

# AMRES Experience with Implementing the “Campus Best Practices” Model

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**Abstract**— This paper summarizes the experience and results that are achieved in the GÉANT “Campus Best Practices” (GN3 NA3/T4) task from the point of view of National Research and Education Network of Serbia, i.e. AMRES. Four NRENs are contributing: UNINETT (Norway), CSC/Funet (Finland), CESNET (the Czech Republic) and AMRES (Serbia). Of these, Serbia is the only one which is faced with solving the problem of poor technological development, the so-called the digital divide problem. NRENs, faced with the digital divide problem, give undivided attention and overall budget for improvement of backbone infrastructure and services, or external NREN connections. Insufficient attention has been focused on understanding and mitigating the problems of discontinuity in the quality of infrastructure, services and expertise of staff, which generally exists between the NREN backbone and campus network. The GÉANT “Campus Best Practices” task examines working model as one possible solution of the problem. The work is aimed at increasing cooperation between NREN’s member institutions in order to arrive at common technical solutions and recommendations for campuses. A description of experiences recently gained at AMRES, during the implementation of the adopted model, could be beneficial to NRENs operating in similar conditions as AMRES.

**Keywords**—best practices; campus network; IT staff collaboration; digital divide

## NOTATIONS

The terms used throughout this paper are defined as follows:

**NRENs** is used to denote *National Research and Education Network* organizations as well as the national networks provided by them.

**Campus network** is used for the local network infrastructure of all organizations served by NRENs and other research and education institutions, regardless of the type of institution or network.

**Working group** is used for the open forums for collaboration between network engineers at campus level, as well as their collaboration with NREN organizations.

**BPD (Best practice document)** is summary document prepared in working group according to experience of participants, and discussion about their lesson learned on some subject. Subjects of BPDs are mainly from technical areas. IT

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community should agree upon summarized recommendation as the valuable for future.

## I. INTRODUCTION

According to current practice, in most countries the NREN is responsible for the development and provision of network services up to campus boundaries. A small number of NRENs are able to take on responsibility for the local network infrastructure within their universities, institutes or even smaller educational and research institutions. The institutions themselves are primarily expected to take on responsibility for this segment and to be responsible for their own development. However, practice shows that when left to themselves, not all institutions have the same level of success. They are often unable to keep up with the pace at which the NREN advances. Smaller institutions in particular are affected. They are not always able to provide the necessary resources and/or fulfill the conditions set for some services.

On the other hand, the NREN and individual campus networks have the same end-users. Users expect a quality service at their working location, thus within the campus. In order that end-users are satisfied with the number of services offered and their quality, in the NREN uniform quality of the network infrastructure and support must be achieved in end-institutions like on the backbone. Since the development of infrastructure and services on the backbone and on campuses falls under different areas of responsibility, the question that is posed is whether there is a methodology, model or measures whose application can lead to the desired goal – the harmonised development of these network segments.

An extensive study, as part of the predecessor GÉANT project, was carried out during 2006 and 2007. One of its parts, the “EARNEST Report on Campus Issues” [1], was dedicated to analysing the state in the campus networks of universities around Europe. The study is accompanied by 52 recommendations which should encourage the development of campuses in the NRENs which apply these recommendations. The recommendations state what should be done, but they do not always say how to achieve that (such document do not go into implementation).

In the same time period, looking for a way to provide support and standardise the development of university and college campuses around Norway, the Norwegian NREN, with

the assistance of the relevant ministry, launched the GigaCampus project (2006-2009). Their work was aimed at increasing cooperation between institutions in order to arrive at common technical solutions and recommendations for campuses. The inclusion of institutions in this process was based on attracting the technical staff employed in them and encouraging cooperation through work in working groups for individual areas. This created a circle of experienced people from the ICT sector who could transfer their experiences to the entire academic community in the form of best-practice national documents, which served as a basis for other activities and the implementation of the goals of the project.

UNINETT is having measurable success in its campuses through this approach. Since the steps which UNINETT is taking are in line with the EARNEST recommendations, and that it highlights one of the possible ways to implement them, the question which arises is whether the Norwegian experience can be applied in other countries. The methods which UNINETT is using in its work at national level served as a basis for defining activity in the task (GN3 NA3/T4) of the GÉANT project in order that other similar activities are launched in other countries. Besides Norway's UNINETT, another three countries are involved in the initial phase: Finland (CSC/Funet), Czech Republic (CESNET) and Serbia (AMRES). Of these, Serbia is the only one which is faced with solving the problem of poor technological development (the so-called digital divide problem). A description of experiences recently gained at AMRES, during the implementation of the adopted model, could be of benefit to NRENs operating in similar conditions to AMRES.

