructure (PKI) from the University of Murcia (Euro6IX partner) will be added (and also used in the Euro6IX project). If a different IPv6-enabled PKI is adopted in other parts of the 6NET project, this will be investigated also.

A second VPN technology, called the X-Bone [http://www.isi.edu/xbone], is has been developed by Information Sciences Institute (ISI), under the context of the DARPA Active Networks programme. UCL has begun work to port this technology to IPv6 and integrate it with the main IPv6 technology base of the 6NET project. Currently it is possible to create IPv6 overlays on an IPv4 infrastructure, further developments are being discussed. The hierarchic nature of the X-Bone will allow several VPN configurations to co-exist, and to be managed dynamically.

Other VPN technologies like MPLS-based VPNs will also be evaluated.

It is intended to integrate commercial router equipment (e.g. Cisco) into parts of these VPN solutions, to the extent that the basic functionality is supported on these routers. Finally, 6NET will endeavour to integrate the technology with the commercial servers available from IBM.

4.2.2 Euro6IX

Activity A4.1 includes the required components for VPN deployment in Euro6IX, including the work on Public Key Infrastructure (PKI).

In the Euro6IX consortium, and regarding the establishment of IPv6 VPNs, our main objectives are to evaluate the most interesting IPv6 IPsec/IKE solutions and to deploy an IPv6 VPN static and dynamic service inside the Euro6IX core and access network.

For doing this with static VPNs, we have defined an evaluation plan to analyze the interoperability and the conformance of the several freeware and commercial IPsec/IKE solutions. We have also established the basic scenarios (13) to do this analysis and the test suite to evaluate each implementation. This process will generate several reports with the test results and a final report will be the definition of the static VPN service with multi-implementation support.

On the other hand, we are also committed to design and deploy dynamic IPv6 VPNs in different platforms and with the use of IETF-defined security policies. In this context, the concept of policy refers to a set of rules governing choices in the behaviour of one specific system. The final motivation is to be able to modify a policy in order to change the behaviour of one VPN without having to re-implement the whole VPN.

With the use of policies, a new network paradigm is being defined. This new paradigm is a shift away from hardware-based, inflexible network VPNs that need to be upgraded manually, to a flexible, programmable VPN-based network in which configuration changes can be automatically and securely –using a PKIv6 service– propagated throughout the network devices belonging to a set of network domains under the control of one, or various, certified network administrators.

The last part of our work is related with the use of static and dynamic VPNs between certified computers (final hosts and/or secure gateways). In this line it is important to mention the use of the PKIv6 or DNSsec services. Both cases are based in public key cryptography, which is suitable, in general, for distributed and dynamic environments, with a medium or big number of communicating parties sending data through insecure channels, as it is the case of VPNs. In fact, it provides a secure communication method for recipients not previously known each other.

And last but not least, we are also interested in providing this static and dynamic IPv6 VPN service, PKIv6-based or not, to some other services that need it. This is the case, for example, of the establishment of IPv6 mobile infrastructures with AAA services, as explained in section 5.3 (also coordinated by UMU).

Euro6IX is also working in VPNs and MPLS.

4.2.3 Proposed Joint Activities

UCL (6NET) and University of Murcia –UMU– (Euro6IX) have already collaborated on a previous project for PKI; this close collaboration is being extended here regarding VPNs and some other security and mobility-related activities.

As we can conclude from the description coming for both projects, most of the activities are very similar. In fact, most of these activities have been (or are planned to be) carried out between the UCL and UMU research groups, defining a VPN end-point in each site, and therefore gaining and sharing experiences for both consortiums. An example of the existing collaboration is shown in Figure 4-2, where an IPv6 IPsec connection based on FreeBSD 4.5 using PKIv6 issued certificates has been established between both sites.

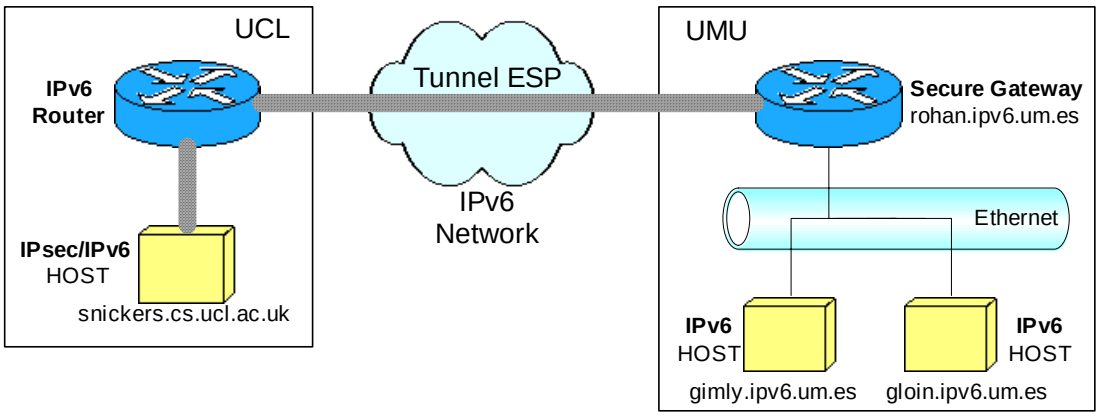

Figure 4-2: IPv6 VPN Joint Trials Between UCL and UMU

We intend to deploy these technologies over a mixed environment including both 6NET and Euro6IX; this may require the resolution of additional problems due to different choices of router and security technology being developed in the two projects.

