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Deliverable D3.2
Annual Report on Campus Best Practice

Deliverable D3.2

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Authors:	Jari Miettinen (CSC/Funet), Vanessa Pierne (RENATER), Tom Myren (UNINETT), Juha Hopia (CSC/Funet), Tomi Salmi (CSC/Funet), Janne Oksanen (CSC/Funet), Jiri Navratil (CESNET), Andrijana Todosijevic (AMRES), Vangel Ajanovski (MARnet), Radoslav Yoshinov (BREN), Carlos Friacas (FCT-FCCN), Vladimir Gazivoda (MREN), Milan Cabak (MREN), Michal Przybylski (CEENET), Hrachya Astsatryan (ASNET-AM), Sergei Kozlov (BASNET), Ramaz Kvatadze (GRENA), Maria Ristkok (EENet/HITSA), Peter Bogatencov (RENAM), Volodymyr Galagan (URAN).

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Abstract
The overall objective of the NA3 T2 of GN4-1 is to examine the key challenges for European campus networks, organise working groups and provide an evolving and to-the-point set of best practice documents for the community. D3.2 reports on the results the work carried out in the Task during the year of the GN4-1 project (May 2015 – April 2016).

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Executive Summary

This publication is an annual report on the activities of NA3 T2, the Campus Best Practice (CBP) Task, during the one-year GN4-1 project.

Fifteen NRENs took part in this work in GN4-1: AMRES (Serbia), ASNET-AM (Armenia), BASNET (Belarus), BREN (Bulgaria), CESNET (Czech Republic), CSC/Funet (Finland), EENet/HITSA (Estonia), FCT-FCCN (Portugal), GRENA (Georgia), MARnet (F.Y.R. of Macedonia, hereafter Macedonia), MREN (Montenegro), RENAM (Moldova), RENATER (France), UNINETT (Norway), and URAN (Ukraine). In addition, CEENET (Central and East European Networking Association) and GÉANT contributed to the task in a supporting role.

The work of the CBP groups resulted in the production of 30 Best Practice Documents (BPDs) and 14 national workshops. Dissemination of the work continued at national and international events and conferences. The workgroup also contributed to the organisation of national and regional conferences and training sessions and delivered 66 conferences presentations during the year.

1 Introduction

Campus Best Practice is Task 2 of Networking Activity 3, Status and Trends (NA3), of the GN4-1 project. The task is based on the previous work carried out in the GN3 project by NA3 T4, led by UNINETT [DN3411], [DN3412], [DN3413], [DN3414], and in the GN3plus project by NA3 T2, led by CSC/Funet [DN321], [DN322]. The origins of the Campus Best Practices lie in the UNINETT GigaCampus project [GigaCampus] The importance of the development of campus networks and services was also raised in the EARNEST report [CampusIssues]. The experiences of the GigaCampus project and the EARNEST report recommendations greatly influenced the establishment of the Campus Best Practices task as part of the GÉANT project. Further reasoning for applying the CBP method within NRENs can be found in AMRES's document on the subject [AMREScbp].

This deliverable reports the NA3 T2 activity for the year of the GN4-1 project, from 1 May 2015 to 30 April 2016.

The objectives of NA3 T2 are to address the current challenges for campus networks through:

- A series of Best Practice Documents (BPD) written in collaboration groups.
- Workshops and training events.
- Dissemination of best practices and BPDs.

The work of the task aims to promote cooperation between peer groups, encourage the development of expertise within the NRENs and the community in general, and support the deployment of best practices in the campuses.

The following NRENs are involved in the task: AMRES (Serbia), ASNET-AM (Armenia), BASNET (Belarus), BREN (Bulgaria), CESNET (Czech Republic), CSC/Funet (Finland), EENet/HITSA (Estonia), FCT-FCCN (Portugal), GRENA (Georgia), MARnet (F.Y.R. of Macedonia, hereafter Macedonia), MREN (Montenegro), RENAM (Moldova), RENATER (France), UNINETT (Norway), and URAN (Ukraine). In addition, GÉANT Association and CEENET participate in a supporting role.

NA3 T2's approach and working methods are described in Section 2 of this report. Section 3 summarises its key results, while Section 4 includes national summaries of CBP activities by NRENs in the member countries. Section 5 summarises and draws conclusions on the work carried out. The Appendices include a list of the national working groups (Appendix A), abstracts of the BPDs written during GN4-1 (Appendix B), a list of presentations of CBP work at conferences (Appendix C) and a list of international-level workshops and training events (Appendix D).

2 Approach

2.1 Technical focus areas

The Task team inherited six work areas from the preceding project (GN3plus), although there have been important shifts in the areas of interest within the focus areas themselves. A brief description of the focus areas follows, alongside the icons that identify each area.

Physical infrastructure. This area addresses the requirements for generic cabling systems on campus, both fibre and twisted pairs. The requirements of the infrastructure in telecommunications and server rooms are also dealt with. This includes power supply, ventilation and cooling, and fire protection, as well as general Information and Communications Technology (ICT) room-plan guidelines. Recommendations for building an audio-visual (AV) infrastructure in lecture halls and meeting rooms are also covered including virtualisation technologies in this area.

Campus networking. This area deals with the campus network itself, and with the routers and switches as its basic building blocks. Requirements for both Layer 2 and Layer 3 are covered. Recommendations for a redundant design are given. Metropolitan area networking and virtual switching is covered. There is a particular emphasis on guidelines for implementing IPv6 on campus. Lightpaths on campus are also dealt with. The work done with digital assessments is included.

Wireless. This area focuses on the wireless infrastructure on campus. Radio planning, design of the wireless network, security considerations, including the implementation of IEEE 802.1X are covered. eduroam requirements and Remote Authentication Dial-In User Service (RADIUS) setup are dealt with. Cookbooks for controller-based implementations are given. Legal aspects are examined.

Network monitoring. This area focuses on network monitoring of the campus network. General requirements and framework conditions for monitoring are given. NetFlow/Internet Protocol Flow Information Export (IPFIX) analysis is covered. Security monitoring, anomaly detection and behaviour analysis are also dealt with. Particular considerations for IPv6 monitoring are given. References to a number of open source tools, many of which have been developed within the GÉANT community, are given.

Communications tools. This area recommends infrastructures for real-time communications with an emphasis on open standards and Session Initiation Protocol (SIP) in particular. The infrastructure itself should be media transparent, coping with voice, video, messaging, document sharing, and shared presence. Particular focus is given to Voice over IP (VoIP) and IP telephony. Best practices from a number of NRENs in Europe are given. Security concerns are discussed and implemented solutions are recommended. Performance issues are also covered.

2.2 The writing process for BPDs

The writing process for the best practice documents has continued unchanged from the GN3plus project. The working groups are coordinated by the NRENs in their respective countries. The same working method has been adopted by the new NRENs that joined the work at the beginning of GN4-1. Appendix A gives an overview of the active working groups within each area in the contributing countries. Figure 2.1 shows the BPD workflow.

Figure 2.1: Writing process workflow for best practice documents (BPDs)

Some of the NRENs which joined later have preferred to write their initial versions of the BPDs in English and not in their native language. As a related new development, task members have peer-reviewed the BPDs of other NRENs. These peer reviews have been aimed at finding some additional viewpoints and use cases, as the original documents are already quite accurate in the details. Peer reviews are undertaken once the English language documents are available, whether in the original or in translation where needed.

2.3 Translation into English and Publication

An internal process and a bookkeeping system for the translation service was used in order to clarify procedures for all partners and enable those involved to manage the translation process, so that the translation of individual documents can now be easily carried out.

The GN3plus approach to translation and web publishing was maintained by the NA3 T2 team for GN4-1; once a document is approved at the national level, it is translated into English and published on the GÉANT website [GÉANTbpds].

Several short articles on the Campus Best Practice (CBP) workshops and training events have also been published in the GÉANT CONNECT magazine. The task poster and fliers were displayed and distributed at all events, with supplementary material from the GÉANT project. New documents are announced when they become available through a mailing list [**BPannouncements**].

2.4 Task Management

The workgroup continued to use the procedures established during GN3plus project year Y2, such as the technical focus area model (Section 2.1) and followed the one-year plan of action summarised in the NA3 T2 GN4-1 activity proposal.

As the GN4-1 project started the number of task members grew by six NRENs. One of the main foci was to support the campus work in the new task member countries. The other task targets included the official reporting, BPD compilation and international events. Due to the large expansion of the activities and duties, the task leadership was shared between CSC/Funet and RENATER.

The work was started with a kick-off meeting in Prague, Czech Republic [CBPkickoff]. Monthly videoconference meetings where work is reported and topical items discussed ensure cooperation within the workgroup. Monthly progress and milestones achieved are documented in monthly reports made available on the workgroup intranet. This reporting mechanism provides an information base, which is utilised for the project's administrative monthly and yearly reporting. The task has a mailing list for official announcements, information exchange and discussion. IMS tools and videoconferencing are used frequently as needed.

NA3 searched for cooperation partners both inside the GN4-1 project and among the community. The aim was to pool efforts and resources in completing major tasks, such as, for example, for organisation of the training events.

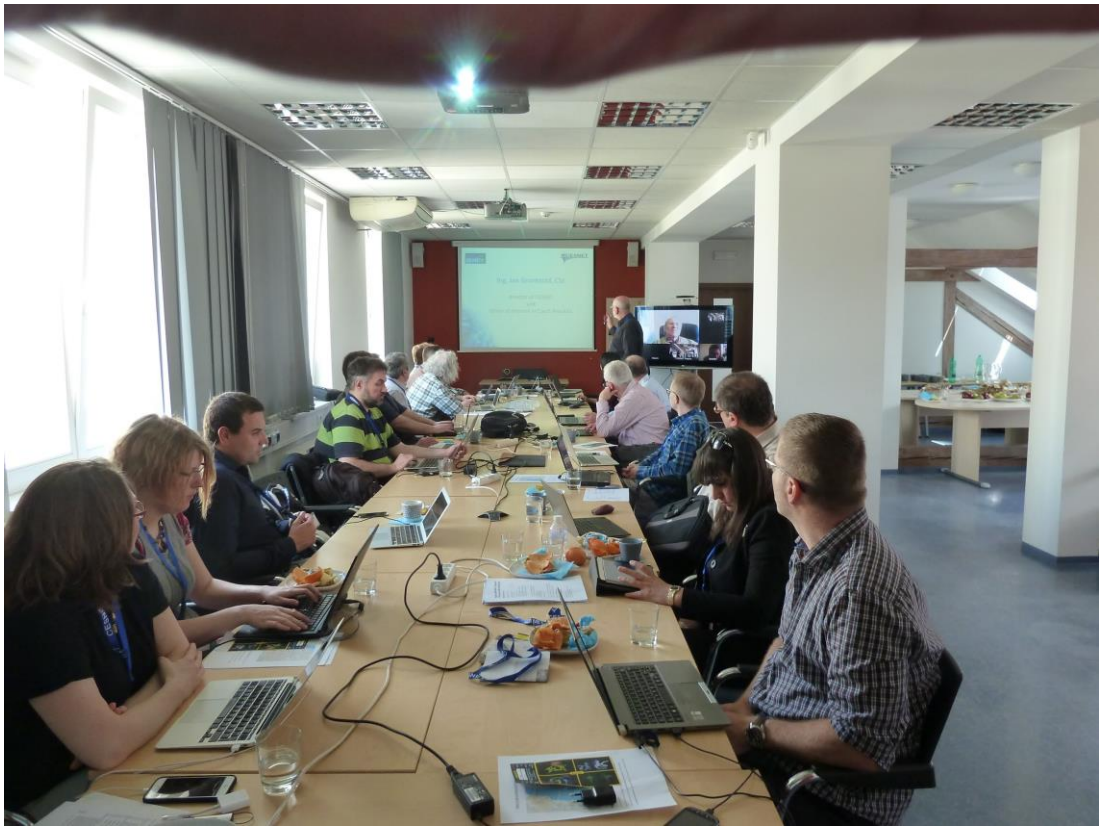

Figure 2.2: NA3 T2 kick-off at the CESNET office, Prague, Czech Republic, 4 May 2015

3 Best Practice Documents

NA3 T2 continued producing a growing toolkit of best practice documents (BPDs), which form the basis of the dissemination efforts of the CBP Task.

