IPv6DISSemination and Exploitation

Information Society Technologies

**Project no. 015926**

**6DISS**

**IPv6 Dissemination and Exploitation**

Instrument: SPECIFIC SUPPORT ACTION

Thematic Priority 2

# D07: Report on the workshop and status of Internet connectivity in the South East Europe (Balkan countries)

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## Executive Summary

This deliverable is a report from the 6DISS technical workshop and the IPv6 Workshop in South East Europe (SEE) that took place on 3-5 of March 2006 in Kopaonic (Serbia & Montenegro). The report includes information on the workshops programmes and presentations, the dissemination material which has been used, the list of the attendees and their affiliation; it also provides a summary of the feedback questionnaire, an analysis of the workshop costs, and information on the workshop sponsors. In addition, a report on the current status of the internet connectivity in the region and present on-going IPv6-related activities is included.

| **Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)** | | |
|---|---|---|
| **Dissemination Level** | | |
| **PU** | Public | ✓ |
| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the consortium (including the Commission Services) | |
| **CO** | Confidential, only for members of the consortium (including the Commission Services) | |

# Table of Contents

# 1. Introduction

This deliverable is a report from the 6DISS technical workshop for South East Europe (Balkan countries) (http://www.seeren.org/6diss-see/) that took place on the on 3-5th of March 2006 in Kopaonic (Serbia & Montenegro). The report includes information on the workshop programme, the presentation and dissemination material distributed to participants, the attendees and their affiliation, a summary of the feedback questionnaire, analysis of the workshop costs, and information about the workshop sponsors.

This deliverable also reports on the one-day workshop "International Workshop on IPv6 Technology: Exploring the Experiences in Research Networking" (http://www.seeren.org/6diss/) which followed the 6DISS training workshop. This workshop was also organised by 6DISS and supported by the SEEREN2 (http://www.seeren.org/) and SEE-GRID (http://www.see-grid.org/) projects. It gave the opportunity for network and system engineers to share experiences gained by IPv6 deployments in research and education networks in the SEE region.

Finally, the deliverable includes a description of the status of the major Internet connectivity links deployed by the NRENs in the South East Europe at the time of the 6DISS workshop and presents on-going IPv6-related activities.

### 1.1. 6DISS objectives

The declared objectives of 6DISS are:

1. To establish and operate a Specific Support Action of information exchange for the optimal transfer of knowledge on Internet deployment and evolution to emerging research network operators, Universities, commercial organisations, ISPs, governments and regulators in the following countries[1]:
   - The Asia-Pacific region,
   - Africa[2],
   - South and Central America,
   - Mediterranean partner countries[3],
   - South East Europe (Balkan countries)[4],
   - Newly-Independent States (NIS)[5],
   - The Caribbean.

[1] The specific countries targeted in each region have been selected on the basis that:
- the developing countries are precisely those identified by the Call,
- the countries are generally lagging behind in the deployment of broadband and preparedness for IPv6, and can therefore benefit most from the support of projects which already have the experience,
- the countries are precisely those with which 6DISS partners have very close working relationships,
- the developing countries in Europe are those that - in the longer term - might become candidates for membership of the EU, or are amongst those with which the EU has special international collaborative agreements for participation in the RTD Programmes.

[2] Including sub-Saharan Africa, South Africa, Angola and Mozambique.

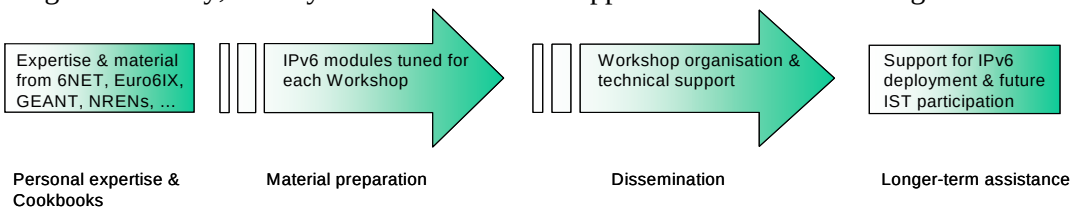
[3] Including Turkey

[4] Including the Associated Countries of Bulgaria and Romania. Turkey and the Republic of Moldova will be invited too

[5] Including the neighbouring country of Afghanistan

2. To enhance the knowledge base of the partners by exchanging deployment experiences with especially India and China.

Diagrammatically, the key thread of the 6DISS approach is shown following:




The target countries for 6DISS are also often ones most likely to benefit from IPv6 adoption, due to their current shortage of global IPv4 addresses.

### 1.2. 6DISS methodology

The main mechanism for raising awareness and making the information transfer is through practical workshops to those people who are directly responsible for the installation, operation and maintenance of the National Research and Education Networks (NRENs) in these developing regions, and also inform strategists/decision makers in these countries of the benefits of deploying IPv6. Specific material will include how to install IPv6 versions of: DNS, DHCP, routing, multicast, QoS, renumbering, monitoring and management, and applications. The presentation material will be improved throughout the project lifetime, taking into account feedback from the participants. Reports will also be made available on the status of standardisation, IPv6 Forum activities, etc.

### 1.3. The Workshops (general)

Workshops are the main mechanism of 6DISS information transfer and collaboration-building.

6DISS has been structured to provide the ideal platform for the discussion of such deployment scenarios, and the exchange of best practices, thereby avoiding duplication of effort, wasting effort on solutions that are known not to work, and generally making the most efficient usage of the available resources. Partners in 6DISS are active in deploying IPv6 on a production basis in their own NRENs and University networks, and documenting the experience in Cookbooks and in IETF informational/best common practice RFCs. The manufacturers in the consortium are also building IPv6 products.

The workshops are not only intended to lead to an improved quality of the Internet infrastructure in these countries, but will also raise the competence of the organisations and - exploiting the personal contacts made through 6DISS - facilitate and encourage their participation in future FP6 Calls and beyond.

Impacts from the workshops will include:

- a positive effect in preventing the "brain drain" from developing countries, by bringing interesting and state-of-the-art activities into these regions, making information and knowledge resources accessible to the scholars both locally and globally.
- the establishment of a communication channel between the scientific communities in the targeted regions and European industry, thus resulting in an increase in the demand for

the specialised services provided by the highly skilled academics and researchers of the region.

- an expansion of the conditions for growth, by enabling the exchange of ideas, launching of joint experiments and projects, disseminating RTD results, and activating market forces; all substantial elements in the process of regional development.
- making European research and industrial concerns aware of the highly skilled personnel who can contribute to the urgently needed improvement of ICT infrastructures; resulting to an increase of the demand for specialised services provided by the highly skilled academics and researchers of the region.

While IPv6 standards and services remain constant, regional variations in practices and operations will require slightly different approaches for collaboration and dissemination. Therefore, the material for this workshop was collected, and the workshop schedule, format and contents were tailored in conjunction with the local organisers, to suit the type of participants, the subjects to be addressed, the location, the host organisation, sponsors, etc.

# 2. 5th Workshop: South East Europe (Balkans)

## 2.1. General Information

The 6DISS workshop in SEE was organised by the 6DISS partners, in particular *GRNET* (leading partner) and *NIIF/HUNGARNET*. The training workshop was held on 3-5th March 2006 in conjunction with the EC FP6 *SEEREN2*, and *SEE-GRID* project meetings. In addition, YU INFO 2006 (http://www.edrustvoscg.org.yu/yuinfo.htm), which is one for the most significant IT conferences in Serbia & Montenegro, was organised at the same location. The venue was Kopaonik (Figure 1) in Serbia & Montenegro, which is located in the centre of the SEE region. The local NREN (AMREJ) supported the organisation of the workshop.