An example of the use of a VPN in the context of the collaboration here would be to hold secure conference between the projects, over the joint infrastructure. This could use certificates (initially manual configuration then later dynamic use of the PKIv6 service).

Other applications requiring VPNs would then be sought.

For the dynamic VPNs there are some differences that need to be studied regarding the different approaches to policy specification taken by the projects. The Android/6NET project has based its specification of policies on the Imperial College approach, whereas UMU/Euro6IX has based theirs on the use of the IETF-defined policies. A joint activity will be defined to try to gain some experience in the interconnection of different policy systems.

Regarding the use of the PKIv6 service to build the VPNs, a really interesting activity will be defined as both projects are using the same PKIv6 implementation, running in UCL and in UMU, which will be cross-certified very soon.

On the other hand, the UCL experiences with X-Bone can be easily exported to the Euro6IX consortium, as some partners, such as UMU, would be interested in testing this system if/when it is ported to IPv6.

4.3 Mobility (Mobile IPv6)

One of the most significant advantages of IPv6 is the coupling of its enhanced global address space with the improved support for Mobile IP. Mobile IPv6 (MIPv6) will be a key component of future wireless network services, but not forgetting wired also.

We can expect MIPv6 to leave Internet-Draft status towards Proposed Standard very shortly. Trials of MIPv6 are thus very timely.

4.3.1 6NET

Mobility is a significant area of attention in 6NET. Many facets are considered, ranging from wireless-only LAN networks in an end-site environment (including specific transition issues from IPv4) using 802.11b equipment, and possibly also Bluetooth and 802.11a, through to the convergence of mobile and fixed network technologies. The introduction of Mobile IPv6 (MIPv6), which has been specified to support mobility as an integral part of the IPv6 protocol will be mirrored in 6NET, and configurations will be tested, leading to possible enhancements. Areas of specific interest for 6NET are issues involved with providing MIPv6 support within a network test-bed of the size developed within this project, handoff latencies, the relationship between autoconfiguration and User/Terminal management, multihoming, multicast, performance, and roaming.

6NET (WP4) will make a detailed analysis of the known performance issues that are evident with regard to handoff latencies with MIPv6, and provide proof of these issues with a series of real-life experiments, calculating the latency times across different components of the test-bed.

While there have been a number of solutions proposed to deal with the handoff issue, there has been limited implementation and experimental evaluation. 6NET will develop a solution to the issue, based (subject to analysis) either on an existing solution, or on a hybrid approach.

6NET will consider the relationship between autoconfiguration and User/Terminal management. The autoconfiguration features of IPv6 provide a very flexible approach to the configuration of v6 addresses, but within a mobile domain with a large number of devices and a large number of addresses, the relationship between the addresses, the users and the terminals must be defined and managed. The Activity will look towards developing a management mechanism to support this relationship.

6NET will analyse the use of MIPv6 as an enabling technology for the provision of wireless overlays/multihoming, and also evaluate the relationship between multicast protocols such as PIM SSM and mobile IPv6.

4.3.2 Euro6IX

The advanced network services and applications that have been selected within Euro6IX will contribute to the goal of advancing the state of the art, preparing the Euro6IX test bed for an effective and quick deployment of new user services over IPv6, and where the main focus is the validation via trials of the scalability and maturity of the approaches taken. Within these services mobile services and applications over fixed and wireless networks, including multimedia, are considered as a central topic within Euro6IX. Deployment of mobility in both wireless and fixed networks, as a native and very important new feasible feature of IPv6, are important issues to be considered in Euro6IX.

In the Mobility on IPv6 networks area, Euro6IX will investigate how IPv6 mobility solutions may scale in a heterogeneous network. Particular attention will be paid to current proposals that modify basic IP mobility with enhancements to increase its efficiency and scalability, and to improve its integration with QoS models, in order to support new and legacy services on a large scale environment. Besides, convergence between mobility in fixed and mobile networks will be studied. As a result of these activities Euro6IX will provide specific recommendations about how to deploy mobility services over IPv6 networks at different levels (backbone and access networks).

Also Euro6IX will investigate the relation of mobility services with other research areas like:

- IPv6 security solution.
- Authentication, Authorization and Accounting (AAA) services.

4.3.3 Proposed Joint Activities

The analysis of the activities proposed in Euro6IX within WP 4 Associated Research Activities, Trials and Evaluation and also in WP 4 IPv6 Application and Service Support from 6NET, indicate several activities that share common backgrounds and objectives. In that sense the activities and evaluation proposed by both projects have certain overlaps that could be avoided by undertaking joint work.

One of the main lines of collaboration that is starting is related to the existing common evaluation that UMU (Euro6IX) and UCL (6NET) are doing in different fields:

- Mobile services and applications over fixed and wireless networks, including multimedia.
- Validation of security mechanisms in a native IPv6 framework, including IPsec, AAA issues, VPNs, and related.