Work was started on 49 best practice documents (BPDs) during the year, of which 30 have been completed in the GN4-1 period. Table 3.1 shows the distribution between the focus areas.

Focus area		No. published
Ref	Name	
1	Physical infrastructure	2
2	Collaboration tools	2
3	Campus networking	13
4	Wireless	2
5	Network monitoring	6
6	Security	5
	Total	30

Table 3.1: The number of BPDs published in each of the six focus areas of CBP, in GN4-1

Table 3.2 lists the BPDs individually. Abstracts of the 24 BPDs can be found in Appendix B.

No.	Document	NREN	Area	Completed
1	Cookbook for Setting up Campus Dormitory Wireless and Cabled Networks	URAN, RENAM	Wireless	March 2016
2	Virtualisation of servers using XenServer open source virtualisation platform	MREN	Physical infrastructure	January 2016
3	Nagios monitoring and SMS based alerts in the academic network of the University of Montenegro	MREN	Network monitoring	January 2016
4	IXP Implementation in the academic network of the University of Montenegro	MREN	Campus networking	February 2016
5	Security Recommendation for an Ubuntu Server-based System	MREN	Security	March 2016
6	Splunk log management	AMRES	Network monitoring	February 2016

No.	Document	NREN	Area	Completed
7	Deployment of Syslog monitoring	AMRES	Network monitoring	April 2016
8	Clients for Digital Assessment	UNINETT	Campus networking, e-Campus Digital Assessments	October 2015
9	Integration for Digital Assessment	UNINETT	Campus networking, e-Campus Digital Assessments	*
10	ICT Architecture for Digital Assessment	UNINETT	Campus networking, e-Campus Digital Assessments	November 2015
11	Logging and Monitoring for Digital Assessment	UNINETT	Campus networking, e-Campus Digital Assessments	December 2015
12	Digital assessment – Juridical Questions	UNINETT	Campus networking, e-Campus Digital Assessments	*
13	Guide to configuring eduroam using Aruba wireless controller and ClearPass RADIUS	UNINETT	Wireless	March 2016
14	AV infrastructures and services within RCTS	FCT-FCCN	Collaboration tools	February 2016
15	Netfilter-based Firewall System	FCT-FCCN	Security	*
16	Implementation of Quasi-SDN Control and Monitoring Systems on Networks with Diverse Equipment	URAN	Network monitoring	January 2016
17	Providing MPLS services to campus edge	CSC/Funet	Campus networking	April 2016
18	Building a Campus Gateway on a Commodity Hardware and Open-Source Software	CESNET	Campus Networking	April 2016
19	Providing high network availability at data centres	CESNET	Campus networking	April 2016

No.	Document	NREN	Area	Completed
20	Authentication and authorisation of external users	EENet/HITSA	Campus networking	*
21	Cloud implementation using OpenNebula	MARnet	Campus Networking	April 2016
22	Monitoring activities at campus computer labs	MARnet	Network monitoring	April 2016
23	Profile and role-based firewall control for campus classrooms labs	MARnet	Campus networking	April 2016
24	Automated workstation deployment	MARnet	Campus networking	April 2016
25	Recommendations for Network Traffic Analysis Using the NetFlow Protocol (update to GN3-NA3-T4-AMRES-BPD-104)	AMRES	Network monitoring	April 2016
26	Best practices for the rationalisation development on sharing of a datacenter	RENATER	Physical infrastructure	*
27	Videoconference	RENATER	Collaboration tools	*
28	Quality of identities repositories	RENATER	Security	*
29	Building a mutualized antispam service	RENATER	Security	*
30	Forensics analysis	RENATER	Security	*

Table 3.2: Best Practice Documents completed in GN4-1

Note that documents marked with an asterisk (*) are not published as approved versions in English at the time of writing. They may, however, be available in the form of a nationally approved non-English version, or as a non-approved English translation.

4 Dissemination

4.1 Conferences Presentations of CBP

A total of 66 presentations of Campus Best Practices were given at international and national conferences during the GN4-1 project. The presentations are individually listed in Appendix C as Table C.1.

4.2 National workshops and training events

A total of 14 National-level workshops were organised by the CBP task in the reporting period. As part of national CBP work, NA3 T2 influenced the programme and CBP work was disseminated at these workshop and training events.

No.	Date	Area	Topic	Country	#days	Participants
1	23–25 April 2015	1	National University Forum	Bulgaria	1	80
2	20 May 2015	1–6	9th RENAM User Conference	Republic of Moldova	1	50+
3	2 June 2015	4	Network monitoring	Norway	1	54
4	4 June 2015	1, 3	AccessFunet and MobileFunet joint meeting	Finland	1	31 (20)
5	18 September 2015	5	Wireless	Norway	1	35
6	October 2015	2	SIP and real-time communication	Norway	2	30
7	23–26 October 2015	1	Meeting of Bulgarian Universities	Bulgaria	1	100
8	2 December 2015	1 ,3	AccessFunet and MobileFunet joint meeting	Finland	1	14 (10)
9	16 December 2015	All	Campus Best Practice French Workshop	France	1	14
10	13 February 2016	5	Dynamic Mathematics	Bulgaria	1	30
11	6 April 2016	3	Campus Best Practice @ Jornadas 2016	Portugal	1	42

No.	Date	Area	Topic	Country	#days	Participants
12	15 April 2016	3	HITSA annual conference	Estonia	1	30
13	19–21 April 2016	1–4, 6	Campus Network and Infrastructure	Norway	3	190
14	22 April 2016	1,3,4 ,5,6	MARnet National Level Campus Best Practice Workshop as part of the International Conference on Informatics and Information Technology (CIIT2016)	Macedonia	1	20

Table 4.1: Workshops organised at the national level

The figures in brackets in the Participants column '(n)' are the number of participants attending remotely. '(TBC)' means that the event had not taken place at the time of writing.

4.3 Selected National events

The task contributed to several major events, which were hosted in the organising NREN's country. Three selected events are listed in Table 4.2 with details presented below in the following sections.

Date	Event	Workshop location	Hosted by	Participants
9–11 September 2015	EC Information Days	Ivane Javakhishvili Tbilisi State University, Georgia	GRENA, ICARTI, Ivane Javakhishvili Tbilisi State University	100
8–11 December 2015	National French R&E Community Conference	Corum (Montpellier Congress Center), Montpellier, France	RENATER JRES	1700
28 April 2016	eduroam training	Belgrade, Serbia	AMRES	30 (TBD)

Table 4.2: Selected National and Regional events in GN4-1

4.3.1 European Commission Information Days (Tbilisi, Georgia)

EC Information Days in Tbilisi, in Information and Communication Technologies and in e-Infrastructures was supported by the EC DG CONNECT project. Additional support was provided by the EAST-HORIZON, EECA-2-HORIZON and EaPConnect projects, the Georgian Research and

Educational Networking Association (GRENA), the International Center for Advancement of Research, Technology and Innovation (ICARTI) and the Ivane Javakhishvili, Tbilisi State University.

The event, gathered more than 100 participants from both the public and the private sector, and focused on the improvement of European and EECA regional cooperation under the Horizon 2020 programme. RENAM gave a presentation on the status of e-Infrastructure and services in Eastern Partnership countries.

4.3.2 JRES National French Conference (Montpellier, France)

JRES 2015 (Journées Réseaux de l'Enseignement et de la Recherche – Education and Research networking days) are organised by RENATER, the French National Research and Education Network. The 2015 event took place from 8–11 December 2015 at the Corum (the Montpellier Congress Centre), in Montpellier, France.

Organised every two years, JRES is dedicated to the ICT community in R&E and consists of four days of conference and a large exhibition. For the first time, a French-to-English translation was provided in the main auditorium and summary of presentations were also be available in English. The conference and exhibition was attended by 1700 persons from the French and international community. The Programme Committee selected three presentations on Campus Best Practice work.

4.3.3 eduroam training (Belgrade, Serbia)

As a part of the CBP training series, this time a regional event for the Balkans, NA3 T2 arranged eduroam training in Belgrade, Serbia.

The event, which took place on 28 April 2016, at the School of Electrical Engineering Computing Centre, University of Belgrade, Serbia, was conducted in the Serbian language. In addition to AMRES administrators, participants from MARNET and MREN were invited. The eduroam training in Belgrade provided attendees with hands-on experience and materials to help them overcome obstacles in day-to-day RADIUS and LDAP server administration. This event also enabled site administrators to feel more comfortable in working in a Linux-based environment.

4.4 International workshops

International-level workshops are a core activity of the Campus Best Practices task. They are intended to provide a space in which to exchange ideas and experiences and offer participants an opportunity to present their recent results and initiatives to the community.

The workshops were organised according to the Y1 plan which was agreed by the partners during GN4-1. The workshop themes were chosen to support the work on BDPs in the NRENs. The workshops were organised in collaboration with several NRENs, with the hosting NREN covering the steering role for practical reasons.

Date	Event	Workshop location	Hosted by	Participants
17 September 2015	Wireless sessions	NORDUnet Technical Workshop (NTW2015), Copenhagen, Denmark	NORDUnet	40
26–28 October.2015	Campus Networking and Security Workshop	Plovdiv, Bulgaria	BREN	88
8–9 March 2016	Thunder in the Campus GN4-1 Symposium	Vienna, Austria	GÉANT	20
25–26 April 2016	Campus Monitoring and Security Workshop	Prague, Czech Republic	CESNET	36

Table 4.3: CBP International-level workshops and training events in GN4-1

Detailed agendas for the four events are given in Appendix D.

4.4.1 Wireless Session in NTW2015 (Copenhagen, Denmark)

The NORDUnet Technical Workshop (NTW2015) is a community event, where the Nordic R&E networking community meet discuss, and work together. It is achieved by the means of plenary sessions with lightning updates, and it is organised as a set of topical or community-specific breakout sessions. The objective of CBP participation there was to provide the feedback on CBP work and achievements and to recruit top level specialists from NORDUnet community to work as the teachers during CBP workshops organised for NRENs.

Funding

The event has been organised and funded by NORDUnet. NA3 T2 contributed there in the form of lightning talks and participation in topical sessions. The travel, accommodation and workshop fees for CBP personnel for this event were paid by the CBP activity.