South Eastern European countries have further developed collaboration in the areas of IPv6 dissemination and deployments with the 6DISS project. This collaboration was initiated in the past between the partners of SEEREN and 6NET (www.6net.org) projects. The 6DISS project built on this successful collaboration and organised this regional IPv6 training workshop. 6DISS and SEEREN partners worked closely in order to define an IPv6 technical training programme that would address the needs of the local networking engineers and researchers and fulfil the main objectives of both projects. Furthermore, the 6DISS organisers cooperated with SEE-GRID partners - who hosted project meetings in the same venue - in order to address their needs.

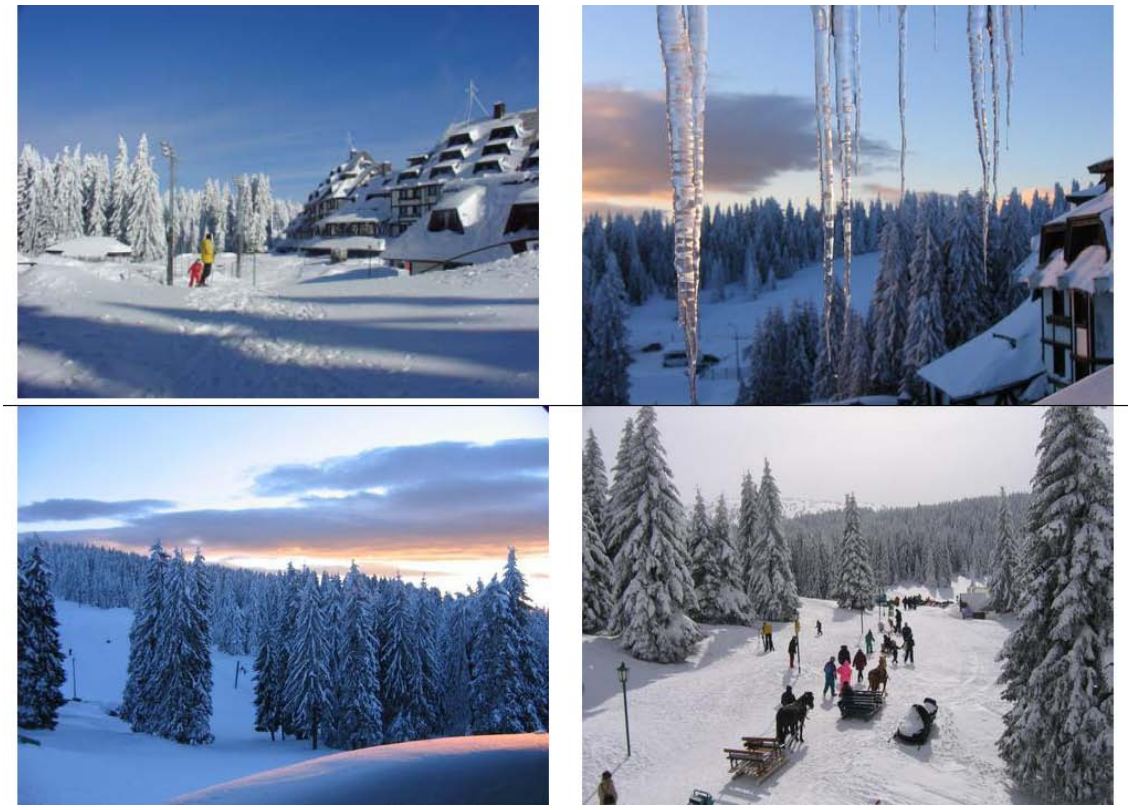


**Figure 1: Venue (Kopaonic)**

In brief, the details of the 6DISS workshop in SEE were as follows:

| | |
| --- | --- |
| *Date:* | *3-5 March 2006* |
| *Location:* | *Kopaonik, Serbia & Montenegro* |
| *In conjunction with:* | *SEEREN, SEE-GRID project meetings, YU INFO 2006* |
| *Local organiser:* | *University of Belgrade / AMREJ* |
| *Lead 6DISS partner:* | *GRNET* |
| *Supported by:* | *NIIF/HUNGARNET* |

### 2.2. Attendees

The majority of the attendees at the workshop were technical personnel from local NRENs, universities, and public institutions connected to the SEE NRENs. The aforementioned organisations have partially deployed IPv6 at their network or are willing to experiment with IPv6 technology in the near future. There were also participants from commercial ISPs that consider offering IPv6 services to their customers. A portion of the participants could influence the deployment of IPv6 technology in their network, as they were responsible for the networking infrastructure in their organisation or company

The majority of the trainees did not have - or had limited - practical experience on the IPv6 technology. However, some of them had very good experience in one or more specific topics, such as IPv6 security. All of the participants, though, had studied the 6DISS e-learning module so there was a common background. It should be noted that all of the trainees had a good understanding of IPv4 protocols and services.

The list of attendees and their affiliations is shown below:

| 6DISS Training Workshop participants | | | | |
|---|---|---|---|---|
| 1 | Athanssios | Liakopoulos | GRNET | aliako@grnet.gr |
| 2 | Miklos | Kozlovszky | MTA SZTAKI | m.kozlovszky@sztaki.hu |
| 3 | Anastas | Misev | IIPMF/MARNET | anastas@ii.edu.mk |
| 4 | Vangel | Ajanovski | Institute of Informatics | ajan@ii.edu.mk |
| 5 | Samra | Mujacic | University of Tuzla | samra.m@bih.net.ba |
| 6 | Seudin | Kasumovic | Univerzitet u Tuzli | seudin.kasumovic@untz.ba |
| 7 | Amir | Hadzimehmedovic | Univerzitet u Tuzli | amir.hadzimehmedovic@untz.ba |
| 8 | Boro | Jakimovski | MARNET | boroj@ii.edu.mk |
| 9 | Aleksandar | Dimeski | Ss. Cyril and Methodius University- Skopje | cano@ukim.edu.mk |
| 10 | Goran | Muratovski | Ss. Cyril and Methodius University- Skopje | gone@ukim.edu.mk |
| 11 | Novica | Nosovic | ETF -SARAJEVO | novica.nosovic@etf.unsa.ba |
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| 17 | Alen | Kopic | PMF, University of Sarajevo | allen_kope@hotmail.com |
| 18 | Alvin | Abdagic | PMF, University of Sarajevo | alvin.abdagic@gmail.com |
| 19 | Dejan | Djukic | ETF BL | djukic@etfbl.net |
| 20 | Mihajlo | Savic | ETF BL | m@etfbl.net |
| 21 | Martin | Potts | Martel | martin.potts@martel-consulting.ch |
| 22 | Stanislav | Spasov | IPP-BAS | spasov@acad.bg |
| 23 | Kozeta | N | University of Tirana | ksevrani@sanx.net |
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| 25 | Danijela | Milic | FPN | danijela.milic@fpn.bg.ac.yu |
| 26 | Vladimir | Vrzic | FPN | vvrzic@gmail.com |
| 27 | Neki | Frasheri | INIMA | nfra@inima.al |
| 28 | Spyros | Athanasakis | GRNET S.A | sathan@grnet.gr |
| 29 | Giorgos | Koutepas | NTUA | gkoutep@netmode.ntua.gr |
| 30 | Emmanuel | Kontakis | University of Macedonia | kontakis@uom.gr |
| 31 | Konstantinos | Chatzithomaoglou | FORTHnet S.A | kchatz@forthnet.gr |
| 32 | Theodoros | Kostis | University of the Aegean | tkostis@aegean.gr |
| 33 | Christos | Theodorakakos | Eugenides Foundation | christost@eugenfound.edu.gr |
| 34 | Antonis | Krassas | Netone | akrassas@netone.gr |
| 35 | Janos | Mohacsi | NIIF/HUNGARNET | mohacsi@niif.hu |
| 36 | Tamas | Maray | NIIF/HUNGARNET | maray@niif.hu |
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| 42 | Pavle | Vuletic | University of Belgrade | pavle.vuletic@rcub.bg.ac.yu |
| 43 | Slavko | Gajin | University of Belgrade | slavko.gajin@rcub.bg.ac.yu |
| 44 | Zoran | Jovanovic | University of Belgrade | zoran@rcub.bg.ac.yu |
| 45 | Dusan | Pajin | University of Belgrade | dpajin@rcub.bg.ac.yu |
| 46 | Dusan | Radovanovic | University of Belgrade | hogar@rcub.bg.ac.yu |
| 47 | Milivoje | Mirovic | University of Belgrade | milivoje.mirovic@rcub.bg.ac.yu |
| 48 | Dragan | Novakovic | University of Belgrade | cupavi@rcub.bg.ac.yu |
| 49 | Branko | Marovic | University of Belgrade | branko.marovic@rcub.bg.ac.yu |
| 50 | Vedran | Custovic | Institute Mihajlo Pupin | vedran@impcomputers.com |
| 51 | Cedomir | Suljagic | Ministry of Science and Environmental Protection of Serbia | cedomir.suljagic@mntr.sr.gov.yu |
| 52 | Muhdin | Mujacic | Procom d.o.o. & Cisco Academy UnTz | procom@bih.net.ba |
| 53 | Milos | Mirkovic | Technicom | yurit@tehnicom.net |
| 54 | Darko | Ilic | Institute Mihailo Pupin | darko@impcomputers.com |