In both projects there are great analogies related to the MIPv6 implementation evaluations and analysis. In that sense it is clearly necessary that both projects can summarise the experience of the various MIPv6 implementations and therefore collaborate in the deliverable contributions. As a result of these activities both projects, plan to provide common specific recommendations about how to deploy mobility services over IPv6 networks at different levels (backbone and access networks). In concrete we can check that both projects have in common:

- The evaluation, configuration, and testing of Mobile IPv6 (MIPv6) implementations.
- Provide an analysis of the area of micromobility.

- Evaluate protocols such as Cellular IP.
- Provide an evaluation of the issues relating to access control / AAA within a wireless LAN.

One item that has been defined in 6NET but that partners from Euro6IX have also indicated their interest is the analysis evaluation of handoff latencies, where the objective will be to provide a detailed analysis of the known performance issues that are evident with regard to handoff latencies with MIPv6, and provide proof of these issues with a series of real-life experiments, calculating the latency times across different components of the (joint) test-bed.

It is clear from the two projects the importance of the evaluation and testing of different mobility stacks, and specially the last version MIPv6 v17 with which experimentation and deployment will be required. Hence we can conclude that lines of collaboration could include:

- To analyze IPv6 macromobility and micromobility and different implementations.
- To obtain throughput measures from MIPv6 implementations.
- To design and implement a micromobility testbed based on the experience obtained from these first test-beds about macromobility.
- To analyze how micromobility could be integrated with Mobile IPv6 and how it could help to increase MIPv6 performance.
- Roaming, wireless and AAAv6.
- Mobile services and applications over fixed and wireless networks, including multimedia.
- Mobility in fixed networks, including MANs, ADSL (though 6NET has no ADSL provision).

Within the actual collaboration defined between UMU-UPM-UCL-UoS, some scenarios have been defined for evaluating the integration between AAAv6 services and mobility within a vertical hand-over mechanism.

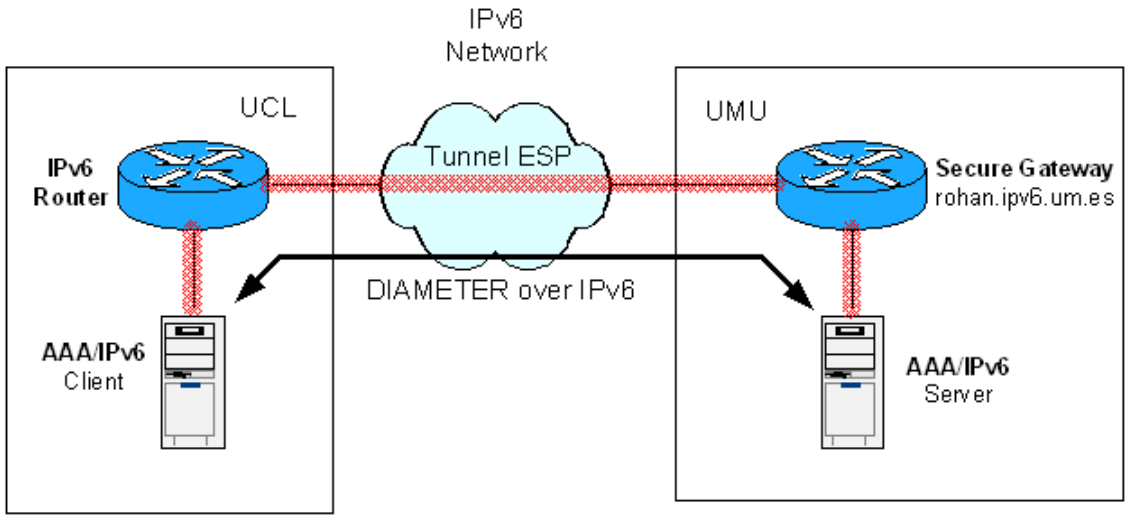

Figure 4-3: MIPv6 and AAAv6 Trials

AAA services are specially important when we talk about mobility, because it is needed to be aware about which user/users can connect to a foreign network and what things they can do inside these networks. Moreover, it could be also interesting to have a register about those movements for accounting reasons. In that sense some lines of collaboration have been defined in order to:

- To define a chain of AAA servers managed by AAA protocol (DIAMETER) over IPv6 between universities.
- Perform MIPv6 and AAAv6 tests, in a proposed scenario like that shown in Figure 4-3.

4.4 Application Development and Porting

An IPv6 infrastructure requires IPv6-ready applications and services. While a number of applications have been ported (e.g. Apache, irc, vic, rat), many remain to be done. The key purpose of collaboration here is to avoid replication of work. We also hope to build a guide to best practice for application porting (a "porting framework").

4.4.1 6NET

The 6NET consortium includes SONY and IBM, specifically to bring innovative applications into the project that will stress the network and be used to evaluate the benefits to end-users that IPv6 can bring, through the expanded IP addresses, integrated auto-configuration, quality-of-service (QoS), mobility and security.

Applications and application-enablers include:

- IPv6 adapted Mbone tools for videoconferencing and multicast streaming.
- Hierarchical video distribution in a mobile, heterogeneous, environment.
- Real-time multimedia streaming with QoS requirements.
- On-line games.
- Application Layer Gateways.

A significant part of the 6NET porting work is occurring in WP6 for Network Management and Monitoring, where the ported tools will be used on the live 6NET infrastructure.