Speakers

From the CBP side, Michal Przybylski presented the lightning talk on “Active Knowledge Transfer – Why do We Need Joint Training Activities”. The talk related to the concept of CBP Academy and was well received by the audience. Two lightning talks were given by Magnus Strømdal: “Current best practices for digital assessment” and “Digital assessment – Logging and monitoring”. These were both related to the series of BPDs being published during GN4-1.

Tom Myren hosted two wireless sessions during the second day. In one of the sessions, Tomi Salmi presented the BPD “eduroam Server Certificate”. Jari Miettinen, Jane Oksanen and Michal Przybylski took part in a “Media Management” session.

Structure and programme

The programme for this event is available at: [NTW2015]. The part of the programme organised by NA3 T2 is given in Appendix D.

NORDUnet Technical Workshop is a three-day event. The programme varies between four parallel tracks and a joint session. The focus of the event is very technical. The meetings and workshops are self-organised. The NTW2015 event organisers support the activities only by facilitation, logistics, facilities and catering.

The wireless session was a half-day event with six presentations. Two technical updates from the leading vendors were included.

Event summary

The event achieved the following:

- Dissemination of information about Campus Best Practices in the NORDUnet community.
- The recruitment of several speakers for the subsequent CBP workshop in Plovdiv, Bulgaria:
  - Hans Nordlof (eduID specialist).
  - Erik Kikkenborg (Streaming solutions).
  - Juha Hopia (eduroam).
  - Vesa Savolainen (Video services).

4.4.2 Campus Networking and Security Workshop (Plovdiv, Bulgaria)

The event was organised on 26–28 October 2015, with the cooperation of Bulgarian Research and Education Network (BREN) and Plovdiv University, using the opportunity of the annual users conference of the BREN community.

The venue was the Hotel Sankt Petersburg in Plovdiv. The objective of the workshop was to present the latest developments and best practices in campus and NREN-related technologies for the research community of Balkan countries and to contribute to the development of short-term service strategy for BREN.

Funding

The workshop was mainly funded by BREN with a contribution from CBP in the form of meeting the travel costs for foreign speakers and catering.

Speakers

Workshop speakers included a range of experts from EU NRENs, local community and the industry.

Structure and programme

The workshop consisted of seven sessions, which were distributed on three days. The first day included the introduction of selected GÉANT services and campus wireless network session. The second day introduced best practices in user identification and management. A full coverage on video service technologies from introduction to development was provided. The security sessions started after the lunch break on the second day and they lasted until the end of the event. As the final item, the Bulgarian community had a special meeting on the future service strategy.

The detailed event structure and programme is presented in Appendix D.

Event summary

The event was attended by almost 90 participants, mainly from Bulgaria, but also from neighbouring countries. The workshop programme was streamlined with planned development activities of the BREN community. The presentations (which referred mainly to existing developments in other countries) were very well received.

Figure 3.2: Cyber Security session in the Campus Networking and Security Workshop in Plovdiv, Bulgaria, 28 October 2015

4.4.3 Thunder in the Campus (Lightning talks), GN4-1 Symposium (Vienna, Austria)

The NA3 T2 task arranged “Thunder in the Campus” (a lightning talk session) during the GN4-1 Symposium 2016 held in Vienna, Austria. The session, held on 9 March 2016, gave an opportunity to present recent BPDs and future initiatives with a speaking time of just eight minutes. A total of eleven presentations were given. The session agenda is given in Appendix 0.

4.4.4 Campus Monitoring and Security Workshop (Prague, Czech Republic)

The workshop was organised by CESNET in Prague during 25–26 April 2016 [CESNETWS2016] . The program covered two days with four sessions on the first day one and a hands-on log analysis training on the second day.

Funding

The event was funded by GÉANT and CESNET.

Participants

The number of participants, their home organisations and countries are not known at the time of writing.

Speakers

The programme included speakers from European universities and NRENs.

Structure and programme

The first workshop day started with the introductions of novel methods and concepts in the field of network monitoring and security. The workshop continued to a more practical approach with tools and experiences from the field. The afternoon started with traffic analysis and incident handling. Finally, the day was completed with presentations of monitoring the new generation networks.

The second day was devoted to a special hands-on training course on L7 traffic security analysis. The day began with introductory lectures and tutorials on the topical threads in the networks. The actual packet analysis part of the training was after the lunch break. The training ended in providing guidelines and tools to the students to create their own flow data analysers.

The detailed event structure and programme is presented in Appendix D.

Event summary

- The workshop provided topical and practical tools and solutions which can be applied in the campus networks.
- Participants recommended repeating of this type of workshop every year in consideration of the dramatic growth in various kinds of attacks and security threats.
- The hands-on part of the workshop was welcomed and it was wished that similar trainings would be include in future training as well.

5 CBP Activities in the NRENs

5.1 AMRES

AMRES, the Serbian NREN, was one of the original four NRENs that started the Campus Best Practice task, and has been active in three of its six technical focus areas, i.e. Security, Network monitoring and Real-time communications. In GN4-1, AMRES formed the user-services working group which is supposed to contribute to Campus networking working area. AMRES produced two BPDs within the Network monitoring area “Splunk log management” and “Deployment of syslog monitoring”. The total number of BPDs written by AMRES since February 2011 now stands at twelve.

AMRES was very active in promoting CBP activities at various events organised under GN4-1 activities: the NREN organised one session at "CBP Technology workshop" in Bulgaria hosted by BREN. During that workshop AMRES also covered four topics, regarding the eduroam service, the monitoring of RADIUS infrastructure, SAML IdP and AMRES CERT activities.

The NREN also took part in the GN4-1 project symposium in Vienna, Austria with one presentation during the “Thunder in the Campus” lightning talk session, when it introduced its experience with DDoS attack. AMRES also chaired the session. AMRES disseminated its best practice experiences on RADIUS monitoring and Linux security at the Campus Network Monitoring and Security Workshop organised by CESNET in Prague, Czech Republic in April 2016.

5.2 ASNET-AM

Campus Best Practice is a new area for ASNET-AM, the Armenian NREN. ASNET-AM conducted several activities related to the Campus Best Practice task, such as:

- Participation in the GN4-1 kick-off meeting in Prague, Czech Republic including the presentation of ASNET-AM activities and plans.
- Preparation of a CBP national work plan for GN4-1.
- Organising regular CBP working group meetings in the leading R&E organisations of Armenia.
- Preparation of a modified version of the BPD “Securing Linux Servers” for use in the ASNET-AM area.

5.3 BASNET

Campus Best Practice is a new area for BASNET, the Belarus NREN. During the reporting period, BASNET studied and analysed CBP principles, the work processes, established a working group and identified an area of interest for future work on BPD.

The working group held two meetings. During the first meeting the CBP principles and processes were discussed, the one-year plan was developed. During the second meeting the topic to work on in the area of monitoring was selected related to power management and monitoring with switched PDUs.

Paper “Power management and monitoring with switched PDUs to increase resilience of network PoP” was presented at the international conference in Minsk, Belarus “Development of informatisation and state system of scientific and technical information 2015” November 2015.

A report on CBP activity in the GN4-1 project was given during the annual National supervisory board meeting of BASNET held on 9 February 2016 in UIIP NASB.

BASNET participated in monthly status meetings and delivered monthly reports.

5.4 BREN

BREN, the Bulgarian NREN, was an active member of the CBP activity in GN4-1. It was engaged in CBP working group meetings, BPD document preparations and organised National and International workshops and seminars.

BREN organised a three-day CBP network security workshop in Plovdiv, Bulgaria during 26–28 October 2015, with the participation from GÉANT, BREN and Bulgarian universities. The sessions, with more than 100 participants in total, were harmonised with those of the National university meeting held during the same dates. BREN also organised two national workshops in November 2015 and February 2016

CBP activities and documents were disseminated on the QONYAon project meeting in Chania, Crete, Greece in August 2015, at the final Conference of the QONYAon project held in September 2015 in Konya, Turkey and at the CEPIS meeting of 26 November 2015 in Vienna, Austria. BREN promoted GÉANT services at the Inspiring Science Education project meeting during February 2016 in Cascais, Portugal and supported CBP activities at the National conference “Dynamic mathematics” on 13 February 2016 in Sofia, Bulgaria.

5.5 CESNET

CESNET, the Czech NREN, is a founding member of the NA3 activity Campus Best Practice. Currently, CESNET main activities are focused on building a new e-infrastructure (network, computing and data centres) to serve key research projects in the Czech Republic and for the wider academic community.

CESNET organises a wide range of events in different fields, including the operation of two working groups in of interest to NA3 T2: the IPv6 WG and the Monitoring WG.

The IPv6 WG maintains special mailing lists, its own web site **[CESNETIPv6WS]** and the electronic journal “root.cz” which regularly publishes news from the IPv6 world. This journal is widely read by IT specialists from the Czech and Slovak Republics. A series of nine articles from the IPv6 field is available at **[ROOTCZIPv6]. The** web page dedicated to IPv6 is at **[CESNETIPv6]**.

The CESNET Monitoring WG organises CNMS2016 “Campus Network Monitoring and Security”, a two-day workshop that was held in Prague on 25–26 April 2016 **[CESNETws2016]**.

CESNET members of NA3 T2 participated in several workshops, organised NA3 T2 teams in other countries, and on a national level organised workshops outside CESNET. For example the CERT/CSIRT & Fenix meeting on 27 January 2016 “Practical experience with DDoS at the campus network”. They also published a series of articles on the server www.root.cz **[CGN_PG1]**, **[CGN_PG2]**, **[CGN_PG3].** The articles opened a nationwide discussion of these matters.

The team actively participate in the GN4-1 Symposium 2016 in the Lightning talks session “Thunder in the Campus“.

CESNET prepared four BPDs in this period:

- Resilient Framework at a University Campus.
- Building campus gateway on a commodity hardware and open-source software.
- Identifying users behind NAT devices.
- DC Connections.

5.6 CSC/Funet

CSC is owned by the Finnish Ministry of Education and Culture and maintains centralised IT systems and supports the R&E functions for higher education and the science sector. Funet, one of the service areas of CSC, is a high-speed data communications network serving the Finnish research community. It connects about 80 research organisations and has about 375 000 users.

CSC/Funet has participated in CBP activities since the GN3 project. In GN4-1, CSC/Funet continued producing BPDs and participating in CBP workshops to disseminate new practices, as well as establishing collaborative national working groups to promote the sharing of information by campus personnel. The groups and focus areas are:

- AccessFunet (wired network technologies).
- MobileFunet (wireless network technologies).
- VideoFunet (video technologies).
- SecureFunet (security issues).

Two of these national working groups – AccessFunet and MobileFunet – were directly involved in the GN4-1 project. CSC/Funet also participated in several video conferences and produced four BPDs, “Service prioritisation as a part of the DC continuity plan”, “Campus network: IPv6 and firewalling”, “Providing MPLS services to Campus Edge” and “Server Certificate Practices in eduroam”. CSC also began a BPD investigated wireless visitor access for end-users without eduroam access.

CSC/Funet and BREN organised the Technology workshop, held in Plovdiv, Bulgaria in October 2015, and which consisted of over 20 presentations and 100 participants from different countries.

CSC representatives gave presentations of CBP activities at the NORDUnet2015 conference in Copenhagen, Denmark ("Server certificate practices in eduroam"), at the Technology Workshops in Plovdiv, Bulgaria ("eduroam, mobility and video services") and at the GN4-1 Symposium in Vienna, Austria ("Providing MPLS services to campus edge").