The rest of this paper is organised as follows: Chapter 2 describes in detail the working model of Campus Best Practice (CBP) activity, Chapter 3 is about the conditions in which the model is applied at AMRES and Chapter 4 is about the experiences gained during the two years of implementing the model at AMRES. The paper ends with conclusions.

## II. CHOSEN MODEL IN GÉANT TASK NA3/T4

The Campus Best Practices model shown in Fig. 1 has been created to explain the procedure through which the NREN approaches the end goal in steps. This goal is the establishment of practices for the continual improvement of campuses, primary services and the level of knowledge and expertise of the engineers/technical staff who develop and/or maintain the networks in them. It starts with ideas on cooperation between these staff, as well as key ideas for achieving the goal. Knowledge and experience sharing between technical staff is encouraged and different forms of cooperation are found and included. New activities are gradually introduced, and they are based on the results of previous steps.

All the activities are divided into six groups so that the entire model comprises six steps, from the first simple steps to the most difficult in terms of the involvement of resources (people and money). The implementation of the first three steps can be begun with a relatively modest budget. In order to move forward to the later steps, more and more financial support is required. Bearing in mind the available budget, GÉANT has adopted a basic working model comprised of the first three

steps. Although the benefits of implementing the basic model are visible, it is useful to view these steps as an introduction to the next, and be aware of the advantages of expanding activity. The steps in Fig. 1 are:

1) *Organise workshops to share experiences.* This is the initial step and a way to facilitate discussion on topics and to present various solutions from the chosen technical areas. The technical areas which are dealt with in GÉANT are physical infrastructure, campus networking (redundancy, IPv6), mobility, security, network monitoring and real-time communications (video, VoIP).

2) *The next step is setting up working groups,* i.e. gathering the inner circle of technical personnel at open forums for cooperation based on their interest for a specific area. Each group is dedicated to one technical area, in which there is currently a large number of similar topics. Participants meet two to four times a year to discuss the chosen topics. The sharing of experiences between meetings is encouraged via mailing lists, wiki pages, etc. The purpose is not simply discussion. In order for them to have real meaning, it is desirable that on the basis of experiences in individual campuses, best practices for all campuses are established and defined in the form of documents.

3) *The development of documents with guidelines and recommendations for campuses* is done via the iterative procedure shown in Fig. 2. In order for the experience concentrated in the working groups to extend outside the groups, the conclusions and recommendations must be put into documents. Documents do not need to be long (15 to 30 pages), but they must describe practical solutions adapted to the needs and capabilities of campuses in the NREN. The real kick-start for the work of the groups should be the initial draft document which is improved in the iterative procedure through in-group discussions, after which the document is made available to the academic community. The collected comments and additions, which the group adopts, are incorporated into the harmonised version of the document.



Fig. 1. Campus Best Practices model

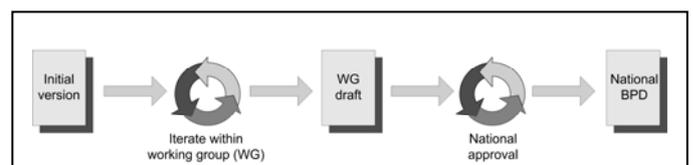


Fig. 2. Development stages of documents with recommendations

4) *Organise common procurements for the needs of a larger number of the campuses* is the fourth step, which is the first in a series of more demanding activities. They are conducted on the basis of the specifications contained in the documents harmonised in step 3. These documents do not always have to contain specifications of equipment or services, but they should contain enough information which can be used to draw up specifications according to which common procurements are conducted for interested campuses. The benefits of implementing this step in the NREN are multiple. They can be seen in savings made in money and the engagement of people involved in procurement, the achieved quality of the specification and uniformity of equipment, which further facilitates maintenance, training, etc.

5) *The provision of consulting assistance in the campus itself* is the concretisation of the recommendations in real conditions in the field, when it is necessary to propose an appropriate solution, after having identifying the problem. Problems which need to be solved frequently come up during the re-design of the current state and during the implementation of the selected solution on campus.