Apart from the 6DISS tutors and the participants who only attended the YU INFO 2006 International workshop, approximately 35 participants followed all the training sessions (Figure 2).

**Figure 2: 6DISS training Workshop and IPv6 Workshop**

### 2.3. Programme outline

The material presented in the 6DISS workshop was determined in close collaboration with the research, academic and commercial community. Informative messages had been distributed via the appropriate mailing lists two months before the materialisation of the workshop, and feedback was taken into account when finalising the workshop agenda. As was requested by most of the participating organisations, the “hands-on” sessions occupied almost 50% of the overall time of the training workshop. The programme of the workshop is presented in the following table:

| 6DISS Training Workshop in SEE | | | |
|---|---|---|---|
| **Duration** | **Programme (1st day)** | **Topics** | **Prerequisites** |
| 2h | *Theoretical session A: Basics of IPv6* | Enable IPv6 in different OS, IPv6 addresses, stateless/stateful auto-configuration, transition mechanisms (tunnels, brokers, 6to4). | 6DISS e-learning module (http://www.6diss.org/e-learning) |
| 2h | *Hands-on session A: Basics of IPv6* | Set and identify IPv6 address in local PCs, capture IPv6 traffic (e.g. RA), create tunnels, inter-connect local isolated networks. | |
| 2h | *Theoretical session B: Routing protocols* | Intra-domain (OSPF, ISIS), and inter-domain (BGP) routing protocols in IPv4/6 networks. | Basic understanding of (IPv4) routing protocols - Troubleshooting experience in IPv4 environments |
| 1,5h | *Hand-on session A: Routing protocols (Group 1 of participants)* | Configure and troubleshoot OSPF and BGP protocols at 6DISS remote testbed. | |
| 1,5h | *Hand-on session A: Routing protocols (Group 1 of participants)* | | |
| **Duration** | **Programme (2st day)** | **Topics** | **Prerequisites** |
| 1,5h | *Theoretical session C: Applications - Basic networking services* | Present some of the most common IPv6-enabled applications and services | 6DISS e-learning module (http://www.6diss.org/e-learning) |
| 1,5h | *Hands-on session B: Applications* | Install and use management, p2p, videoconferencing, streaming, etc applications. Configure DNS | |
| 2h | *Theoretical session D: Advance IPv6 services and Security* | IPv6 Security and Firewalls, Quality of Service, | Some knowledge on security and QoS |
| 1,5h | *Hands-on session D: Security* | Maintain ACLs in 6DISS remote testbed, enable WinXP firewall, QoS configuration templates. | |
| 1h | *Session E: Open discussion on IPv6 addressing* | Discuss the transition to IPv6 for a hypothetical network | |

The programme of the workshop was published and maintained in advance at the Website (http://www.seeren.org/6diss-see/Programme.php?language=en).

### 2.4. Presentation material

The theoretical presentations were built based on the available 6DISS modules. The list of modules that were used is the following:

- Introduction to IPv6
- IPv6 Associated Protocols
- IPv6 Addressing

- IPv6 Autoconfiguration
- IPv6 Routing Protocols
- IPv6 DNS
- IPv6 Management
- IPv6 Applications
- QoS
- Security

Responsible for the technical presentations and the hand-on sessions were:

- Athanassios Liakopoulos (GRNET)
- Dimitrios Kalogeras (GRNET)
- Janos Mohacsi (NIIF/HUNGARNET)

### 2.5. Workshop labs

The hand-on sessions used both the local PC-based lab (Figure 3) and the 6DISS lab in Brussels (Figure 4). The local lab consisted of 20 PCs and was used for basic IPv6 exercises using the WinXP operating system. A Linux server running Scientific Linux 4.2 was used to support the exercises related with basic services, and management tools. The remote lab in Brussels was used for external (BGP) and internal (OSPFv3) routing exercises.