5.7 FCT-FCCN

FCT is the Portuguese national funding agency for science, research and technology and FCCN is the unit responsible for planning, management and operation of the Portuguese NREN. Campus Best Practice activity for GN4-1 included:

- A videoconference with CBP members was held on 30 October 2015.
- A CBP session was held at Jornadas 2016 (the FCT-FCCN annual member meeting), at the Universidade do Algarve in Faro, Portugal, during 6–8 April 2016.

5.8 GRENA

GRENA, the Georgian NREN, conducted many activities related to the Campus Best Practice task, some of them are listed below:

- A CBP national work plan was prepared for GN4-1.
- Presentation of GRENA activities at European Commission MathGeAr workshop in Batumi, Georgia during 3–5 June 2015.
- Meeting with representatives of universities. Network monitoring and security aspects were discussed.
- Represented at CBP workshop in Plovdiv, Bulgaria
- Working with Eastern Partnership NRENs on the development of the BPD concerning distributed NOC.
- Participation in preparation of paper for TNC 2016 Conference "EaPConnect – Sustainable Networking Infrastructure across GÉANT and Eastern Partnership Region".

In addition, regular monthly national working group meetings took place, where the status of the network infrastructure and needs in different universities were discussed.

5.9 HITSA-EENet

HITSA (the Information Technology Foundation for Education in Estonia) of which EENet (the Estonian NREN) is a structural unit, has participated in CBP activities since May 2015. The working areas for GN4-1 were Campus Network and Wireless.

The national CBP working group was established among Estonian universities and schools of higher education and brought specialists together to discuss and share their experiences. In addition to

videoconferences, three face-to-face meetings were carried out during the GN4-1 period, in September 2015, January 2016 and March 2016.

The Wireless focus area BPD "Troubleshooting for eduroam in the campus network" was started at the beginning of 2016 but work was postponed due to the delay in starting the national programme of modernising information technology in schools for 2015–2023. EENet disseminated CBP activity internationally in the GÉANT community at the meeting of the Task Force on Communications and Public Relations (TF-CPR), the group that connects the communication specialists of all the European NRENs.

5.10 MARnet

MARnet, the Macedonian NREN, was established in 1994 year by the Ministry of Research of R. Macedonia as an organisational unit of the Ss Cyril and Methodius University in Skopje. In 2011 MARnet became a public institution responsible for the development, organisation and management of the unique educational and research telecommunication network in Macedonia. MARnet was first involved in the Campus Best Practice task activities within the framework of the GN3plus project.

A national plan for the task was made during summer 2015. The MARnet CBP team organised one national level event planned for the very end of the project, the CIIT 2016 National Level Campus Best Practice Workshop as part of the International Conference on Informatics and Information Technology [CIIT2016], scheduled for 22–24 April 2016. This workshop was envisioned as a closing event of the task, where all members of networking staff from all higher-education campuses in Macedonia were invited. The main goal of this dissemination event was to present the GN4-1 project and Campus Best Practice task, to discuss in more detail the goals accomplished, the BPDs completed and strengthen relations between the University NOCs for creating and documenting future best practices.

5.11 MREN

The Montenegrin Research and Education Network (MREN) was established in June 2005. MREN aims to create, promote, offer, participate in and make effective use of modern telecommunication technologies in Montenegrin R&E. MREN has been a part of NA3 T2 since the GN3plus project.

MREN has had a focus on network monitoring with a secondary interest in security issues. The NREN has gathered a national working group to raise awareness among IT staff of the University regarding CBP. In GN4-1, MREN expanded contributions to new CBP work areas: Physical infrastructure, Campus networking and Network monitoring.

MREN produced and published three BPDs: "Virtualisation of servers using XenServer open source virtualisation platform"; "IXP Implementation in the academic network of the University of Montenegro"; and "Nagios monitoring and SMS based alerts in the academic network of the University of Montenegro". Another BPD, "Security recommendation for Ubuntu server based systems", started during Y2 of GN3plus, was also completed.

5.12 RENAM

RENAM, the NREN of Moldova, joined the CBP task in May 2015 and has been active in three technical areas: Security, Wireless and Campus Networking.

In 2015 RENAM, in cooperation with URAN (the Ukrainian NREN), produced a new BPD within the Wireless technical area "Cookbook on Setting up Campus Dormitory Wireless/Wired Networks".

RENAM actively promoted CBP activities at a national level. Several presentations during the 9th RENAM Users' Conference on 20 May 2015 were devoted to campus networking and related services for campus users. RENAM disseminated its best practice experiences at various international events. The results related to security area were presented at the GÉANT DDoS Mitigation in the NREN Environment Workshop held during 10–11 November 2015 in Vienna, Austria. Three presentations in the area of specific services and networking infrastructure development were presented at the14th RoEduNet International Conference: Networking in Education and Research (NER2015) during 24–25 September 2015 in Craiova, Romania.

RENAM participated in CBP activities within the regional EaPConnect project coordinated by GÉANT. This activity is taking in consideration GÉANT CBP and other documents and will support development of Campus-level networking in the EaP region.

5.13 RENATER

RENATER, the French NREN, has participated in the task since Y4 of the GN3 project. Besides collaborating and exchanging with the French and European community, RENATER has a MoU (memorandum of understanding) with WACREN (West and Central African Research and Education Network), so is keen to disseminate best practices to West Africa.

In this Task, RENATER shares the lead with CSC/FUNET and is in charge of managing and coordinating the national working group. The working group is composed of participants from universities, research centres and metropolitan or regional networks. Indeed, most of the institutions are connected to RENATER backbone through a metropolitan network. This variety of profiles allows the working group to choose many "hot" topics, covering the needs of the community.

During this first year, the French working group delivered five BPDs which are not yet available in an approved English version.

In October 2015, RENATER sent a speaker to the Campus Networking Workshop in Plovdiv, Bulgaria, hosted by BREN, who presented five BPDs. The French BPDs and the task were also presented during three sessions at the JRES conference, organised by RENATER in December 2015. The conference addressed 1700 people from the R&E community.

CBP activity has been a real opportunity for RENATER to bind the user's community around a project dedicated to enhancement and exchange of best practices.

5.14 UNINETT

UNINETT, the Norwegian NREN, has for a number of years implemented the full CBP model. During GN4-1, CBP work focused on the four areas: Real-time communications, Network Monitoring, Wireless, and Security. Even at the end of the reporting period, BPDs are still being written with a view to publishing and disseminating these through SIG work.

In addition to the above-mentioned work areas, UNINETT have during Y1 produced a series of BPDs related to Digital Assessment (e-campus related). The six BPDs (see Table 3.2) have been produced within NA3 T3 (the GÉANT Green Team), with the translation and publication work done within NA3 T2.

In addition, UNINETT has written a "Guide to configuring eduroam using Aruba wireless controller and ClearPass RADIUS", in response to increased use of this equipment type in the Norwegian HE sector.

Two other BPDs are still in progress: "SIP infrastructure and VoIP status in Norwegian HE" and "Organising the Security organisation". These are due to be finalised after the formal end of GN4-1.

The National R&E conference was held in Tromsø, Norway in June 2015. In addition, UNINETT organised four national workshops in GN4-1, within the following areas: Network Monitoring, Wireless (after NTW2015), "SIP and real-time communications" and "Campus and Infrastructure" (due at the end of April 2016).

5.15 URAN

URAN, the Ukrainian NREN, joined the CBP task in May 2015. At that time URAN was involved in researching a number of networking areas of interest to R&E networking communities in Ukraine and the results of these investigations were keenly anticipated by users.

In the area of wireless networking several universities were interested in providing WiFi access to their staff and students both in university buildings and students dormitories. URAN called together a working group to develop an approach to setting up WiFi networks in universities without cost to the universities themselves. This approach was successfully implemented at two universities in Kyiv, Ukraine. URAN, together with RENAM, produced a BPD published in March 2016: "Cookbook on Setting up Campus Dormitory Wireless/Wired Networks". The results of this work were presented at the Mikrotik User Meeting in Kyiv, Ukraine in December 2015 [URANwireless].

In the area of network monitoring, URAN faced the problem of using a large variety of different types of equipment from various vendors, such as Juniper, Cisco, Alcatel, D-Link, Huawei, TP-Link, etc. Changes and modifications are introduced to the networks on an almost daily basis, so a proposed administrative solution was implemented and tested. The experience was disseminated in a BPD named "Implementation of Quasi-SDN Control and Monitoring Systems on Networks with Diverse Equipment", published in January 2016.

URAN's client communities drew attention to the issue of junk-mail, spam and the area of Security. It is no secret that concerns have been voiced recently as to the security of globally available cloud-

based mailing services (Google being just one example). An approach to unwanted mail elimination was formulated, implemented and tested. Based on the results of the implementation, a BPD, ”Introduction to on-campus maintained cloud based mailing services and SPAM filtering” evolved. This is expected to be published shortly after the end of the GN4-1 project.

6 Conclusions

The task was very active in all its work areas. Six new NRENs joined the task and new CBP teams were established in each of them. The task published 30 new BPDs, arranged four international workshops and made 66 presentations of CBP at Conferences.

The training activities continued with emphasis to both the practical activities and future planning. During the first year of GN4, NA3 T2 Campus Best Practice Task delivered 30 new BPDs – far exceeding the target of 10 for the year. The quantity and quality of the documents was comparable to the previous project, although the work was completed in one year and not in two. The fact that the newly admitted partners were able to complete BPDs is considered a very positive sign.

Looking to the future, and bearing in mind the funding model for CBP will not be available during the next GÉANT project, the existing CBP members are evaluating various models for continuing with CBP effort. After some discussion, the SIG (Special Interest Group) framework in the GÉANT Association looks to be a strong candidate for this purpose.

Appendix A Working Groups

A list of active working groups in each participating NREN is given below. The leaders listed are those that are active at the time of writing. Working group leaders that are marked with an asterisk in the tables below are not members of the NA3 T2 team. This means that the costs of their work are not charged to the GN4-1 project budget, but are borne entirely by the NREN. The local NREN coordinators are also listed.

A.1 AMRES

The NREN coordinator is Andrijana Todosijevic (AMRES).

Area	Group	Current leader	Founded
1	Physical infrastructure	Nemanja Ninkovic	November 2009
5	Network monitoring	Marko Eremija and Andrijana Todosijevic	September 2009
6	Security	Miloš Kukoleča	September 2009
2	Multimedia – VoiP	Andrijana Todosijevic	June 2013
3	User-services working group	Marko Eremija and Andrijana Todosijevic	May 2015

Table A.1: Serbian working groups

A.2 ASNET-AM

The NREN coordinator is Hrachya Astsatryan (ASNET-AM).

Area	Group	Current leader	Founded
3	Networking	Eugene Prokhorenko	June 2015
6	Securing Linux	Arthur Petrosyan	June 2015
4	Wireless	Andranik Hayrapetyan	July 2015
1	Virtualisation	Wahi Narsisian	August 2015

Table A.2: Armenian working groups

A.3 BASNET

The NREN coordinator is Sergei Kozlov (BASNET).

Area	Group	Current leader	Founded
5	Network monitoring	Sergei Kozlov	July 2015

Table A.3: Belarus working groups

A.4 BREN

The NREN coordinator is Radoslav Yoshinov (BREN).