6) *As the largest level of support for campuses, the model envisages the inclusion of members of the working groups in the work to implement solutions on campus in line with existing recommendations and documents*, during which the level of capability of engineers on campus is increased but also experience for new documents and topics for which practise has not yet been established is gained.

In the document [2] there is a detailed description of the model together with recommendations for all NRENs which want to begin these activities at national level. Some of the open questions regarding the model are whether it is scalable and applicable to large NRENs, and how applicable it is in poorly developed NRENs and conditions of poor financial support.

### III. CONDITIONS IN WHICH THE MODEL WAS IMPLEMENTED IN AMRES

When the project was started, the AMRES network had approximately 150 institutions, of which the majority were faculty campuses and research institutions. The network is managed by four service centres. They are the computing centres of the largest state universities in Belgrade, Niš, Novi Sad and Kragujevac. AMRES services are financed by the relevant ministry. AMRES services are completely free of charge for all institutions and users. Depending on their geographical location, campuses are directed to expect support from their own service centre.

In the meantime, AMRES has been established as an organisation, so that the middle of the third year of the GÉANT project coincides with the start of the new period of development. In the transitional period, there are many issues which need to be solved, so this period is not suitable for starting new practices for campuses.

Part of usual practice in AMRES for a long time was the organisation of regular meetings (two or four times a year) for campus and service centre engineers. The programme of the gatherings was made up of different contents: providing information to the community about strategic decisions, presentations with technical details of services or activities, discussions about technical and other issues which the administrator faced, guest lectures about innovative services and research projects by our colleagues from other countries. From these activities Campus Best Practices was initiated.

The remaining parts of the model, described as steps 4, 5 and 6 in the previous chapter, are also not unknown to AMRES. For example, common procurements for campus needs have been organised several times in the past, motivated by limited resources and a desire to secure as much equipment as possible. Only the service centres were involved in choosing the technical solution and equipment specification, so in some way the choice was imposed on campuses. However, in contrast to developed countries, institutions in AMRES are positively affected by this as long as the selected equipment is much better than the equipment their individual budgets allow them to purchase. Campuses in AMRES often consult their service centre about procuring equipment when they are unsure of the necessary technical characteristics or solutions. Service centres also very frequently help institutions on campus during the implementation of chosen solutions, and most frequently when establishing the most simple configurations (when a campus has just joined the academic network), or especially difficult configurations.

The training of technical staff on AMRES campuses has been gradually increased through Cisco Academy training. Cisco Academies are organised in several locations in the network with all required equipment. However, it was noticed that there was a lack of documents, with which, in written form, technical staff on campuses could acquaint themselves with current AMRES practice.

It is important to underline that all the AMRES activities described are organised as isolated activities, but not as part of a planned implemented model which would lead to a lasting and planned process on which campuses can rely. Other NRENs are also likely to have experiences with similar isolated activities organized more or less frequently. It is important to underline the difference between isolated procedures and a consciously implemented model in the NREN, even when it is limited to some of the first steps. Each step is a solid foundation for the next, which can be moved on from, depending on the degree of implementation of the model, which the NREN is able to support.

### IV. AMRES'S INITIAL EXPERIENCES WITH THE CBP MODEL

Before the start of the GÉANT project, two steps from the proposed model were completely new to AMRES: developing/using its own best-practice documents (BPDs) and organising the community into working groups for individual technical areas. Thus the first priority for team members was to interest the on campus engineers in these activities. The experience gained over three years of implementation of the

organisational model, which AMRES can transfer, pertains to establishing and gaining support in its NREN community for these activities: establishment of/cooperation in working groups for technical areas and writing/using one's own BPDs.

In NRENs which have not yet met the concept of cooperation through working groups, like AMRES, the successful outcome of initial activities may depend on the choice of technical areas for which working groups are formed and the choice of topics for the first BPDs. The reason for this is because these choices in the initial phase are imposed on the community. It is important to address current unresolved challenges and a prominent need for recommendations in a particular area. After activities have been begun and after the first positive effects within a working group, participants propose topics for future BPDs. Proposals to establish groups for other areas, directed at team members, come after this, as a clear sign that the community has accepted the concept.