4.4.2 Euro6IX

In A4.2, Euro6IX has produced an extensive list of applications to be developed and ported within the project.

Euro6IX is also committed to making ported code available in a shareware repository. However, where possible all ported code will be fed back to the developer code trees, for full integration, as soon as possible.

4.4.3 Proposed Joint Activities

The main priorities from this joint activity are:

- Identify packages that need to be ported to support IPv6.
- Avoid replication of work - identifying which projects port which applications, including those outside 6NET/Euro6IX (e.g. Internet 2 and WIDE projects).
- Establish best common practice for porting and application development (including a "porting framework").
- Share ported code to increase the trial user base, e.g. Euro6IX can run the network management tools ported by 6NET, and vice versa.
- Promote the use of ported applications in IPv6 test-beds and networks.

By showing that real IPv6 applications bring clear benefits for the end-user we will provide reasons for the user to switch from IPv4, and create the demand.

6NET will make its GRID components available to Euro6IX partners.

Both projects will continue work on enhancements to vic and rat (6NET) and ISABEL (Euro6IX), and seek to use these tools for project conferences.

Both projects can contribute to the 6LINK (IPv6 Cluster) applications database.

4.5 Multimedia

Multimedia services, in particular video and audio streaming, are becoming increasingly popular on the Internet, and will be required in early IPv6 deployments.

4.5.1 6NET

In 6NET, WP5 includes an activity on multimedia streaming and conferencing tools.

4.5.2 Euro6IX

The multimedia application enhancements and trials occur in WP4 of Euro6IX, under A4.2.

4.5.3 Proposed Joint Activities

It is not expected that either project will develop significant, wholly new multimedia applications, but existing ones will be enhanced and deployed on the project, and used to validate the network.

We will thus run available media streaming tools, e.g. VideoLAN, icecast, shoutcast, between partners on the joint infrastructure.

4.6 Multihoming

In today's Internet, multihoming to several ISPs is a widely used strategy to increase the availability and resilience of Internet Services. The IETF multi6 WG is defining the requirements of multihoming and analysing the issues that are known from multihoming in IPv4. A parallel working group, outside the IETF scope exists also (ipv6mh).

The recent problems with KPN/Qwest, Worldcom and Global Crossing have highlighted the advantages for ISPs to be multihomed. Renumbering is a very hard and work intensive task in IPv4, where the change of the Internet Service Provider is one of the most frequent causes for this need. In IPv6 this should be much easier, but not painless either. The "IPv6 Stateless Address Autoconfiguration" and "Router Renumbering for IPv6" are the basic concept descriptions so far. The situations where renumbering might be useful, or necessary, are also more complex in IPv6. It varies from a one-time change (connect/disconnect to the Internet) to frequent changes (time of day dependent, load sharing or other multihoming goals).

The Activity on renumbering will provide practical experiences on how network stability and uninterrupted addressability can be maintained and what is the effort to renumber depending on the needed frequency.

There is a relationship between multihoming and DNS. Support from DNS to renumbering is under discussion in the IETF, especially dynamic updates security requirements have to be studied. The AAAA/A6 analysis might be of some influence as well.

4.6.1 6NET

6NET (Activity A4.5) is concerned with the possible impact of multihoming on the very aggressive growth of the number of routing table entries that are monitored, and the increased instability of the routing system. This reality will be studied and techniques to control it will be suggested.

4.6.2 Euro6IX

Within the Euro6IX project the effects of multihomed ISPs and customer networks will be studied from an ISP point of view as well as from an Internet Exchange point of view. Especially the aspects of growing routing tables, address aggregation and routing decisions on site border routers will be under investigation.

Furthermore the way of decision finding for source addresses and default router within end systems will be studied (as well as the influence to applications).

The aim of the multihoming considerations in Euro6IX is to gather experiences in dealing with multihoming scenarios and to give a guideline how end-systems, Internet Service Providers and Internet Exchanges can survive and interact in a multihomed environment.

4.6.3 Proposed Joint Activities

The most suitable place to realize joint activities with respect to Multihoming are the locations where 6NET and Euro6IX networks are peering or are co-located. There it is possible to establish a "pseudo" ISP or customer network, which has an uplink into both IPv6 networks and which gets address space out of the range of the two peering providers.

Besides that it is possible to make these investigations within nearly all connected networks if these networks get connections to (and addresses from) another upstream provider who is part of the complementary IST project.

Also it would be possible to use connectivity to 6Bone available from both projects, or from specific partners, with different prefixes, to make some additional trials.

4.7 Security

The security area has some overlap with VPNs (see above). However, there are other aspects of security to be considered, e.g. availability of IPv6-enabled firewalls, public key infrastructures, security in mobile environments and so on.

4.7.1 6NET

In the framework of 6NET's WP structure, security-related activities are described in A3.5 Network Security, and as dictated by context in a fairly concise way.

However, for the benefit of the reader of this document (6NET: D7.9) it seems appropriate to briefly review the contents of WP3 and its main activities. This helps clarify the background for security tasks, and where the potential for collaboration between 6NET and Euro6IX can be found.

6NET A3.1: "Routing" deals with all major aspects of (unicast) Routing technology and protocols, both within the operational domain (IGP) as well as the relationships with other operational domains (EGP).