Area	Group	Current leader	Founded
1	Physical infrastructure	Radoslav Yoshinov	2013
5	Network monitoring	Toni Atanasov	2013
6	Security	Prof. Stefan Hadjitodorov	2013
2	Multimedia – VoiP	Philip Ivanov	2013
2	Videoconferencing	Orlin Kouzov	2016

Table A.4: Bulgarian working groups

A.5 CESNET

The NREN coordinator is Jiri Navratil (CESNET).

Area	Group	Current leader	Founded
2	IP telephony	Jan Ruzicka*	Nov 2009
3	IPv6	Martin Pustka	Jan 2010
5	Network monitoring	Tomas Podermanski	Nov 2009

Table A.5: Czech working groups

A.6 CSC/Funet

The AccessFunet working group covers three areas: Virtualisation and Datacentre (1), LAN Infrastructure and IPv6 (3) and Security (6).

The NREN coordinator is Manne Miettinen (CSC).

Area	Group	Current leader	Founded
1,3,6	AccessFunet	Janne Oksanen and Kaisa Haapala	February 2010
4	MobileFunet	Juha Hopia and Tomi Salmi	May 2009

Table A.6: Finnish working groups

A.7 FCT-FCCN

The NREN coordinator is Carlos Friaças (FCT-FCCN).

Area	Group	Current leader	Founded
3	Networking	Carlos Friaças	July 2013

Table A.7: Portuguese working groups

A.8 GRENA

The NREN coordinator is Ramaz Kvatadze (GRENA).

Area	Group	Current leader	Founded
5	Network monitoring	Ramaz Kvatadze and Nino Tsulaia	May 2015
6	Security	Temur Maisuradze and Zurab Modebadze	May 2015

Table A.8: Georgian working groups

A.9 HITSA

The NREN coordinator is Maria Ristkok (HITSA)

Area	Group	Current leader	Founded
3	Campus Networking	Mehis Tuisk	September 2015
4	Wireless	Indrek Rokk	September 2015

Table A.9: Estonian working groups

A.10 MARnet

The groups were organised in an interdisciplinary manner as task groups directly related to the main areas of the proposed BPDs.

The NREN coordinator is Vangel Ajanovski (MARnet).

Area	Group	Current leader	Founded
5,6	Access control and monitoring for campus computer labs	Vangel Ajanovski	May 2013
4,6	Campus wireless infrastructure and security	Anastas Mishev	May 2013
1	Virtualization and cloud campus services infrastructure	Boro Jakimovski	May 2013

Table A.10: Macedonian working groups

A.11 MREN

The NREN coordinator is Vladimir Gazivoda (MREN).

Area	Group	Current leader	Founded
1	Physical infrastructure	Dragiša Krstajić and Vladimir Gazivoda	May 2015
3	Campus networking	Vladimir Gazivoda	June 2013
5	Network monitoring	Milan Čabak	May 2013
6	Security	Milan Čabak and Vladimir Gazivoda	June 2013

Table A.11: Montenegrin working groups

A.12 RENAM

The NREN coordinator is Peter Bogatencov (RENAM).

Area	Group	Current leader	Founded
4	Wireless networks and technologies	Pavel Rosca	May 2015
3	Campus networking	Peter Bogatencov	May 2015
6	Security	Maxim Orbu	May 2015

Table A.12: Moldovian working groups

A.13 RENATER

The NREN coordinator was Vanessa Pierné (RENATER), replaced by Jean-François Guezou (RENATER) in February 2016.

Area	Group	Current leader	Founded
4	Quality of identities repositories	Alain Zamboni	September 2015
6	Building a mutualised anti-spam service	Laurent Aublet Cuvelier	September 2015

Area	Group	Current leader	Founded
2	Videoconference	Sami Honein	September 2015
6	Analyse Forensics	Jean Benoit	September 2015
1	Best practices for the rationalisation, developement on sharing of a datacenter	Didier Pin	March 2014

Table A.13: French working groups

A.14 UNINETT

The NREN coordinator is Magnus Strømdal (UNINETT).

Area	Group	Current leader	Founded
1	Physical infrastructure	Helge Stranden	January 2006
2	Real-time communications (SIP)	Jardar Leira	January 2006
3	Network architecture	Vidar Faltinsen	January 2006
5	Network monitoring	Arne Øslebø	June 2005
4	Mobility	Tom Myren	December 2006
6	Security	Rolf Sture Normann*	June 2008

Table A.14: Norwegian working groups

A.15 URAN

The NREN coordinator is Volodymyr Galagan (URAN).

Area	Group	Current leader	Founded
4	WiFi on Campus	Slava Shkarupin	September 2012
5	Networking Monitoring and Control	Yevhenii Preobrazhenskyi	November 2013
6	Anti-Spam	Collective leadership	June 2014

Table A.15: Ukrainian working groups

Appendix B Abstracts of GN4-1 BPDs

The abstracts below provide a summary of the contents of the 30 BPDs produced during Y1 of GN4-1. Completed BPDs are available on the project web page [GÉANTcbp].

B.1 Cookbook on Setting up Campus Dormitory Wireless and Wired Networks (URAN, RENAM)

This document provides guidelines, in the form of practical steps, leading to the deployment of wired and wireless networks in university student's hostels with subsequent provision of telecommunications services over the network, including access not only to commodity Internet, but also to services provided by the URAN and RENAM Associations to their customers. The approach described allows setting up the infrastructures without funding from the parent universities.

B.2 Virtualisation of Servers using XenServer (MREN)

The BDP describes the virtualisation of servers using the XenServer open source virtualisation platform.

XenServer is the leading open source virtualisation platform. XenServer is an enterprise-class, cloud-proven, virtualisation platform that delivers all of the critical features needed for any server and datacenter virtualisation implementation.

XenCenter provides all the virtual machine management, monitoring and general administration functions in a single interface. Role-based administration improves security by maintaining a tiered access structure with varying levels of permissions. MREN will use XenServer as the main virtualisation platform for the implementation of an Internet Exchange Point (IXP) in Montenegro.

B.3 Nagios Monitoring and SMS-based alerts in the University of Montenegro Network (MREN)

Nagios is a powerful monitoring system that enables organisations to identify and resolve IT infrastructure problems before they affect critical business processes. Designed with scalability and flexibility in mind, Nagios protects the organisation's business processes from unknown outages.

Nagios is a powerful open-source tool that provides instant awareness of an organisation's mission-critical IT infrastructure.

Nagios allows administrators to detect and repair problems and mitigate future issues before they affect end-users and customers. Nagios sends alerts when critical infrastructure components fail and recover, providing administrators with notice of important events. Alerts can be delivered via email, SMS, or a custom script. One of the tasks of the Information System of the University of Montenegro is to monitor overall network and system performance, as well as to monitor peripheral connections.

The BPD covers Nagios monitoring realisation in the academic network of the University of Montenegro, with custom scripts developed for monitoring various services and SMS-based alerts.

B.4 IXP Implementation in the University of Montenegro Network (MREN)

The BPD covers procedures, steps, and benefits for implementing IXP in the academic network of the University of Montenegro.

An Internet exchange point (IX or IXP) is a physical infrastructure through which Internet service providers (ISPs) and Content Delivery Networks (CDNs) exchange Internet traffic between their networks. The primary purpose of an IXP is to allow networks to interconnect directly, via the exchange, rather than through one or more third-party networks. The advantages of direct interconnection are numerous, but the primary reasons are cost, latency, and bandwidth.

B.5 Security Recommendation for an Ubuntu Server-based System (MREN)

This BPD describes the basic and advanced tools that provide security for the Ubuntu server from a variety of attacks and threats from the Internet.

Recommendations for increasing security during the actual installation of the Ubuntu server, as well as recommendations for creating user accounts, are contained in the document. Furthermore, the document will present some of the most important security tools such as: firewall, fail2ban, psad, tripwire. Emphasis is placed on increasing the security of web and mail servers.

B.6 Splunk Log Management (AMRES)

Log messages are automatically documented events in the form of chronological records, containing information about the IT system and network. Managing log messages is of great importance for each NREN and allows efficient and quality analysis of the service functioning and usage, as well as the network as a whole. Furthermore, it provides the possibility of quick and easy search within a large number of generated log messages, troubleshooting and extracting relevant data for later use. Splunk

log management software is a comprehensive tool that allows you to collect and search large amounts of log messages of various types, create dynamic reports and graphical representation of the desired result. The paper discusses and explains the processes of collection and analysis of AMRES eduroam service log messages, and gives examples of Splunk web applications usage in presentation and analysis of service statistics and end-users behaviour.

B.7 Deployment of Syslog monitoring (AMRES)

Although syslog protocol has a simple structure and has been used since the beginning of the 1980's, it is still a very useful protocol that can provide information about network or services problems. The paper covers basics of configuration of syslog daemon and gives recommendation regarding deployment of newer versions of syslog daemons on Linux-based servers. This document provides the examples of simple syslog monitoring in network.

B.8 Integration for Digital Assessment (UNINETT)

A specialised Digital Assessment working group identified key integrations. Data from existing systems should be re-used in the assessment solution.

The BPD identifies six existing systems, defining which system is an authoritative data source, and describes integrations for exchange of data to/from the assessment systems.

The document targets developers, system integrators and technical staff.

B.9 Clients for Digital Assessment (UNINETT)

The working group looked at available client solutions for digital assessment, including the use of "Bring Your Own Device" (BYOD) compared to institution-owned equipment.

The document does not list the various assessment solutions available, but focuses on the requirements and the *pros* and *cons* of client solutions. The BPD targets technical staff with responsibility for planning and hosting digital assessment at university.

B.10 ICT Architecture for Digital Assessment (UNINETT)

This BPD describes a shared ICT architecture for digital examinations, with an emphasis on the requirements of digital written exams, with restrictions of the use of notes or unauthorised aides.

The work was carried out by two working groups (the Digital Workflow Working Group and the ICT Architecture Working Group), composed of participants from Norwegian universities and university colleges as part of the eCampus programme. This BPD is part of a series of reports on digital exams

that also covers the requirements concerning infrastructure, client equipment and a planned integration specification.

This BPD describes the recommended best practice for digital workflows in connection with the holding of exams (electronic management of assessment) in Norwegian higher education. Work processes for digital assessment are described alongside process charts and a table of changes from current practice to a future digitalised process (in Appendix B). A well-functioning ICT architecture depends on the right level of standardisation of processes and information. The BPD describes these conditions and forms a basis for further standardisation work on surrounding areas.

A reference architecture for digital exams is described through process analysis, information architecture, application maps, services and integrations.

B.11 Logging and Monitoring of digital assessment (UNINETT)

While working with digital assessment, UNINETT discovered that the vendors of digital assessment solutions have different approaches to logging and monitoring.

The BPD defines and lists requirements for logging and monitoring, and describes policies for how to carry out logging and monitoring in a consistent way during digital assessment. The document targets management and technical staff with responsibility for planning and hosting digital assessment at the universities.

B.12 Digital assessment – juridical questions (UNINETT)

Several of the digital assessment software solutions are designed to be run as cloud services (private or public cloud). The BPD lists the legal requirements and which steps to follow to successfully use public cloud services for assessment solutions.

This BPD is generic and applies to cloud services for the university in general. The document targets management and security staff with responsibility for services moving to public clouds.