The AMRES criteria for the selecting technical areas were: a prominent need for recommendations in a particular area, experience gained in the area and/or campuses interested in the area. Based on these criteria, three groups were formed in AMRES: for physical infrastructure, network monitoring and security.

- The group for physical infrastructure was established due to the need to define recommendations for institutions which have just joined the NREN, but also for improving infrastructure in current campuses by adopting harmonised technical solutions (for powering and cooling for example). In this period, the inclusion of secondary schools in AMRES, i.e. a potentially large number of new institutions to the network, was planned.
- The group for network monitoring was formed due to the need to transfer experience concentrated in one AMRES service centre to the community.
- The group for security was formed due to campus' interest in cooperating to solving a wide range of technical issues (firewall, CERT, AAI, etc.), but also due to the need to familiarise new technical staff with existing practice.

Offering insight into the experiences of other NRENs plays a special role in gaining support for Campus Best Practices activities in one's own community. AMRES used the following methods:

- *presentation of solutions of other NRENs in order to encourage its own community to discuss its needs:* Campus Best Practice activities have their own organisation model but also their own technical results (available at [3]). The organisational model needs to be partially described in the initial phase, but it is easier to use the technical solutions of other NRENs to attract the attention of the technical staff in one's own community. However, what is good practice for one NREN is not necessarily good for the NREN of another country. For example, aware that its institutions have much more modest requirements, AMRES used UNINETT's BPDs in the area of physical infrastructure to encourage

discussion about its own needs and the development of its own BPDs.

- *experts from other NRENs were invited to workshops organised for AMRES campus staff:* Upon the adoption of the CBP concept, within AMRES, the special need for cooperation on current technical topics for AMRES campuses, such as wireless, eduroam or authentication infrastructure, was expressed. Campus staff still do not have enough experience in these areas to form working groups to work on the creation of BPDs, but they can currently strengthen the campus community through gaining common experience in mastering services in new technical areas.

At AMRES, we are of the opinion that all activities need to be planned while embracing previous positive experiences. Initially, it is necessary to identify activities in one's own network which are similar to those offered in the model in Fig. 1. It is enough to choose one activity with which campus staff had a positive experience in the past and through this activity present to them the value of the CBP model and provide the necessary explanations. If initial positive effects are achieved, uniformity in presenting these activities and constant reference to previous events are of further help. Advice from and the support of the public relation (PR) service are desirable, but they are often not available to NRENs with a digital divide problem. Things are made easier thanks to the GÉANT CBP team who sees itself as demonstrators of what can be done in other countries. Recently the team is being ready to offer support to NRENs which are interested in the model and to organise workshops in line with NREN needs, as an initial activity in moving the campus community of the NREN towards the CBP concept. Training and workshops take place at national and regional level, depending on the subject concerned (info available at [6]). AMRES contributes the task team's effort to organize workshops at the South East European.

During the three years period, AMRES effort resulted in ten best practice documents developed. Of these, four are translated to English and published along with documents produced by other task member NRENs. The English documents covering topics from six technical focus areas (i.e. physical infrastructure, campus networking, wireless, network monitoring, real-time communications and security) are available at the GÉANT and TERENA web sites [3]. A mailing list is set up to announce the publishing of new BPDs [7]. AMRES BPDs are available in the Serbian language on the AMRES wiki website [4].

A lack of experience with BPDs affects the process of creating them, their content and the quality of initial BPDs. "Wishing to explain everything" and cover different cases, AMRES's initial BPDs are long (around 50 pages) and contain a lot of theory. There is no need to discourage the creation of such BPDs. They should be viewed as a good starting point from which shorter documents, focused on recommendations, will come. Time is needed to arrive at appropriate forms and quality, through group work and discussion.

Introducing campus categorisation for which appropriate solutions are proposed, in some cases, can lead to a reduction

in the number of options considered and therefore more concise documents. Group members need time to agree on the boundaries of each category. In a NREN the size of AMRES, it has been demonstrated that defining two or three categories by which to divide campuses is optimal.

AMRES is still looking for enough precise methods to determine how effective the topics of the initial BPDs and BPDs created after them were, i.e. whether the recommendations in these BPDs were accepted and implemented on campuses. Some of the orientation indicators are visits to the AMRES wiki pages, then the number of views of lectures recorded at workshops (which are available on the AMRES media portal [5]), the increase in the number of institutions in AMRES which began to use certificates after the publication of the BPD [Securing Service Access with Digital Certificates](#) etc.