6NET A3.2: "DNS and DHCP" is responsible for providing reliable DNS Services (from the very beginning of the core network's life-cycle) and (eventually) support for DHCP.

6NET A3.3: "IPv6 Routing Registry" is tasked with contributing to the extension of RPSL to support IPv6 and to eventually [as soon as the language extensions have been documented in (draft) RFCs or RIR-issued Documents] deploy the new technology in 6NET.

6NET A3.4: "Multicast" aims at introduction and management of IPv6-based multicast services. This activity includes responsibility for the multicast routing layer, and thus is complementary to A3.1, which takes care of the unicast routing layer.

6NET A3.5: "Network Security" is described as covering 3 different areas, i.e. "Securing the Router", "Securing the Routing Protocol" and "Securing the Network".

Building on this framework, and taking into account the early results from other work packages in 6NET (in particular WP1 and WP6), a "mission statement" for "Security" in 6NET WP3, for the 2nd half of 2002 and subject to amendment, can be derived as follows:

Support, propose and implement:

- Technical and configuration measures to ensure (and support) reliable operation of the core and access network, and the ability to do proper (i.e. secured) management.
- Measures to *pro-actively* prevent attacks on the availability, performance or operational integrity of the network (core, access and partners' segments), or to at least contain the impact of such attacks.
- Measures to efficiently detect and *react* to anomalies in the regular operations of the network, in particular (D)DoS attacks.

This responsibility does not extend to application level security, however.

4.7.2 Euro6IX

The Euro6IX security work is defined in A4.1. In this activity, security is approached from several points of view that we are going to detail in the next paragraphs.

The first task we have been doing is related with the design and further implementation of a PKI over IPv6 service. Generally speaking, a PKI is a set of hardware, software, people, and procedures needed to create, manage, store, distribute and revoke public key certificates. With this, a PKIv6 is able to provide trusted and efficient private key and public key certificate management to IPv4 and IPv6 communications, thus enabling the use of authentication, non-repudiation, and confidentiality basic security services. To get this objective, the basic components of one public key infrastructure are normally a certification authority, one –or several– registration authorities, and a directory server. Some other extra components, like smart cards, time stamp servers, OCSP servers, and so on, can be implemented depending on the level of services offered by a particular PKI. In our case, all these services have been implemented in order to provide a high security infrastructure for distributed systems and applications.

On the other hand, some activities regarding security in mobile environments are starting to be carried out. The main topic in this research line is the AAAv6 activity (see description above) that will be also headed by UMU inside the Euro6IX consortium. The main objectives regarding this AAAv6 activity are to define a chain of AAA over IPv6 servers managed by an AAA protocol as Diameter, to use the established VPNs to secure communications between AAA servers and to integrate Mobile IPv6 with this framework.

Some other protocols and frameworks will be analysed and established by the Euro6IX partners. This can be the case of DNSsec as an alternative to the use of public key infrastructures, and the extension of the PKIv6 service, that normally only issues and revokes identity certificates, with X.509 attribute certificates or SPKI credentials.

It is also important to mention that these designed and implemented security services will be applied to all the applications defined in the Euro6IX A4.2 activity with security requirements. This can be the case of the collaborative environments (as AGWS) or the videoconference applications (as ISABEL). This integration will be tested in internal trials and shown to the IT community in the project-defined public trials and events.

4.7.3 Proposed Joint Activities

The projects will seek to identify common security tools and trials for the joint infrastructure. In 6NET, we currently see some focus on secure network management and the ability to detect and react to attacks on the network, while Euro6IX's early work is more focused on establishing a PKIv6 service. However, there are many areas where the projects' activities will overlap.

One good example of collaboration is already defined between UCL (6NET) and UMU (Euro6IX), which already have up and running the PKIv6 service designed and implemented by UMU (see Figure 4-4). Both services will be cross-certified very soon, providing a trustworthy point between both projects. In that sense, every X.509v3 certificate issued by the UMU PKIv6 service for Euro6IX entities (users and processes) can be used to establish secure SSL/TSL, S/MIME and/or IPsec communications with 6NET entities, and vice versa (with the UCL PKIv6 service). Some other interoperability tests regarding certification and revocation of certificates, distributed LDAP directories, cross-certification of VPN devices using the SCEP protocol, etc. will be also run between both partners, or some others interested in these security services.