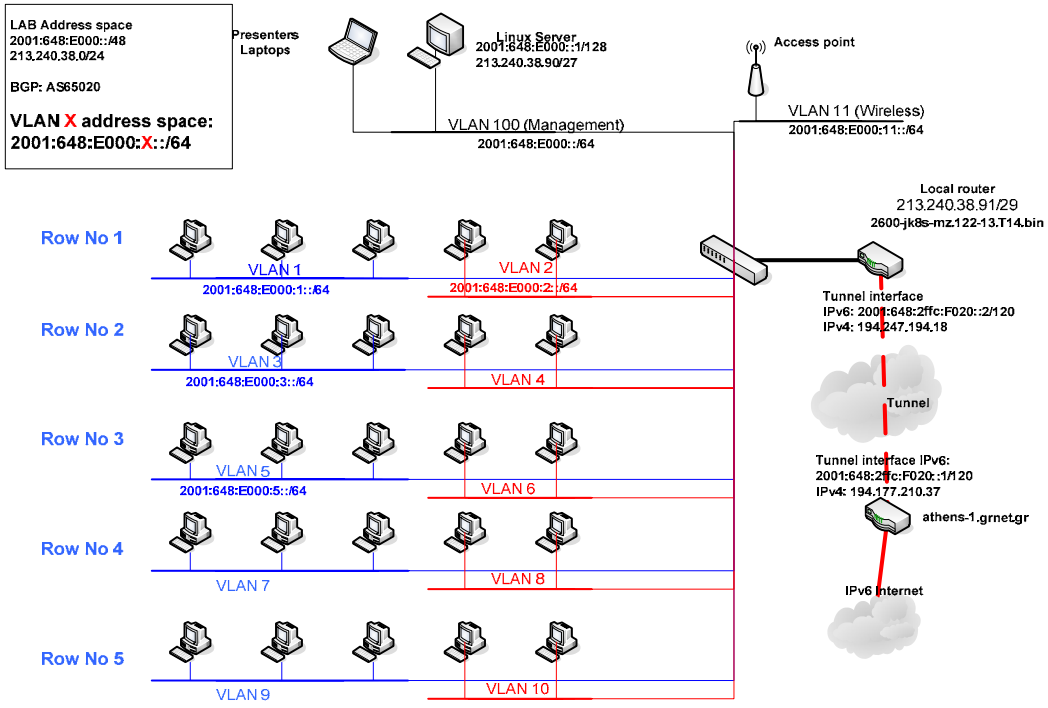



**Figure 3: PC lab in SEE – Internet connectivity**

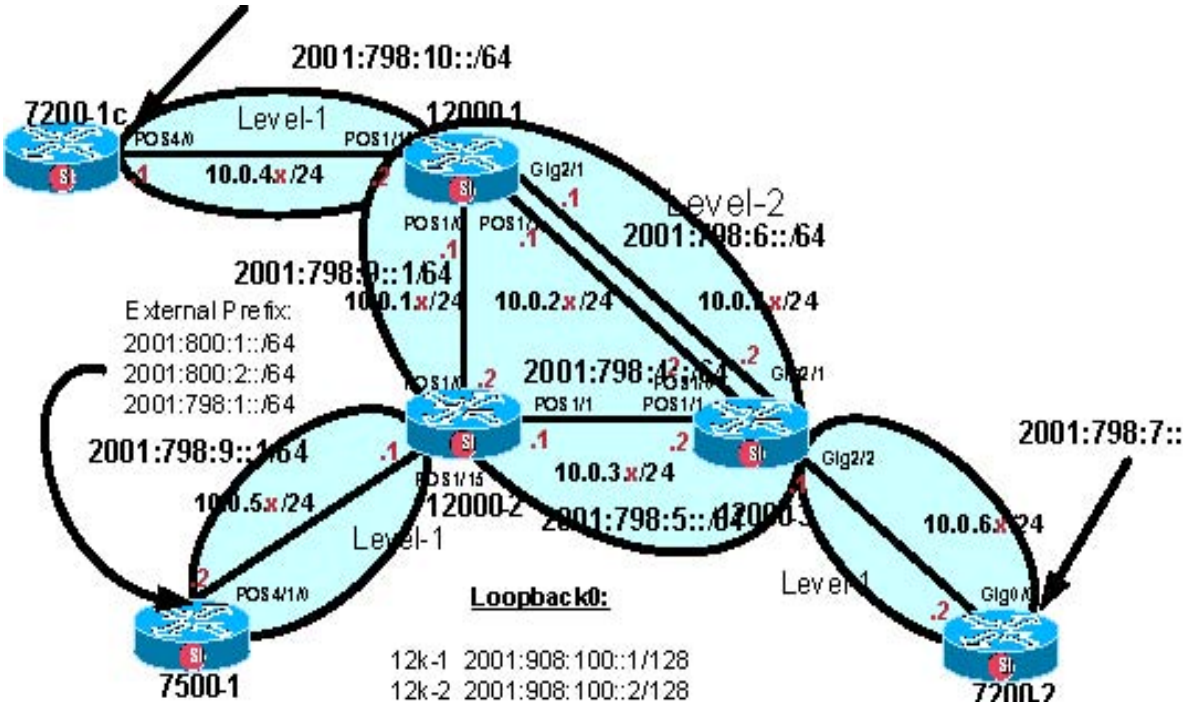



**Figure 4: Lab topology in Brussels – Routing information**

### 2.6. International Workshop on IPv6 Technology

The one-day workshop "International Workshop on IPv6 Technology: Exploring the Experiences in Research Networking" (http://www.seeren.org/6diss/) followed the 6DISS training workshop and provide an opportunity for SEE engineers to share their experiences gained by IPv6 deployments in research and education networks in the SEE region. The 6DISS organisers invited all NRENs – including their interconnected academic / research institutes – to present IPv6 related activities. In addition, a Call for Papers was published inviting researchers to submit papers reporting on original research, experiment results and experiences. Topics of interest included the following areas:

- IPv6 Transition Mechanisms
- IPv6 & Security Issues
- IPv6 Unicast / Multicast Protocols
- IPv6 Mobility
- IPv6 QoS and Performance Measurements
- IPv6 Management & Monitoring Tools
- IPv6 and Advanced Applications (GRIDs, P2P, Multicast, ...)
- Deployment experiences & best practices of IPv6 technology

The Deputy Minister (science and environmental protection of Serbia) Cedomir Suljagic participated in the opening of the "International Workshop on IPv6 Technology" (Figure 5). The workshop was also supported by the SEEREN2 (http://www.seeren.org/) and SEE-GRID (http://www.see-grid.org/) projects. The programme of the workshop is depicted in the following table and may be found in http://www.seeren.org/6diss/Programme.php?language=en

| *Title* | *Presenter* |
|---|---|
| Section A | IPv6 Technology & New Opportunities |
| **Workshop Opening** | Cedomir Suljagic (Deputy Minister for science and environmental protection |
| **IPv6 technology and new services (keynote speech)** | Prof. Zoran Jovanovic (AMREJ/UoB) |
| **Experiences from the Verat.net project** | Milos Prodanovic (Eunet) |
| **The 6DISS Project: IPv6 Dissemination & Exploitation** | Athanassios Liakopoulos (GRNET) / Martin Potts (Martel) |
| **IPv6 achievement in GÉANT** | Janos Mohacsi (NIIF/HUNGARNET/DANTE) |
| Section B | **IPv6 Advancements in South East Europe** |
| **IPv6 activities in SEEREN2*** | Jorge Sanchez (GRNET) |
| **IPv6 activities in Serbia & Montenegro** | Dušan Pajin (AMREJ) |
| **IPv6 activities in Greece*** | Dimitrios Kalogeras (GRNET/NTUA) |
| **IPv6 activities in Bulgaria** | Stanislav Spassov (ISTF) |
| Session C | **Technical Presentations** |
| **IPv6 deployment in the Greek School Network** | Dimitrios Kalogeras (GRNET/NTUA) |
| **IPv6 Transition Mechanisms, their Security and Management** | Georgios Koutepas (NTUA) |
| **IPv6 over xDSL: The DIODOS Proposal** | Athanassios Liakopoulos (GRNET) |

***(*) postponed***

**Figure 5: Photos from the International Workshop on IPv6 Technology**

### 2.7. Workshop CD-ROM and 6NET books

Multiple documents and open-source applications were compiled in a CD-ROM, which was freely distributed to the participants at the end of the workshop. The contents of the CD-ROM included:

- 6DISS E-learning module
- IPv6 E-books (6NET cookbook, IPv6 ABCs by Cisco)
- 6NET technical documentation (basic and advanced services, applications, transitioning, management, etc)
- Workshop presentations (latest versions)
- A complete set of 6DISS module
- A compilation of monitoring tools (some of them were used during the hands-on sessions)
- A compilation of management tools (some of them were used during the hands-on sessions)

One set of "Cookbooks" from the 6NET project was made available (at no cost) to each of the 8 groups. The books were distributed at the beginning of the workshop, in order to allow participants to seek for further information during the breaks of the hand-on training sessions. At the end of the workshop, all the participants received the material in electronic form.