B.13 Guide to configuring eduroam Using Aruba Wireless Controller (UNINETT)

The BPD describes one possible way of configuring eduroam on Aruba wireless controllers and using Aruba ClearPass as a RADIUS server. Configuration of both the wireless controller and ClearPass Policy Manager is shown step-by-step, using screenshots with explanatory text.

B.14 AV infrastructures and services within RCTS

This document provides a view about Audio/Video infrastructures and services within RCTS (Rede Ciência, Tecnologia e Sociedade), the Portuguese Research & Education Network.

The main goal of this document is to provide an updated picture of RCTS' existing A/V infrastructures and services, which were built over the years with the community's cooperation. This document was written also to raise local awareness about what is deployed and also to the benefit of other R&E communities, which may be building the same type of services. This work is essentially a status document, similar to the one published in April 2015 about VoIP Network Status in the Portuguese R&E.

The portfolio of Audio/Video services is diversified, covering content production, collaboration tools and high-end videoconferencing. A peek into the future of Web-based Audio/Video services is also part of this document, on the WebRTC chapter.

B.15 Netfilter-based Firewall System (FCT-FCCN)

Confronted with growing capacity and flexibility needs on the network border system, a firewall security solution was developed at Instituto Politécnico de Lisboa, Portugal, completely based on open source software.

This BPD describes the development, preparation and deployment process of systems currently supporting the border functions, including traffic filtering and IP address translation (NAT). Several used components are analysed in detail, as well as their interaction and their relationship with external systems.

B.16 Implementation of Quasi-SDN Control and Monitoring Systems on Networks with Diverse Equipment (URAN)

This BPD provides an analysis of possible solutions and guidelines, depicted as practical steps, leading to the deployment of a software platform that provides network administrators with an automated monitoring and control tool.

The BPD allows interested readers to implement the proposed solution, with all necessary steps described in detail.

B.17 Service Provisioning to Campus Edge using MPLS BPD (CSC/Funet)

This BPD introduces the MPLS-based network connectivity service portfolio available to campuses in Finland provided over the FUNET backbone network.

The document is intended as a practical guide for end user organisations. MPLS Layer 2 / VPLS and Layer 3 VPN architectures are explained. Use case examples for remote office interconnection and data centre colocation are provided. Feature comparison between pure optical Lightpaths and MPLS-based VPNs within Funet are presented, as well as international connectivity using the GÉANT Multi-Domain VPN service platform.

B.18 Building a Campus Gateway on a Commodity Hardware and Open-Source Software (CESNET)

This BPD describes a way to build a high-speed BGP router using commodity hardware with Linux and Bird routing demon. Previous efforts did not find wide acceptance because the performance of available server hardware could not match the routing speeds of specialised hardware routers. This is no longer the case.

B.19 Providing high network availability at data centres (CESNET)

This BPD focuses on and describes computer IP network design and technology in the area of data centres, which helps to ensure the increased availability of virtualised systems.

The massive virtualisation, technical development of data centres and the growing functions and demands on centralised IT services are accompanied by growth in the importance of technicians ensuring the stability and availability of network services provided. The increased availability of services operated at data centres requires redundancy, ideally on each infrastructure layer of the data centre.

B.20 Authentication and Authorisation of External Users in the Campus Network (EENet/HITSA)

Universities have a lot of user accounts and various duplicated systems to hold their data: study systems, educational environments, libraries, shared folders, mailboxes and wireless connectivity. It can be complicated to handle the data of visiting lecturers, guests, current students or alumni in these systems on an efficient and sustainable basis. Universities often issue reusable accounts with evergreen credentials or make available networks and systems to non-authenticated users.

The BPD outlines an optimal set of user management requirements and best practices which enable a safe network experience for both users and service providers without adding extra overhead on IT-services. The BPD can be used as a basis for creating in-house network policies or be enforced as one without further changes. In brief, the document ratifies that university networks should not be anonymously accessible and evergreen accounts are not acceptable in sense of cyber security of today. The document also creates a common set of rules for handing out user accounts and managing user credentials for both larger and smaller organisations on the same principles.

B.21 Cloud Implementation using OpenNebula (MARNET)

This BPD discusses how to create a private cloud with an open solution and technology.

OpenNebula provides a simple and flexible solution for the management of a virtualised data centre. Both private cloud and hybrid cloud scenarios are supported – starting with a virtualisation tool to manage the local virtual infrastructure, to a combined local infrastructure with a public cloud-based infrastructure. OpenNebula supports public clouds by providing cloud interfaces to expose its functionality. OpenNebula is recommended because it is free and simple to use (compared to the well-regarded alternatives OpenStack and VMware). OpenNebula is introduced as a cloud management solution for applications relevant to the higher-education (HE) sector. The proposed architecture for HE is further discussed, with descriptions of the front-node, server-nodes and storage-nodes.

B.22 Monitoring Activities at Campus Computer Labs (MARnet)

Computer-based teaching laboratories at the universities in Macedonia are used in three general situations: practical demonstrations of various technologies as part of the teaching process, individual work by students on their assignments, and as an environment for conducting exams of many different types.

Administrators, teachers and students are different stakeholders in this processes, requiring various levels of access and monitoring as a way of checking the status of each process in real-time and retrospectively. Work is evaluated largely on the monitoring of relevant activities going on within the classrooms. The BPD discusses the processes, stakeholder requirements, and some possible solutions with details of the environment, proposed system, network architecture and various software tools to facilitate easier monitoring by the different stakeholders.

B.23 Profile and Role-based Firewall Control for Campus Classrooms Labs (MARnet)

Computer-based teaching laboratories at the universities in Macedonia are used in three general situations: practical demonstrations of various technologies as part of the teaching process, individual work by students on their assignments, projects, and as an environment for conducting exams of many

different types. Depending on the special use-cases for each situation, different access permissions are required, different network setups are required, access to online resources should be permitted/denied. In most situations teachers should be able to perform this, without detailed network administration knowledge or direct access to equipment. This BPD presents the design and development of such a system, together with the tools that enable and ease the implementation of such process.

B.24 Automated Workstation Deployment (MARnet)

The main topics of this BPD are workstation deployment operations based on generalised Windows-based images. Several longstanding practices with imaging solutions are compared and discussed against recent developments of FOG (the Free Open source Ghost project – https://fogproject.org) computer cloning and management suite. Various problems when imaging Windows 10 and legacy Windows 7 workstation installations are presented, with possible solutions. The latest FOG releases made significant changes in the infrastructure of the overall system, which may lead to significant performance issues and need to be addressed. The concluding recommendation is to continue with the use of the current FOG release until the new version has sufficiently matured.

B.25 Recommendations for Network Traffic Analysis Using the NetFlow Protocol (AMRES)

The BPD presents the procedures used for network traffic analysis, which provide a clear overview of the structure of traffic and enable the efficient detection of potential problems and irregularities.

The document reviews the technologies applied in network traffic analysis before presenting detailed recommendations for traffic analysis based on statistics obtained through the NetFlow protocol. Examples are given of the correct configuration of the NetFlow protocol on network devices, as well as examples of the indirect implementation of the NetFlow protocol in situations where network devices do not support it. The document also includes an overview of the implementation of the NetVizura NetFlow Analyzer system for analysing NetFlow statistics, which is used as a Network Management System in the Academic Network of Serbia and in other NRENs.

B.26 Best practices for the rationalisation development on sharing of a datacenter (RENATER)

The BPD focuses on the development and sharing of a data center. The purely technical aspects of the technological choices were described in a previously published BPD "Environmentally responsible datacentre", so they are not repeated in this document. The main strategic issues addressed are: Is a data center needed? Should it replace the means already in place? To outsource or conversely mutualise?

These choices obviously have an impact on the research results or the quality of an information system. The document is not written to prescribe choices but to enlighten the reader about the consequences. The BPD discusses the various points that should be considered before making decisions.

B.27 Videoconference (RENATER)

The BPD describes how an NREN or service provider can deploy a multi-protocol videoconferencing service environment that offers an easy-to-use experience to the end-users.

The document shows all the needed elements of the platform to support multi-protocol access and support access from a wide range of devices like videoconference rooms, desktops, tablets or phones. The dimensioning of the technical infrastructure to support the large number of simultaneous connections required is analysed and the integration of several Multipoint Control Units (MCUs) is addressed.

Dedicated to end-users, the service must provide a booking web portal. The document explains how to integrate it on the platform. The document does not describe the implementation by the end user (videoconference room, end-point etc.), but, because of its popularity, web conferencing is discussed at the end of the document.

B.28 Quality of identities repositories (RENATER)

Educational institutions have a range of users (student, staff, researcher, lecturer, alumni, guests) managed by as many applications. Most of the time these applications provide identities to the directory that holds the accounts of the users.

The BPD explains the importance of the quality of the identity stored in the directory, especially in an identity federation context; it then describes what are the traps and how to tackle the issues. A template for a self-evaluation framework is added to help the institution assess the potential gap between practices and the best practice, and to plan the roadmap to improve their management of identities policies and practices.

B.29 Building a mutualised antispam service (RENATER)

Spam mitigation is a question of statistics. The larger the sources, the higher is the quality of your filtering. It is therefore a good option to build a national antispam service and not only to share the hardware and the software but also the knowledge. This service should offer a shared platform that integrates all the most recent technologies to reject spams, viruses, phishing, and all undesirable emails.

Implemented by an NREN, this platform can wash the email flow from the entrance of the network backbone, limiting the risks. The BPD describes the requirements and the features of a strong and resilient national infrastructure, the different elements and customised filters that can be added and

their associated advantages and inconveniencies. It also explains how to manage the protection level to minimise the risk of losing legitimate emails.

B.30 Forensics analysis (RENATER)

When a security team (a CSIRT/CERT for example) has to respond to a serious security incident, it needs as much information as possible about the nature of incident, the attack vector, and the impact on the affected system, etc. The information has to be both correct and trustworthy to take a serious decision.

Digital forensic analysis is focused on examining the digital systems and acquiring information in a trustworthy way so that security teams can use its results for incident response.

The BPD shows how forensic analysis provides useful information on how to react thoroughly and properly when a security incident occurs. The guidelines are intended to help both technical people that will be doing the analysis (like established CERT, security team or an IT team member), and potential victims. The document helps the reader from first response up to filing a complaint.

Appendix C Conference Presentations

A total of 66 presentations of CBP were given at international and national conferences during the GN4-1 project; these are listed individually in Table C.1.