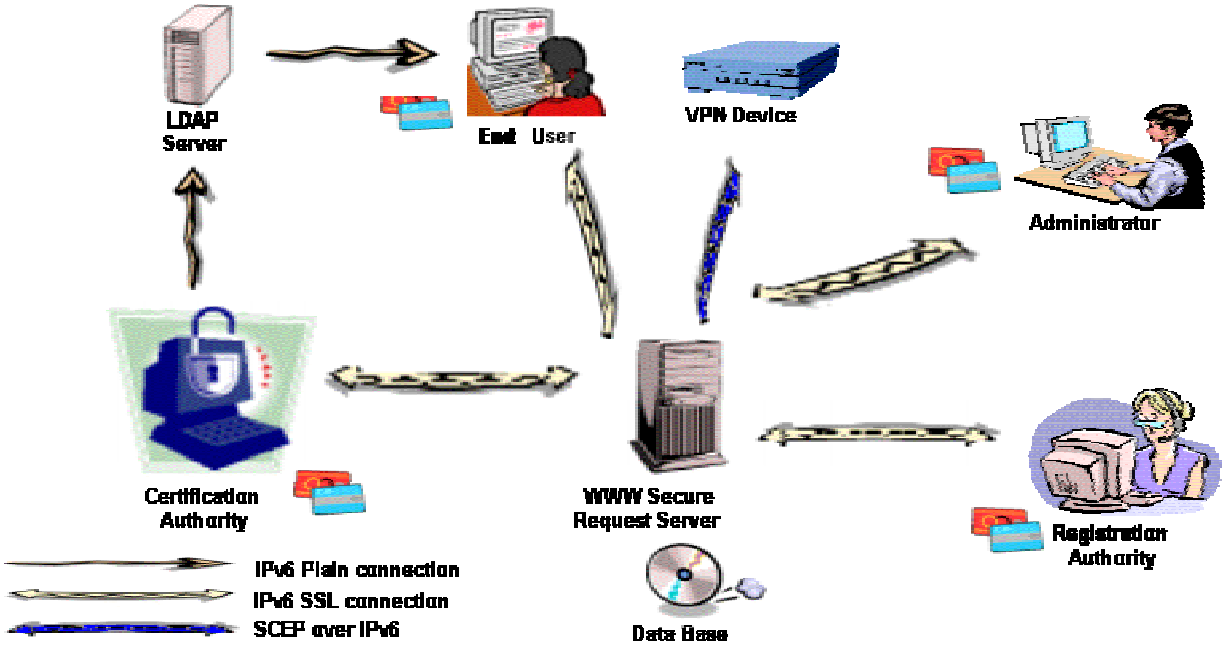

Figure 4-4: UMU-PKIv6 Main Architecture

Some other collaboration points will be established between both projects. In this sense, as soon as Euro6IX starts getting results regarding security in mobile environments (including AAAv6 –as commented above–), DNSsec, and security in collaborative environments (as AGWS) and videoconference applications, those results will be sent to the interested partners in 6NET, as it can be the case of UCL, which it is also working in some of these activities (like the provision of security to their own videoconference applications –vic, rat, sdr, and so on–).

In this line, we can conclude that regarding security aspects, it seems that a real collaboration can be achieved with the main intention of avoiding any duplication of work between both projects.

In more general terms, avenues for collaboration will include PKIs and DNS.

6NET is aiming at the deployment of a PGP-based web of trust (initially) to support the protected transmission and controlled exchange of "secrets" or other sensitive elements of data, which are required to support securing the (unicast) Routing Layer in 6NET.

As soon as multicast becomes available in the core network, the same (or similar) mechanisms can be applied to protect the multicast routing in the core.

6NET offers to share the description of the approach and mechanisms, as well as the operational experience, with Euro6IX. Simultaneously, 6NET is interested to learn from, and build on, the experience with the deployment of PKIs over IPv6 as soon those become available from Euro6IX.

Given the fact that some partners in 6NET have a considerably long track record in testing and prototyping advanced DNS functionality, as well as deploying cutting-edge implementations (IPv6 and DNSsec), DNSv6 and DNSsec is an important area of activity.

DNS Services in general (performance, reliability, credibility) are crucial for the operation of all components on the Internet. There is no architectural difference here, looking at 6NET or Euro6IX.

In fact both projects have to commit to offering those services to their partners and user communities. However it's likely to see different centers of "gravity" evolving (e.g. core- and backbone-oriented aspects in 6NET vs. larger user community-oriented aspects in Euro6IX).

Thus DNS is an obvious field of activity where 6NET and Euro6IX should regularly exchange ideas, results, procedures, and operational experience.

5. FUTURE COLLABORATIONS AREAS

Here we identify areas for collaboration that have not yet been discussed in detail, but which we feel are likely to be in scope in the project.

5.1 Transition

The aim of this activity is to examine and validate all aspects concerning the transition strategies for evolving from IPv4 to IPv6, for backbone, organisational and end site operators.

5.1.1 6NET

6NET (WP2) will demonstrate how to achieve a smooth integration and co-existence of IPv4 and IPv6. It will specify a set of network services available for all participants, document co-existence mechanisms and test many of the existing transition tools.

Several deployment scenarios have been identified to show the evolutionary stages from the existing IPv4 backbone and organisational networks to an IPv6-based environment. The possible scenarios are generally considered to be:

- IPv6 tunnels over IPv4 networks, configured manually or via 6to4.
- "IPv6 over X", where X might be an ATM Permanent Virtual Circuit (PVC) or Multi-Protocol Label Switching (MPLS) encapsulation.
- Native IPv6 infrastructure, e.g. IPv6 running on a Packet over SONET (PoS) interface.

The end goal of 6NET is a native IPv6 network of a production quality similar to today's IPv4 pan-European network. During the transition from IPv4 to IPv6 there will be a long period in which IPv4-only and IPv6-only nodes need to co-exist with each other. A node on an IPv6-only network needs to be able to exchange information with nodes on IPv4-only networks and vice versa. IPv4 and IPv6 may need to coexist on the same routers and links. Translation tools specified in the IETF 'ngtrans' Working Group will be investigated.