### 2.8. Sponsors

The 6DISS workshop organisers (GRNET and AMREJ) raised the following sponsorships:

EUnet (Belgrade): Internet (IPv4) connectivity to the venue local network

Spinaker (Belgrade): 25 PCs for the training lab

Cisco Systems (Belgium): Partially sponsored accommodation and travel expenses for the participants

Cisco Systems (Belgrade): Gala dinner for the workshop participants

### 2.9. Summary of Costs

The total cost to 6DISS for the organisation of this workshop is estimated at €12.2K. This is within the budget (€20K) set aside for each workshop. The cost breakdown is shown in the following table:

| Description | Estimation of costs (in K€) | Comments |
|---|---|---|
| Organisation | 1,4 | Meeting rooms, lunch and coffee expenses for all participants in the workshop. Internet connectivity to the venue and PC lab were sponsored by EUnet and Spinaker, respectively. |
| Accommodation | 7,2 | Accommodations expenses for all participants during the workshop period. Partially sponsored by Cisco Systems. |
| Transportation | 3,6 | Travel expenses for all the participants to move to/from the venue. Partially sponsored by Cisco Systems. |
| Other | 0,0 | Cisco Systems sponsored the gala dinner organised for all participants from 6DISS, SEEREN, and SEE-GRID projects. Small gifts, - e.g. folders, mouse pads, etc. - were also distributed by sponsors. |

### 2.10. Workshop Dissemination

A number of promotional actions were taken in advance in order to support the 6DISS training workshop in South Eastern Europe, as well as to disseminate the 6DISS objectives in the region:

#### 2.10.1. Mailing Lists

Four different mailing lists were set up for communicating information on the 6DISS project status and IPv6-related activities in SEE. The mailing lists were targeting to various groups of people as follows:

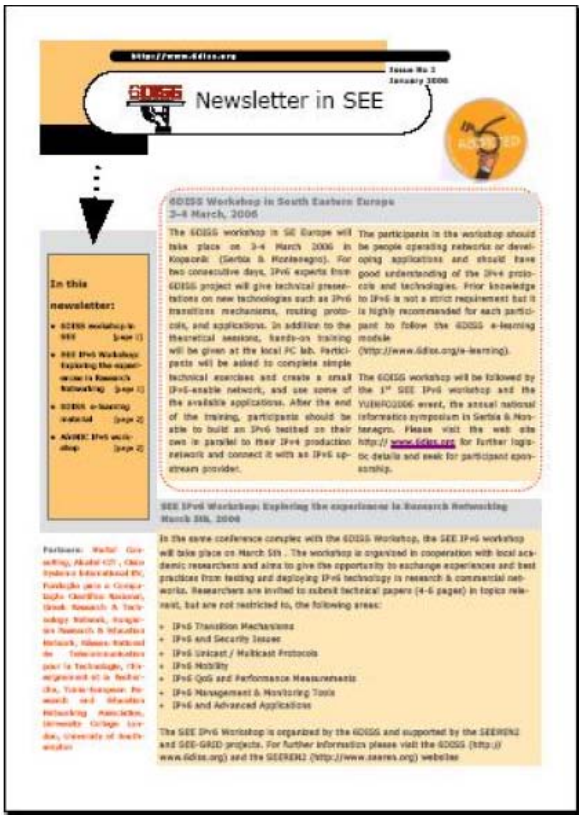
- Educational & Research (30 recipients)
- Commercial Sector (29 recipients)
- Governmental Agencies (28 recipients)
- Dissemination activities and Press coverage (30 recipients)

The objective of these mailing lists was to keep the recipients informed about the latest developments in the field of IPv6 (e.g. current deployment status and best practices), increase awareness regarding new market opportunities, create a communication channel among the communities in SEE and the rest of Europe and the world, exchange ideas for future co-operation in the context of other networking projects, etc. They were also used to distribute 6DISS newsletters, IPv6 related documents and to exchange information about the forthcoming workshops.

### 2.10.2. Newsletters

Two newsletters were compiled and disseminated to the Research & Education Communities of SEE, providing –among others- information on the workshop's objectives and logistics, the prerequisites for participation and the subjects that would be discussed. The newsletter encouraged the recipients to participate, and provided all the necessary links where further information could be reached and registration for participation could be done.


**6DISS Newsletter in SEE, Issue No. 1**




**6DISS Newsletter in SEE, Issue No. 2**

Another newsletter will be published in the following month analysing the results from the workshop.

### 2.10.3. Poster

The poster shown in Figure 6 was sent to the SEE NRENs a few weeks in advance of the 6DISS workshop. Each NREN was responsible to distribute a number of copies to each local university, institution and other organisation in order to stimulate interest in the workshop from the targeted groups.

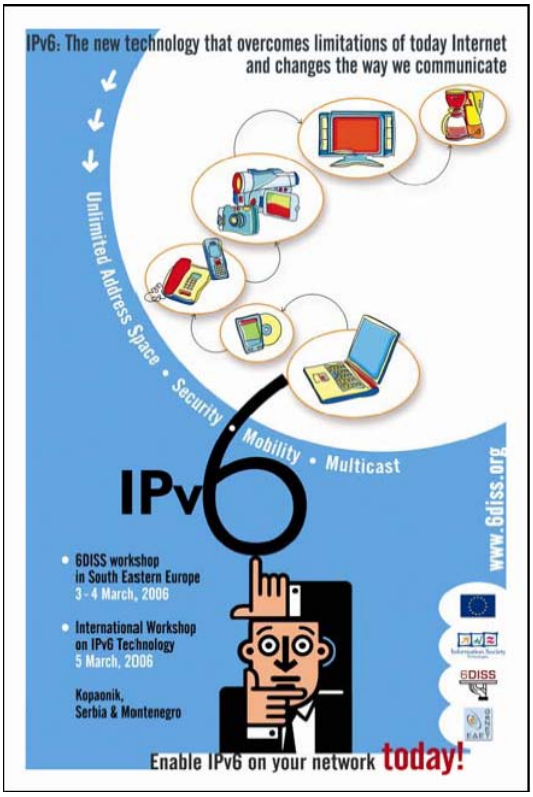



**Figure 6: Poster for the SEE workshop**

Apart from raising the awareness for the 6DISS workshops in SEE, the poster briefly presents the advantages of the IPv6 technology in technical terms and exhorts the reader to enable IPv6 in his/her network.

### 2.10.4. Other dissemination material

A sticker and a mouse-pad, as shown in Figure 7, were distributed to the 6DISS workshop trainees, as well as to the participants of other SEE projects that took place in Kopaonik at the same time. Both of them include information regarding the 6DISS Website.


**Figure 7: Sticker and mouse-pad**

# 3. Opportunities for further co-operation

IPv6 interconnection services have been supported by the SEEREN infrastructure during the last two years. In addition, all the NRENs have established IPv6 logical connections among themselves and exchange IPv4/6 traffic. Therefore, a limited operational experience is available in all NREN NOCs involved in the SEEREN project.

Among the SEE NRENs, AMREJ (Serbia & Montenegro) and ISTF (Bulgaria) have made great progress in IPv6 deployment in their national networks. Both NRENs have required IPv6 address space and offer IPv6 interconnections services to local Universities and Institutes. Some of the IPv6 basic services, such as DNS and Web servers, have been upgraded to support IPv6. In addition, security policies via ACLs and firewalls tend to be fully aligned for IPv4 and IPv6 protocols. Other NRENs did not report any IPv6 activities - other than SEEREN activities - in their countries, including activities at local universities. Therefore, AMREJ and ISTF - and the universities in these two countries, such as the University of Belgrade - are potential partners in the SEE region that could participate to IPv6-related projects in the near future.

## 3.1. Follow-up actions

The SEEREN2 project still remains the main driving force for the deployment of IPv6 technology in most SEE countries. Apart from IPv6 interconnection services, SEEREN2 aims to enhance the monitoring / management infrastructure and provide multicast over IPv6. Security is also among the priorities of the SEEREN2 project. Therefore, strengthening the IPv6 activities in SEEREN2 is considered as a main follow-up action after the training workshop. GRNET, as a common partner in the 6DISS, SEEREN2 and SEE-GRID projects, is working towards this direction.