Given the starting point for the implementation of the Campus Best Practices model in AMRES, the impression is that the implementation of the first three steps of the model is bringing large benefits to the community. Individual groups of activities from different parts of the Campus Best Practice model (in Fig. 1) can be implemented separately, but it is better to follow the proposed order so that stronger support for the introduction of the increasingly more difficult activities can be gained over time in the NREN.

Establishing all six steps is undoubtedly a long-term process. The way in which the process is initiated, who is the leader of activities in the NREN and the support gained over time in the NREN for these activities affects its sustainability.

Compared to UNINETT, in which the process was initiated within the framework of strategic management, in the case of AMRES, activity was adopted through participation in the GÉANT project.

Members of the GÉANT task team, mainly from one AMRES service centre (Belgrade University computing centre), are the leader of CBP activity in AMRES. The NREN's decision to carry out CBP activities was enough to implement the model up to the third step, so in the initial phases of adopting the mode, the activity leader could also be a larger university or group of universities interested in these activities. However, the further expansion of activity is only possible with adequate financial support. To us it seems that the most natural leader of CBP activity for campuses in a NREN is the NREN organisation itself, as the organisation which can harmonise and implement an appropriate funding model.

In Fig. 3 the connection of the leader of activity in the NREN with institutions which fund the NREN and the on-campus IT community is shown. For the concept to be durable in the NREN, it is necessary to secure the support of both sides. The shaded areas represent the support given by one party to the other party. The greater the area, the greater the expressed support through the number of participants in working groups or the number of positive strategic management decisions. In order to gain support, activities can at first be directed at one and/or the other party. Different topics motivate these groups to support activity.

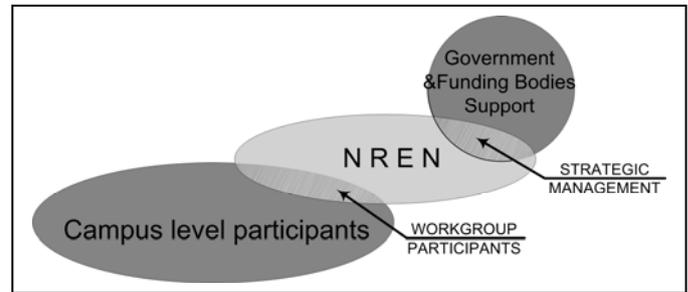


Fig. 3. Connection of activity participants in the NREN

Staff on campuses shows much greater interest in BPDs, technical solutions and results of the implementation of the model, whereas only its organisation approach catches the attention of strategic management.

Initial activities in AMRES were directed at campuses, and through them a wide base of potentially interested participants was included. Over period of implementation of the model in AMRES, a solid base for the next CBP activities in this target group was formed. However, there are two facts which should be highlighted, because of which, in our opinion, the process of adopting the model was more complicated:

- **experience is concentrated in AMRES's service centres.** Outside the service centres there are many more who expect results. Thus it is not easy to recruit members of working groups and achieve the numbers for them.
- **AMRES services are completely free of charge for all institutions and users.** As long as network services cost zero euros, users on campuses do not attempt to perceive and differentiate the level of support of the NREN, i.e. "every expansion of the list of obligations" of the NREN towards campuses must be financed from some source. Thus, it is not easy for the NREN organisation to secure the financial support to incorporate steps 4, 5 and 6 of the model into the established practice on campuses.

Activities to gain strategic management support, in AMRES, have been left for a later date. The situation is helped by strategic management also being directed to other sources of information, and its decisions are often based on the positive experiences of other NRENs. Significant support can be expected since activities aimed at campuses are over time received at the same intensity and level of success as NRENs in developed countries.

## V. CONCLUSION

It is important to note the difference between isolated steps aimed at improving the state on campuses and the Campus Best Practice model, which leads towards the establishment of a long-term and planned process of support for campuses, which campuses can rely on in the future. Small financial support is needed to begin CBP activity. It brings large benefits to the community. In order for the CBP concept to be sustainable in

the NREN, it is necessary to ensure the support of technical staff on campuses, as well as that of strategic management and the bodies which fund NREN activities. Today, a solid base for the next steps has been created. Further implementation of the steps of the model in AMRES will depend on the NREN's capability to implement them.

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