6NET will study IPv6 transition at three levels:

- In the core network, at early deployment stages prior to a native IPv6-only core, or in parts of the backbone that are not run fully native. This activity will run until month 24, by which time the core network native IPv6 testing will be well advanced.
- In the organisational (NREN) networks, where the NRENs need to offer connectivity to end user sites (typically the universities). This activity will span the entire project.
- Within University sites, where IPv6 needs to be introduced as a new network layer enterprise service, whether for production IPv6 services or support of IPv6 research projects. This activity will span the entire project.

5.1.2 Euro6IX

Euro6IX does not have specific (directly funded) transition activities in the project, but will, most probably, deploy "large scaled" transition mechanism as part of the infrastructure of the IX.

5.1.3 Proposed Joint Activities

While 6NET has a whole WP devoted to transition, and Euro6IX has no man months directly allocated, it is expected that Euro6IX will deploy transition mechanisms (e.g. DSTM or NAT-PT). Thus one collaboration area will be for 6NET to pass its results to Euro6IX partners for consideration, and for Euro6IX to feed deployment experience, e.g. for scalability of mechanisms, back to 6NET.

5.2 Network Management and Monitoring

Having the management and monitoring facilities available now for IPv6 available also for IPv6 is a key requirement prior to commercial deployment. Both projects will undertake significant work in this area.

5.2.1 6NET

WP6 is defining the management architecture for the network.

The NRENs in 6NET have significant experience in MAN and WAN networks management. Some tools that are already available –mainly for IPv4 environments- will be adapted for the management needs of the 6NET project. For example:

- NetraMet is already capable of measuring IPv6 flows.
- NetFlowMet conforms to the Meter-MIB, the IETF standard for Flow Measurements. The identification of Measurement Points and appropriate Meter-MIB flow configuration styles and tools are key point to be solved for the actual deployment of the tools.
- NetFlow from Cisco is another flow measurement tool integrated in their IOS. Support of NetFlow for IPv6 is currently scheduled for the end of 2002, according to information rovided by the manufacturer.
- RIPE Test Traffic stations, allow tracking of the RTT and various parameters between two remote locations. Such equipment could be very efficient in a monitoring an IPv6 network the size 6NET will be. The obstacle to surmount in order to have IPv6 capable TT stations is to get an IPv6 version of the NTP protocol.

Additionally, there are many public domain tools for network and traffic monitoring; most of them are designed for IPv4 environments (applications and transport). One of these that should be mentioned, and will be considered for implementation is MRTG.

SNMP and CLI play a major role in today's device monitoring and configuration platforms. To maintain the availability of these facilities in IPv6, a study on their evolution to IPv6 will be performed.

The use of tunnels and various transition techniques create additional complexity in the network management. Specific tools and procedures will be evaluated and developed in order to be able to monitor/debug a network using these techniques. For instance with tunnelling it should be possible to check the type of traffic transported across the tunnel to be sure not authorised traffic is flowed (security attacks, etc.) using transition mechanisms. This activity will consider, if appropriate, to provide specific tools and procedures for the transition mechanisms that will be deployed and tested in the 6NET project.

Two 6NET partners (IBM and Cisco) have network management solutions (Tivoli and CiscoWorks) in their product portfolio. These partners will make available these products and solutions to be tested and used in the project as these become IPv6 enabled.

Finally, recommendations to manufacturers and to the appropriate IETF WGs will be made and written in a 6NET "IPv6 Network Management cookbook" made available to Network Operations Centres. These tools will be proposed for implementation in the 6NET pilot network as soon as they have been tested and validated. Envisioned tools are:

- An IPv6 enabled looking glass facility for configuration management.
- A CIM-based topology and monitoring server.
- A manager side native IPv6 SNMP client.

5.2.2 Euro6IX

Network management and monitoring falls under A3.3 in Euro6IX.

In addition, several application development tasks are being carried out in A4.2, with focus in:

- Intrusion Detection Systems.
- Overall Network Management Tools.

5.2.3 Proposed Joint Activities

Management and monitoring tools will be implemented and evaluated in both projects.

Different classes of tools can already be identified:

- Traffic classification and visualisation, traffic aggregation.
- Network devices and link monitoring equipment (automatic alarm and trouble ticketing system).
- Reporting the events that have occurred during a given period of time and storing information in a database.
- Checking the consistency of the network information (routing tables, etc.).

Security concerns and constraints will be addressed in at least two different ways: Adapting the management architecture to provide special requirements in securing the traffic in the network and defining security levels for the management tools and procedures themselves.

An important role in the management architecture will be played by the NOCs. The requirements for such entities – and the operational procedures – will be precisely evaluated and defined.

IPv6 MIBs are still the subject of discussion at the IETF, and at this stage, so, it will be very important to participate the IETF network management and monitoring WG discussions with IPv6 focus.

5.3 Access

New access mechanisms are emerging that can be used for IPv6 services, e.g. Bluetooth and UMTS, supplementing existing methods such as dial-up, ISDN, DSL, Wireless LAN, Satellites, Power Line Communications and Cable Modems. It is important that IPv6 can reach out to end-users over these access infrastructures.

5.3.1 6NET

There is no specific access technology activity in 6NET, bar Wireless LAN, which features in at least WP2 and WP4.

5.3.2 Euro6IX

Euro6IX considers many mechanisms in WP3.