In addition, SEEREN2 members plan to participate to the “Training the Trainers” workshop organised by 6DISS and take advantage of the 6DISS Tiger Team regarding operational issues during the deployment of IPv6 services in the SEEREN infrastructure.

# 4. Analysis of the feedback questionnaire

A questionnaire has been especially designed by 6DISS to obtain feedback from the participants, regarding the suitability of the course material and the presenters to convey the information, and the relevance of the information to the requirements of the attendees.

Each participant was initially requested to give some information about:

- his/her organisation and job responsibilities
- plans for IPv6 deployment in his/her organisation

Also, for each theoretical presentation and hands-on session, each participant was requested to assess "usefulness", "quality of presentation", "familiarity with the topic", "quality of the course documentation", "general organisation", etc.

## 4.1. General Questions related to participants and IPv6

**SEE 6DISS Workshop**
Kopaonik, 3-4 March 2006

**Feedback Questionnaire**

Participants

In total, 54 persons registered for the 6DISS IPv6 training and IPv6 Workshop. Approximately 40 persons participated in the IPv6 training and 27 feedback forms were returned

| **Employment sector** | | |
|---|---|---|
| | Government | |
| | University or other higher education | 16 |
| | Schools or further education (K19) | |
| | Research | 4 |
| | Health | |
| | Commercial | 6 |
| | Other (please specify) | 1 |
| | | 27 |

| **Job function** | | |
|---|---|---|
| | Government advisor | |
| | Senior Manager | |
| | IT Manager | 2 |
| | System administrator | 6 |
| | Network administrator | 12 |
| | Reseacher/Postgraduate | 11 |
| | Undergraduate | 3 |
| | Other (please specify) | 2 |
| | | 36 |

| **Usage of IPv6** | | | |
|---|---|---|---|
| you use IPv6 | yes | 6 | 25% |
| | no | 18 | 75% |
| | | | |
| your organisation use IPv6 | yes | 4 | 15% |
| | no, but planned in the next year | 10 | 37% |
| | no, but planned in the longer term | 10 | 37% |
| | no, and no plans as yet | 3 | 11% |

### 4.2. Questions regarding the Workshop

About the Workshop

| **usefulness of the topic** | Very Useful | Useful | Slightly Useful | Not Useful |
|---|---|---|---|---|
| Basics of IPv6: Theoretical | 16 | 7 | 3 | 0 |
| Basics of IPv6: Practical | 16 | 8 | 0 | 1 |
| IPv6 Routing protocols: Theoretical | 7 | 11 | 8 | 0 |
| IPv6 Routing protocols: Practical | 9 | 10 | 5 | 2 |
| | | | | |
| IPv6 Applications: Theoretical | 10 | 13 | 3 | 0 |
| IPv6 Applications: Practical | 9 | 11 | 1 | 1 |
| Advanced IPv6 services and Security: Theoretical | 7 | 11 | 2 | 0 |
| Advanced IPv6 services and Security: Practical | 9 | 7 | 2 | 1 |
| Open discussion on IPv6 addressing | 4 | 8 | 1 | 0 |

| **Quality of presentation** | Excellent | Good | Average | Poor |
|---|---|---|---|---|
| Basics of IPv6: Theoretical | 14 | 10 | 2 | 0 |
| Basics of IPv6: Practical | 12 | 9 | 4 | 1 |
| IPv6 Routing protocols: Theoretical | 8 | 10 | 8 | 0 |
| IPv6 Routing protocols: Practical | 8 | 13 | 3 | 2 |
| | | | | |
| IPv6 Applications: Theoretical | 12 | 14 | 0 | 0 |
| IPv6 Applications: Practical | 9 | 12 | 1 | 1 |
| Advanced IPv6 services and Security: Theoretical | 10 | 14 | 0 | 0 |
| Advanced IPv6 services and Security: Practical | 9 | 11 | 1 | 1 |
| Open discussion on IPv6 addressing | 4 | 8 | 1 | 0 |

| **Famiiar with the topic ?** | None | some | most | all |
|---|---|---|---|---|
| Basics of IPv6: Theoretical | 3 | 15 | 7 | 1 |
| Basics of IPv6: Practical | 10 | 11 | 5 | |
| IPv6 Routing protocols: Theoretical | 8 | 17 | 1 | |
| IPv6 Routing protocols: Practical | 14 | 11 | 1 | |
| | | | | |
| IPv6 Applications: Theoretical | 9 | 13 | 4 | |
| IPv6 Applications: Practical | 13 | 9 | 2 | |
| Advanced IPv6 services and Security: Theoretical | 8 | 12 | 3 | |
| Advanced IPv6 services and Security: Practical | 9 | 9 | 2 | |
| Open discussion on IPv6 addressing | 4 | 8 | 2 | |

| **Quality of course documentation** | |
|---|---|
| excellent | 11 |
| good | 12 |
| average | 2 |
| poor | |

| **General WS organisation** | |
|---|---|
| excellent | 12 |
| good | 13 |
| average | 1 |
| poor | |