No.	Date	Event	Presentation	Speaker
1	4 May 2015	GN4-1 Campus Best Practice Kick off Meeting, Prague, Czech Republic	RENAM network and services	Peter Bogatencov
2	4 May 2015	GN4 NA3 T2 Best Campus Practices Kickoff Meeting	Academic Scientific Research Computer Network of Armenia: ASNET-AM	Hrachya Astsatryan (ASNET-AM)
3	4–5 May 2015	GN4-1 NA3 T2 Best Campus Practices Kickoff Meeting Prague, Czech Republic	Georgian Research and Educational Networking Association – GRENA	Ramaz Kvatadze (GRENA)
4	20 May 2015	9th RENAM Users' Conference	Development strategy of RENAM – the operator of the National Infrastructure for Research and Education	Peter Bogatencov, Grigore Secrieru
5	20 May 2015	9th RENAM Users' Conference	IdM Federation deployment in Moldova	Valentin Pocotilenco
6	20 May 2015	9th RENAM Users' Conference	Developing of common computational infrastructure for providing unified services for the scientific-educational community in Moldova	Nicolai Iliuha

No.	Date	Event	Presentation	Speaker
7	20 May 2015	9th RENAM Users' Conference	Deployment of Scientific Cloud Computing infrastructure in Moldova	Peter Bogatencov, Nichita Degteariov
8	20 May 2015	9th RENAM Users' Conference	Some Aspects of RENAM 10G Optical Backbone Development	Pavel Rosca
9	21 May 2015	The 5th International Conference "Telecommunications, Electronics and Informatics", Chişinău, UTM, 2015	Identity Federation Service Implementation in Moldova	Peter Bogatencov, Valentin Pocotilenco
10	28–29 May 2015	ERIS 2015 Education and Research in Information Society, Plovdiv, Bulgaria	A model for assessment of professional competence in physical therapy students	Radoslav Yoshinov (BREN)
11	2 June 2015	NATO Meeting Security Challenges Through Data Analytics and Decision Support, Aghveran, Armenia	Security Issues of the e-Infrastructure for Environmental Research	Hrachya Astsatryan (ASNET-AM)
12	3–5 June 2015	European Commission MathGeAr project workshop http://www.mathgear.eu/meetings, Batumi, Georgia	e-Infrastructures for research and education in Georgia	Ramaz Kvatadze (GRENA)
13	15 June 2015	RDA Europe Workshop on "Engagement in RDA from Southern-Eastern Europe, Mediterranean and Caucasus region", Athens, Greece	RDA Activities in Armenia	Hrachya Astsatryan (ASNET-AM)

No.	Date	Event	Presentation	Speaker
14	1 September 2015	European Commission MathGeAr project workshop http://www.mathgear.eu/meetings, Kutaisi, Georgia	e-Infrastructures for research and education in Armenia	Hrachya Astsatryan (ASNET-AM)
15	11 September 2015	Horizon 2020 Eastern Partnership (EaP) Information Day Research & Innovation in e-Infrastructures, 10-11 September 2015, Ivane Javakhishvili Tbilisi State University, Tbilisi, Georgia	Status of e-Infrastructure and services in Eastern Partnership countries	Peter Bogatencov
16	15 September 2015	QONYAon Final Conference, Konya, Turkey	Best Practices and Quality Assurance in LMS	Radoslav Yoshinov (BREN)
17	15 September 2015	QONYAon Final Conference, Konya, Turkey	The e-facilitator as key player for e-Inclusion	Radoslav Yoshinov (BREN)
18	15 September 2015	QONYAon Final Conference, Konya, Turkey	European Research an Education Infrastructures. GEANT Services	Roumen Trifonov (BREN)
19	16 September 2015	NTW2015	Server room environment and power monitoring at UNINETT	Morten Brekkevold (UNINETT)
	16 September 2015	NTW2015	Low cost WiFi monitoring probes	Arne Øslebø (UNINETT)
20	16 September 2015	NTW2015	Current Best Practices for digital assessment	Magnus Strømdal (UNINETT)

No.	Date	Event	Presentation	Speaker
21	16 September 2015	NTW2015	Large scale intrusion detection infrastructure	Arne Øslebø (UNINETT)
22	16 September 2015	NTW2015	WiFi for guest solutions	Tom Myren (UNINETT)
23	16 September 2015	NTW2015	eduroam service certificate practices	Tomi Salmi (CSC/Funet)
24	24 September 2015	NER 2015, Craiova, Romania	New Technologies Implementation in RENAM National Backbone	Grigore Secrieru
25	24 September 2015	NER 2015, Craiova, Romania	Integrated Scientific Computing infrastructure in Moldova	Peter Bogatencov (RENAM)
26	24–26 September 2015	ETAI 2015, XII International Conference on Electronics, Telecommunications, Automation and Informatics, Ohrid, Macedonia	Specifications for Centralized DataCenter serving the educational cloud for Bulgaria	Radoslav Yoshinov (BREN)
27	24–26 September 2015	ETAI 2015, XII International Conference on Electronics, Telecommunications, Automation and Informatics, Ohrid, Macedonia	The e-facilitators in School	Radoslav Yoshinov (BREN)
28	25 September 2015	NER 2015, Craiova, Romania	EaP Connect project: Regional Networking Infrastructure for Providing Modern Services for Research and Education	Peter Bogatencov (RENAM)

No.	Date	Event	Presentation	Speaker
29	28 September 2015	CSIT 2015, Yerevan, Armenia: Training "Green ICT for National Research and Educational Networks"	Green ICT in ASNET-AM	Hrachya Astsatryan (ASNET-AM)
30	28 September – 2 October 2015	XXV Symposium on Nuclear Electronics and Computing – NEC 2015 http://indico-new.jinr.ru/conferenceDisplay.py?confId=60, Budva, Montenegro	Network and Computing Infrastructure for Scientific Application in Georgia	Zurab Modebadze (GRENA)
31	30 September 2015	CSIT 2015: Round Table "Establishment of a National Supercomputer Center of Armenia"	Establishment of a National Supercomputer Center of Armenia	Hrachya Astsatryan (ASNET-AM)
32	30 September 2015	CSIT 2015, Yerevan, Armenia: Round Table "Establishment of a National Supercomputer Center of Armenia"	E-Infrastructure in Armenia: Status and Perspective	Vladimir Sahakyan (ASNET-AM)
33	5 October 2015	International Symposium on Astronomical Surveys and Big Data, Byurakan, Armenia	Armenian Virtual Observatory: Services and Data Sharing	Aram Knyazyan (ASNET-AM)
34	October 2015	CBP Technology workshop, Plovdiv, Bulgaria	Recommended Security systems for Wireless networks	Jean Benoit (RENATER/Strasbourg University)
35	October 2015	CBP Technology workshop, Plovdiv, Bulgaria	User account management and authentication	Jean Benoit (RENATER/Strasbourg University)

No.	Date	Event	Presentation	Speaker
36	October 2015	CBP Technology workshop, Plovdiv, Bulgaria	WiFi access network infrastructure	Jean Benoit (RENATER/Strasbourg University)
37	October 2015	CBP Technology workshop, Plovdiv, Bulgaria	Protecting campus vulnerable assets	Jean Benoit (RENATER/Strasbourg University)
38	October 2015	CBP Technology workshop, Plovdiv, Bulgaria	Strasbourg CERT organisation and activities	Jean Benoit (RENATER/Strasbourg University)
39	October 2015	CBP Technology workshop, Plovdiv, Bulgaria	Working together – eduroam use cases	Juha Hopia (CSC/Funet)
40	October 2015	CBP Technology workshop, Plovdiv, Bulgaria	Video services from A to Z by NORDUnet	Vesa Savolainen (CSC/Funet)
41	October 2015	CBP Technology workshop Plovdiv, Bulgaria	Introduction to eduroam	Marko Eremija (AMRES)
42	October 2015	CBP Technology workshop Plovdiv, Bulgaria	Monitoring of RADIUS infrastructure	Marko Eremija (AMRES)
43	October 2015	CBP Technology workshop Plovdiv, Bulgaria	SimpleSAMLphp Identity Provider Configuration	Nebojsa Ilic (AMRES)
44	October 2015	CBP Technology workshop Plovdiv, Bulgaria	AMRES CERT activities	Milos Kukoleca (AMRES)
45	30 October 2015	Union of Automatics and Informatics, Invited Lecture, Sofia, Bulgaria	BREN Network Infrastructure Serving the Educational Cloud of Bulgaria	Radoslav Yoshinov (BREN)

No.	Date	Event	Presentation	Speaker
46	11 November 2015	GÉANT DDoS Mitigation in the NREN Environment Workshop, 10 & 11 November 2015 in Vienna	DDOS protection solutions in private, governmental and research and educational Networks	Alexandr Golubev (RENAM)
47	8 December 2015	MikroTik User Meeting, Kiev, Ukraine	Massive deployment of Mikrotik Router boards for wireless/cable service provision in a very noisy environment http://mum.mikrotik.com/presentations/UA15/presentation_3063_1449654544.pdf	Slava Shkarupin (URAN)
48	15 December 2015	Nordic WiFi community meeting [NOW15]	Wlan monitoring and controlling probes (RaspPi)	Arne Øslebø (UNINETT)
49	December 2015	JRES, French National Conference, Montpellier, France	Constitution of an Identity Repository (Campus Best Practice 2014)	Alain Zamboni
50	December 2015	JRES, French National Conference, Montpellier, France	Operating a Mailing List Service: Best Practices	David Verdin – Laurence Moindrot – Jose Martins Da Cruz – Dominique Lalot – Luc Veillon
51	December 2015	JRES, French National Conference, Montpellier, France	Campus Best Practice	Vanessa Pierné Jean-François Guezou (RENATER)
52	9 February 2016	National supervisory board meeting of Belarusian NREN BASNET	NREN BASNET progress report for year 2015	Sergei Kozlov (BASNET)
53	13 February 2016	Dynamic Mathematics, Invited Lecture, Sofia, Bulgaria	Information Society 2015 and Beyond. The Pillars of Education	Radoslav Yoshinov (BREN)

No.	Date	Event	Presentation	Speaker
54	March 2016	GÉANT Symposium, Vienna, Austria	Netfilter-based Firewall System	Carlos Friaças (FCT-FCCN)
55	March 2016	GÉANT Symposium, Vienna, Austria	Mitigating DDoS attacks – AMRES experience	Milos Kukoleca (AMRES)
56	March 2016	GÉANT Symposium, Vienna, Austria	Providing MPLS services to campus edge	Jani Myyry (CSC/Funet)
57	March 2016	GÉANT Symposium, Vienna, Austria	SIG – Campus Best Practices	Jari Miettinen (CSC/Funet)
58	April 2016	CBP Campus network monitoring and security workshop, Prague, Czech Republic	Campus Best Practice: Forensics Analysis and incident handling	Jean Benoit (RENATER/Strasbourg University)
59	April 2016	CBP Campus network monitoring and security workshop, Prague, Czech Republic	Monitoring of RADIUS infrastructure	Marko Eremija (AMRES)
60	April 2016	CBP Campus network monitoring and security workshop, Prague, Czech Republic	Securing Linux servers	Milos Kukoleca (AMRES)
61	5 April 2016	Association of Information Technologies. Invited Lecture, Sofia, Bulgaria	BREN Network Infrastructure, Serving the Educational Cloud	Radoslav Yoshinov (BREN)
62	8 April 2016	TF-MSP/SIG-MSP Meeting in Ljubljana Slovenia	Campus Best Practice – Future, Training ideas in the context of a new SIG	Jari Miettinen (CSC/Funet)
63	15 April 2016	HITSA national conference	Authentication and Authorisation of users in the campus network	Mehis Tuisk (EENet)

No.	Date	Event	Presentation	Speaker
64	25 April.2016	CNMS2016	The challenges of deploying and operating a large scale distributed IDS in an academic network	Arne Øslebø (UNINETT)
65	25 April 2016	CNMS2016	Low cost WiFi monitoring probes	Arne Øslebø (UNINETT)
66	25 April 2016	CNMS2016	Low cost WiFi monitoring probes	Arne Øslebø (UNINETT)

Table C.1: Conference presentations of CBP in GN4-1

Appendix D Agendas for International-level Workshops and Training Events

NA3 T2 organised four European-level expert events in GN4-1. This appendix shows the presentation programme of each workshop.