5.3.3 Proposed joint activities

It is not clear which access technologies will be available in common to both projects at this stage. However, we can expect IPv6-ready commercial DSL modems soon (6WIND have a product just launched), thus common work items may be identified in the next six months.

6. COMMON ACTIVITIES AND DELIVERABLES/MILESTONES

In this section we list some common deliverable points, at which the potential collaborative work item areas are due to produce deliverable texts. By studying joint contributions, some knowledge sharing and/or reduction of duplication of effort may be obtained.

The table includes appropriate entries up to M18 (the date of the next major joint workshop).

Topic	6NET		Euro6IX	
	Deliverable	**Due/leader**	**Deliverable**	**Due/leader**
Infrastructure and connectivity	Network design (D1.1)	M3 (DANTE)	IX infrastructure (D2.1), then Backbone infrastructure (D2.2). Also infrastructure (D3.1)	M6 (TILAB), then M12. Also M8 (TID)
Multicast	Intra-domain multicast service (D3.4.1), then inter-domain (D3.4.2)	M12 (ACONET), then M18	Application development and porting (D4.1, D4.1A)	M6 (UPM, UMU), updated at M12
VPN	First VPN deployment (D4.3.1)	M12 (ULANC)	Application development and porting (D4.1, D4.1A)	M6 (UPM, UMU), updated at M12
Mobile IPv6	MIPv6 survey (D4.1.1), then MIPv6 support guide (D4.1.2)	M4 (ULANC), then M12	Application development and porting (D4.1, D4.1A)	M6 (UPM, UMU), updated at M12
Applications and porting	Application list (D5.1), then development (D5.3)	M4 (IBM), then M12	Application development and porting (D4.1, D4.1A)	M6 (UPM, UMU), updated at M12
Multimedia	Application list (D5.1), then development (D5.3)	M4 (IBM), then M12	Application development and porting (D4.1, D4.1A)	M6 (UPM, UMU), updated at M12
Multihoming	Initial report on theory (D4.5.1)	M8 (ULANC)	Network handbook (D2.3)	M18 (TILAB)
Security	First VPN deployment (D4.3.1)	M12 (ULANC)	Application development and porting (D4.1, D4.1A)	M6 (UPM, UMU), updated at M12
Transition	Site, NREN and core transition scooping documents (D2.1.1, D2.2.1, D2.3.1), then Transition cookbooks (D2.1.2, D2.2.2, D2.3.2)	M6 (UoS), then M12 (UoS)	-	-
Network management and monitoring	Management architecture draft (D6.1.1) then final (D6.1.2), plus tools (D6.2.1)	M6 (RENATER) then M12, plus M6	Management control (D3.2, D3.2A)	M12 (TID), updated at M18
Access technologies	WLAN access (D4.2.1)	M6 (ULANC)	Network implementation (D3.1)	M8 (TID)

Figure 6-1: 6NET-Euro6IX Common Interest Deliverables

7. PROJECT DIFFERENTIATORS – AN OVERVIEW

Figure 7-1 summaries the major project differences, as discussed at the joint workshop in Madrid in March 2002.

6NET	Euro6IX
Single backbone, like one European-wide network, starting with STM-1 links, rising to 2.5Gbit/s links in Year 2.	Interconnection between telco networks and exchange points, starting with 34 Mbps.
Collaborative Network Management, at different layers.	Independent Network Management, commercially oriented, with SLAs
End user networks oriented to “campus” type sites, i.e. typically universities.	Networks oriented primarily to commercial end-users. Peering, transit and IX arrangements for local traffic exchange. Also covering ISP, campus and enterprise networks, and those considered as telco “customers”.
The targeted User Community is the European research and education environment.	The target User Community is broad, including other telcos and ISPs, as well as industrial research departments.
Validation of technology to build end user applications and proof-of-concept environment.	Validation of network services and tools. Also some specific applications, access devices, transition, billing and accounting and ULDR.
Some applications development, including GRID components, web services and gaming. Many network management and monitoring tools will be ported to support IPv6.	Strong focus on tools and applications porting and IPv6-enabled development, for example peer-to-peer messaging.
Main policy constraint is the Acceptable Use Policy from the NRENs in the consortium.	Legal issues related to IPv6 security, privacy and liberty concerns, data protection and personal data, etc.
Special focus on transition strategies (Pan-European core, NRENs and end sites)	

Figure 7-1: 6NET-Euro6IX Project Differentiators

8. SUMMARY AND CONCLUSIONS

In this deliverable we have summarized the results of the initial discussions between the 6NET and Euro6IX projects on potential avenues for collaboration.

The initial areas for collaboration will be:

- Joint workshops and trials.
- Infrastructure interconnectivity.
- Project study areas:
    - IPv6 multicast.
    - IPv6 virtual private networks (VPNs).
    - IPv6 mobility.
    - Application porting.
    - Multimedia applications.
    - IPv6 multihoming.
    - Security

Two joint workshops have already been held, and at least three more are planned. Infrastructure connectivity is in place in at least the UK6X (though the use of the connection awaits mutual AUP and other policy discussions). We expect to progress demonstrators of Future areas of cooperation may include the following project study areas:

- Network management and monitoring.
- IPv6 access mechanisms.
- IPv4-IPv6 transition techniques.

The projects will also seek to explore other avenues for collaboration as and when appropriate to do so.