| **Recommend to your colleagues ?** | |
|---|---|
| yes | 25 |
| no | 2 |

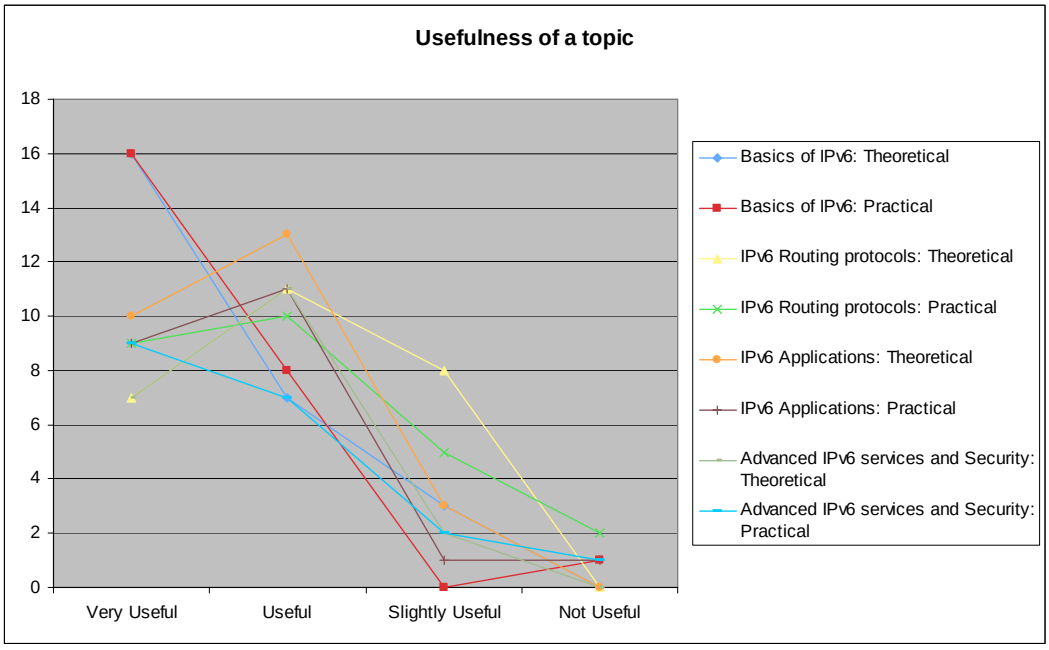



**Figure 8: Usefulness of the topics**

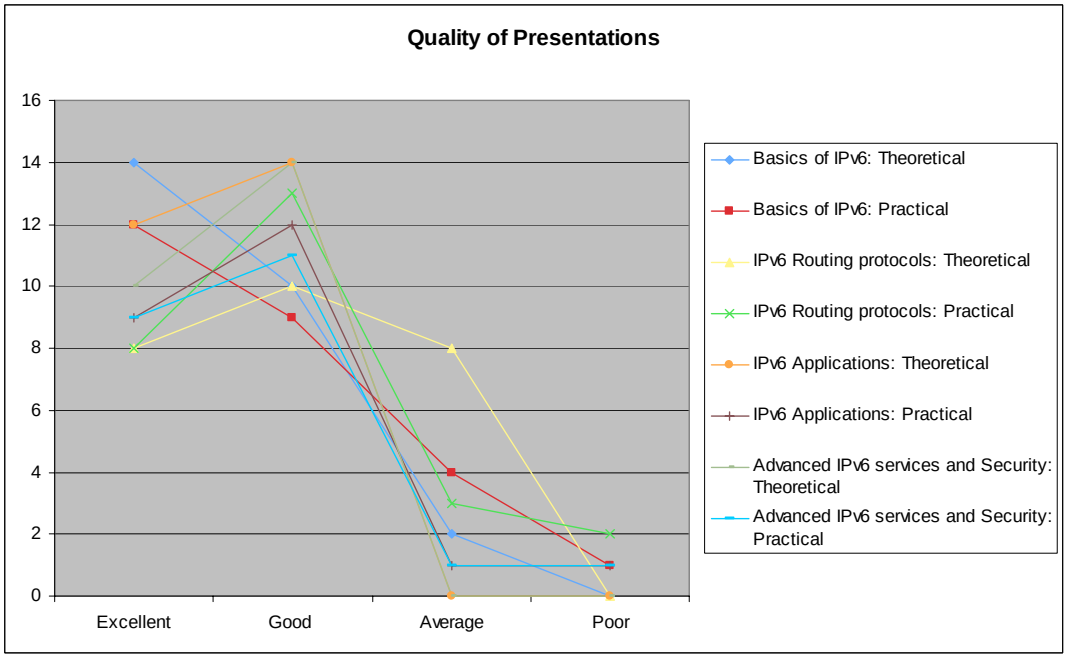



**Figure 9: Quality of the presentations**

### 4.3. Participants Comments

| more on the covered topics | |
|---|---|
| | Creation of IPv6 address |
| | More about routing and configuring a network |
| | Practice |
| | IPv6 applications |
| | IPv6 on GRID |
| | Advantages and benefits of using IPv6 in GRID |
| | Advanced IPv6 services |
| | Routing protocols |
| | Services and security |
| | More focused for ISPS and access |
| | Hands-on labs |

| less on the Topics covered | |
|---|---|
| | Theory of IPv6 |
| | IPv6 services and security |
| | IPv6 routing protocols |
| | In general stuff that we don't or won't use in our network |
| | Very specialized details |

| other comments | |
|---|---|
| | More often workshops |
| | More specific exercises |
| | Nice |
| | More practical sessions |
| | Slower on advance topics |
| | Maybe to do survey before the workshop about the topics and it understanding (like routing protocols, security and such advance topics) |
| | More days and less hours on those days (not more than 7); two sessions in a day (each 3-4 hours) |
| | Involve people who have better skills in teaching to give the presentations |
| | Excellent! Thank you! |
| | Too much theoretical materials that can not be covered in only 2 days However, it's good to have all these theoretical materials in the presentations in order to see how much more is there to learned |

It should be noted that the participants had different technical backgrounds. For example, some of the participants were network engineers (and therefore more interested in routing protocols and troubleshooting practices) while others were system administrators (and therefore more interested in applications and monitoring tools).

# 5. Background information about the region

## 5.1. SEEREN2

The South Eastern European Research and Education Networking initiative, SEEREN2 (www.seeren.org), aims at expanding European research networking in SEE by providing connections between the National Research and Education Networks in eligible countries (SEEREN NRENs) and GÉANT, the Pan-European Research and Education network. The eligible countries are Greece, Hungary, Romania, Albania, Bosnia-Herzegovina, Bulgaria, FYR of Macedonia, and Serbia-Montenegro. Greece, Hungary and Romania and Bulgaria already have GÉANT connectivity; the other countries listed are therefore intended to be the main beneficiaries of SEEREN2. SEEREN2 will oversee the design and implementation of this connectivity between the partner NRENs and the regional GÉANT points of presence. These international connections will open doors for the beneficiaries to the many scientific and educational communities of the European Union.


**Figure 10: SEEREN2 partners**

### 5.1.1. SEEREN2 specific objectives

Some of the most important objectives of the SEEREN2 project include:

- To upgrade the South-East European eInfrastructure interconnecting the National Research and Education Networks (NRENs) of Albania, Bosnia-Herzegovina, Bulgaria, Greece, Hungary, FYR of Macedonia, Serbia-Montenegro, and Romania;
- To interconnect the beneficiary NRENs to the major GÉANT2 Points of Presence (PoPs) in this area and thus to the Pan-European research network. The major GÉANT2 PoPs in the region are located in Athens, Sofia, Budapest, Bucharest, Ljubljana, Zagreb and Vienna;

### 5.1.2. Status of Internet connectivity

After a tender evaluation procedure, conducted by a team of experts from DANTE, GRNET, NIIFI, RoEduNet and ISTF, converged towards the network topology, shown in Figure 11.

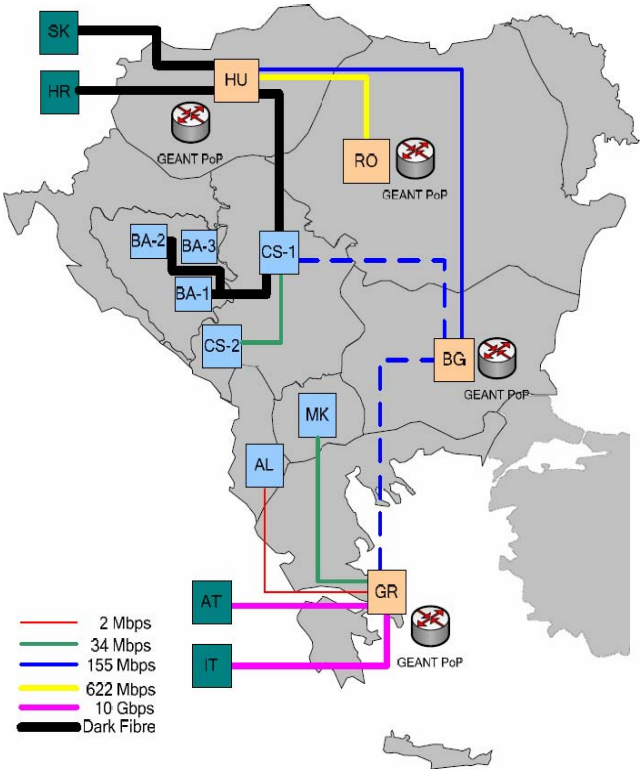



**Figure 11: The IP infrastructure in SEE**

The following SEEREN2 links are already operational:

- Belgrade – Athens;
- Belgrade – Podgorica;
- Skopje – Athens;

Furthermore, an intermediate add-drop point in Sofia has been deployed recently, and a new routing policy has been designed and implemented. The new topology provides *significant* redundancy to beneficiary countries (Serbia & Montenegro, FYRoM and Bosnia and Herzegovina in the future) and to Bulgaria. Through the installation of this complex technical solution, collaboration has been achieved between the NOCs of the involved NRENs - which is one of the main objectives of the project.