D.1 Wireless Session in the NORDUnet Technical Workshop 2015

Held in Copenhagen, Denmark, 15–17 September 2015.

Presentation: Day 3	Presenter
Wireless	Chair: Tom Myren (UNINETT)
Experiences with Cisco IOS controller	Petter Bjørbæk (UiO), Vidar Stokke (NTNU)
AirOS vs IOS development	Georg Michelet, Carlo Terminiello (Cisco)
eduroam server certificate a Best Practice Document	Tomi Salmi (CSC/FUNET)
WaaS – service description and technical solution	Frans Panken (SURFnet)
WiFiMon tool – what is it and results achieved	Brian Bach Mortensen (NORDUnet)
Very High Density 802.11ac Design and Deployment Basics	Fredrik Andersen, Ben van Zeggelaar (Aruba Networks, Inc.)

Table D.1: Wireless Session in the NORDUnet Technical Workshop 2015.

D.2 Campus Networking and Security workshop

Held in Plovdiv, Bulgaria, 26–28 October 2015.

Presentation: Day 1	Presenter
Opening and Welcome	Radoslav Yoshinov (BREN)
Workshop introduction	Jari Miettinen (FUNET/CSC)
GÉANT Services	Chair: Andrijana Todosijevic (AMRES)
Introduction to eduroam	Marko Eremija (AMRES)
Monitoring of RADIUS infrastructure	Marko Eremija (AMRES)
SimpleSAMLphp Identity Provider Configuration	Nebojsa Ilic (AMRES)
Federating Any on-premise established identity management system with Office 365 cloud services	Vasko Sazdovski (MARnet)
WIFI in Campus	Chair: Janne Oksanen (CSC/FUNET)
WLAN network planning and setup	Juha Hopia (CSC/FUNET)
Recommended Security systems for Wireless networks	Jean Benoit (Strasbourg University)
WiFi access network infrastructure	Jean Benoit (Strasbourg University)
Social event by BREN	

Presentation: Day 2	Presenter
Users Identification and Management	Chair: Michał Przybylski
User account management and authentication	Jean Benoit (Strasbourg University)
Centralised authentication of users in Sweden – eduID – discuss the software project, its components, underlying assumptions	Hans Nordlof (SUNET)
Case Study – access to higher education sector via eduID	Hans Nordlof (SUNET)
Video services from A to Z by NORDUNET	Chair: Jari Miettinen (FUNET/CSC)
Introduction to the video services	Vesa Savolainen (FUNET/CSC)
Implementing video services:	Vesa Savolainen, Jari Miettinen (FUNET/CSC)
Developing future tools	Vesa Savolainen, Jari Miettinen (FUNET/CSC)

Cyber security	Chair: Michał Przybylski
Protecting campus: vulnerable assets	Jean Benoit (Strasbourg University)
Cyber Security in Cloud Networks	Volker Lempert, Dudi Gladshstein (ECITele)
Cyber security strategy for Bulgaria (BREN)	Radoslav Yoshinov (BREN)

Presentation: Day 3	**Presenter**
CERT activities	Chair: Radoslav Yoshinov (BREN)
Amres CERT activities	Milos Kukoleca (AMRES)
Strasbourg CERT organisation and activities	Jean Benoit (Strasbourg University)
CERT Bulgaria activities	Biserka Radeva, (CERT Bulgaria)
Round table on Bulgaria's service strategy	Chair: Radoslav Yoshinov (BREN)
Round table	Radoslav Yoshinov (BREN)
Wrap-up and recommendations	Radoslav Yoshinov (BREN)
Farewell	Radoslav Yoshinov (BREN)

Table D.2: Campus networking and security workshop agenda.

D.3 Thunder in the Campus (Lightning talks), GN4-1 Symposium

Held in Vienna, Austria on 9 March 2016.

Presentation	Presenter
Thunder in the Campus	Chairs: Jiri Navratil (CESNET), Andrijana Todosijevic (AMRES)
Digital assessment, an overview	Magnus Stromdal (UNINETT)
DDoS attack mitigation/DDoS attack challenges	Miloš Kukolèca (AMRES)
Practical experience with DDoS at the campus network	T.Podermanski (CESNET)
Providing MPLS services to campus edge	Jani Myyry (CSC/Funet)
Netfilter-based Firewall System	Carlos Friacas (FCT/FCCN)
Building Campus border router on the open-source software and commodity hardware	T. Kislinger (CESNET/BUT)
Advanced processing of NetFlow data using libnf library	M. Gregr (CESNET)
CMon – multi-domain monitoring for AWS (Alien Wavelength Service) and GTS (GÉANT Testbed Service)	Trupti Kulkarni (GÉANT)
Ad hoc infrastructure for digital assessment	Magnus Stromdal (UNINETT)
CBP Academy	Michał Przybylski (CEENET)
SIG – Campus Best Practices	Jari Miettinen (CSC/Funet)

Table D.3: Thunder in the Campus session agenda

D.4 Campus Network Monitoring and Security workshop, CNMS2016

Held in Prague, Czech Republic during 25–26 April 2016.

Presentation: Day 1	Presenter
Methods and Concepts	
The challenges of deploying and operating a large scale distributed IDS in an academic network	Arne Oslebo (UNINETT)
Collecting and processing of data from security tools in CESNET	Andrea Kropáčová (CESNET)
Monitoring security incidents versus Privacy Rights	Laban Mwansa, Jorge Carrillo (Cape Peninsula University of Technology)
Tools, applications and experiences	
Reputation Shield	Václav Bartoš (CESNET)
Securing Linux servers	Miloš Kukoleča (AMRES)
Cybersecuriy Training with Cyber Range	Koji Okamura (Kyushu University)
Integration of custom built services (firewall, monitoring, software deployment) in the FCSE network – practical example how to integrate three custom solution into a complex and distributed network in FCSE	Vladislav Bidikov (St.Cyril and Methodius University Skopje)
Traffic Analysis, Reporting of Anomalies or Incidents	
Forensics Analysis and incident handling	Jean Benoit (Strasburg University), Aleš Padrta (West Bohemia University)
Case study: Network Behavior Analysis as a Service at GÉANT – project NSHaR	Artur Kane (Flowmon evangelist)
Monitoring of RADIUS infrastructure	Marko Eremija (AMRES)
Low cost WiFi monitoring probes	Arne Oslebo (UNINETT)
Monitoring on new generation of networks	
Basic L2, L3 Security at the Campus Network	Matěj Grégr (FIT/BUT Brno)
Tutorial to Build Own Application for Processing nfdump Data	Tomas Podermanski (BUT Brno)
Building Open High-Speed Aggregation Router	Pavel Kislinger (CVIS/BUT Brno)
Monitoring at 100 Gbps, outlooks for 400 Gbps	Viktor Puš (CESNET)

Summary of the first day with discussions	Jiri Navratil (CESNET)

Presentation: Day 2 **(Practical course: Tools for Security Analysis for Traffic on L7)**	**Presenter**
Introductory lessons and hands-on tutorial on flow-based detection of current threats	Hands-on tutorial
Practical analysis of real traffic traces to find DDoS and other attacks	Practical session
Creating your own flow data analyser	Extending NEMEA with new analysis modules

Table D.4: Campus network monitoring and security workshop agenda

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[CESNETIPv6]	IPv6 in the CESNET2 network http://www.cesnet.cz/services/ip-connectivity-ip/ipv6/?lang=en
[CESNETIPv6WS]	Information about IPv6 (in Czech) https://www.ipv6.cz/Hlavn%C3%AD_strana
[CESNETWS2016]	CNMS 2016, Campus network monitoring and security workshop https://www.cesnet.cz/cesnet/events/cnms2016/?lang=en
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[CGN_PG3]	T. Podermanski and M. Grégr, Implementing CGN: Law Requirements, Alternatives and IPv6; Root.CZ article 29 June 2015 (in Czech) http://www.root.cz/clanky/implementujeme-cgn-zakon-alternativy-a-ipv6/
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[CONNECT]	GÉANT CONNECT Magazine http://www.geant.net/MediaCentreEvents/CONNECT/Pages/default.aspx
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[NOW15] Nordic WiFi community meeting December 15 2015 https://events.nordu.net/display/NOWI15/Welcome

[NTW2015] NORDUnet Technical Workshop 2015 https://events.nordu.net/display/NTW2015/Welcome

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Glossary

AMRES	Serbian NREN
ASNET-AM	Armenian NREN
AV	Audio Visual
AWS	Alien Wavelength Service
BASNET	Belarus NREN
BPD	Best Practice Document
BREN	Bulgarian NREN
BYOD	Bring Your Own Device
CBP	Campus Best Practice
CDN	Content Delivery Network
CEENET	Central and East European Networking Association
CERT	Computer Emergency Response Team
CESNET	Czech NREN
Cmon	Muti-domain Circuit Monitoring system
CNMS 2016	Campus Network Monitoring and Security Workshop (CESNET), 25–26 April 2016
CSC	Scientific Computing Ltd, base organisation of Finnish NREN FUNET
CSIRT	Computer Security Incident Response Team
DC	Datacenter
DDoS	Distributed Denial of Service
EENet	Estonian NREN
EUNIS	European University Information Systems Organisation
FCT	Fundação para a Ciência e a Tecnologia, the base organisation of Portuguese NREN FCCN
FUNET	Finnish University and Research Network, Finnish NREN
GRENA	Georgian Research and Education Networking Association, the Georgian NREN
HITSA	The Estonian Information Technology Foundation for Education, the base organisation of the Estonian NREN EENet
ICT	Information and Communications Technology
IDS	Intrusion Detection System
IPv6	Internet Protocol version 6, RFC2460
ISP	Internet Service Provider
IXP	Internet Exchange Point
JRES	Journées Réseaux, French National Conference
MARnet	Macedonian NREN
MCU	Multipoint Control Unit
MPLS	Multi-Protocol Label Swiching, RFC3031

MREN	Montenegro NREN
NA3 T2	NA3 Task 2, Campus Best Practice
NA3	GN4-1 Networking Activity 3, Status and Trends
NAT	Network Address Translation, RFC1631
NER2015	14th RoEduNet International Conference: Networking in Education and Research, 24–25 September 2015, Craiova, Romania.
NOC	Network Operations Centre
NORDUnet	NORDUnet A/S, collaboration between the Nordic NRENs
NREN	National Research and Education Network organisation
NTW2015	NORDUnet Technical Workshop 2015
RADIUS	Remote Authentication Dial-In User Service, RFC2865
RCTS	The Portuguese NREN backbone network
RENAM	Moldovan NREN
RENATER	French NREN
SAML	Security Assertion Markup Language
SDN	Software Defined Network
SIG	Special Interest Group
SIP	Session Initiation Protocol
SMS	Short Message Service of mobile telephony
TNC	The Networking Conference, former TERENA Networking Conference
UIIP NASB	United Institute of Informatics Problems, a state scientific organisation in Belarus
UNINETT	Norwegian NREN
URAN	Ukraine NREN
VoIP	Voice over IP
VPN	Virtual Private Network
WaaS	Wavelength as a Service
WebRTC	Web Real-Time Communication over the Web
WiFi	Wireless Fidelity – a local area wireless computer networking technology
WLAN	Wireless Local Area Network