Prior to the implementation of the links to Albania and Bosnia-Herzegovina, some pre-conditions had to be met by the respective NRENs. These pre-conditions were initially designed to assist the incubating NRENs to move towards a sustainable development.

The interconnection of the NREN autonomous systems in the SEE countries is shown in Figure 12. According to the international tender results, the link between Belgrade and Athens has an option for a break-out point in Sofia which has the effect of splitting the link into two point-to-point links AMREJ – ISTF and ISTF – GRNET. Also, all links will be upgraded, and new networks (BIHARNET and MREN - which currently do not have AS numbers) will be connected. This configuration brings new possibilities for the redundancy in the SEE NREN

connections between themselves and to GÉANT. However, the increased complexity of the network and the new possibilities leads to an increasing complexity of the previously mentioned, unresolved routing problem, now not only for AMREJ, but also for ISTF, GRNET, MARNET and INIMA. Note that the recently formed MREN is in networking terms still a part of AMREJ – it uses addresses from AMREJ's address space and belongs to AMREJ's AS 13092.

According to the second phase of the implementation roadmap, Bosnia and Herzegovina has the opportunity to be connected to the backbone of the SEEREN network utilising a "Dark Fibre" solution. Currently, the consortium is designing from scratch the internal network. This network is expected to build the fundamentals of a new network and assist the country to remove this digital divide.

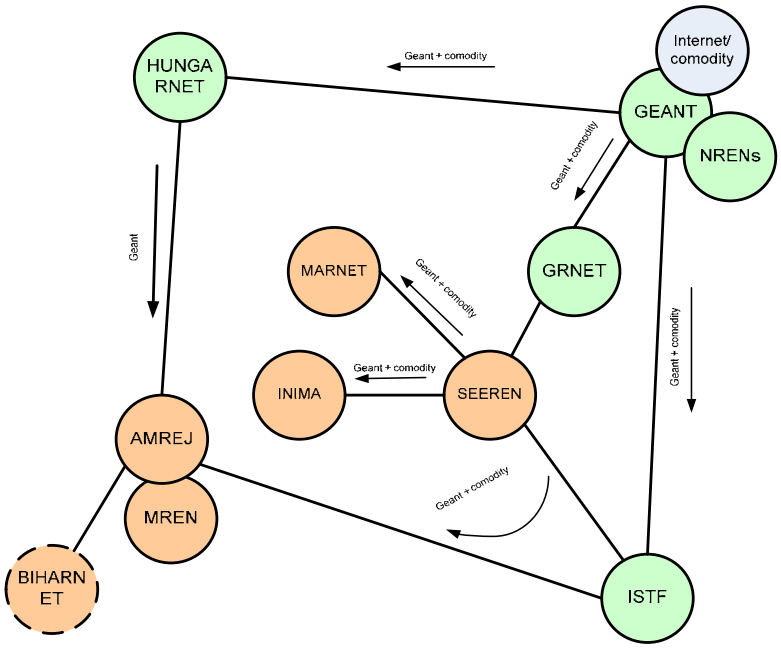



**Figure 12: Routing in SEEREN2**

### 5.2. Experience of IPv6 and ongoing projects

In the SEEREN project, the "predecessor" of SEEREN2, achieved to provide IPv6 interconnection services between the NRENs over the Carrier Provider's MPLS network. The implemented solution integrated the 6PE technique with the Carrier Supporting Carrier (CsC) technique, as shown in Figure 13.

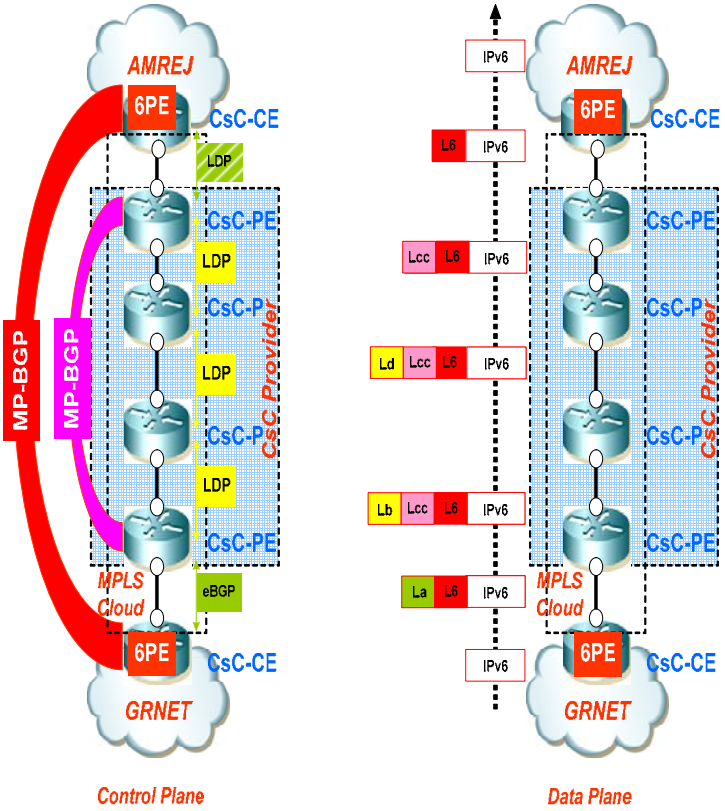



**Figure 13: 6PE over CsC implementation in SEEREN**

In SEEREN2, IPv6 interconnection services are also provided in the SEE core network, even if the network topology has dramatically changed and new Carrier Providers offer the interconnection circuits. The NRENs, in the context of SEEREN2, have committed to do all the necessary actions in order to extend IPv6 connectivity to local universities and research institutes. IPv6 Multicast services are planned to be enabled at the core network during the lifetime of the SEEREN2 project. A study and extended testing is planned to be performed over the SEEREN2 infrastructure. Finally, SEEREN partners have committed to deploy various management tools, such as “Looking Glass”, in order to monitor their IPv6 networks.

## 6. Conclusion

Workshops are a key mechanism through which information will be transferred to the developing countries. The workshops will enable to build constituencies and raise awareness; disseminate, benchmark and validate the research results from IST; promote European technologies; exchange best practices; and explain about activities related to standards and interoperability issues.

GRNET led the 6DISS workshop for the South East Europe region, and was supported by NIIF/HUNGARNET. The 6DISS technical workshop and International IPv6 Workshop on IPv6 technology took place on 3 -5 of March 2006 in Serbia & Montenegro. Approximately 35 network engineers and system administrators participated in the two events. The material was selected according to the participants' requirements, as expressed via mailing lists. In order to optimise travelling costs, the workshop was organised in conjunction with the SEEREN2 and SEE-GRID project meetings.

The set of dissemination material included all issues of Internet deployment and evolution; especially IPv4-IPv6 transition/coexistence strategies, DNS, DHCP, Routing, QoS, Security, Monitoring and Management tools, and Applications.

According to the evaluation forms and the comments from the participants in the SEE workshop, it is concluded that there is significant interest in the region for the IPv6 technology. The participants expressed positive comments on the workshop usefulness and organisation issues. They also "requested" 6DISS to organise more workshops in the region with more specific technical subjects.

The Internet connectivity to this region is provided by the EC FP6 SEEREN2 project, which "extends" the GÉANT2 network in the region. SEEREN2 project will present SEEREN2 is the main driving force for the deployment of IPv6 technology in the SEE. For the time being, the AMREJ (Serbia & Montenegro) and ISTF (Bulgaria) have some IPv6 deployments inside their countries.