Federated POP: a successful real-world collaboration

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Introduction

A successful collaboration of research networks (such as National Research and Education Networks and GÉANT) is clearly visible in Europe for number of years now. From providing basic IP connectivity to advanced services these networks enabled efficient cooperation in many research areas. GÉANT network and Cross Border Fibre owned by NRENs allow performing such cooperation on a pan-European and even global scale. Creation of multi junction facilities - where several networks are interconnecting - may deliver new possibilities for cooperation and provide many benefits in terms of overall cost of network infrastructure and service portfolio.

Federated PoP definition and features

JRA1 Task 3 of the GN3 project considered a number of aspects of sharing network resources among multiple independent but collaborating networks and provided a definition for a federated PoP. The federated PoP is a physical site where several networks such as NREN and/or GÉANT are co-located to offer services in a joint manner. Inside the federated PoP network operations are carried out in accordance with collaborative agreements and equipment is shared where possible by the network entities present in the federated PoP. A federated PoP might be also seen as an extension of Cross Border Fibre (CBF) concept. While CBF involve just two parties that interconnect with each other a federated PoP involves a number of parties that interconnect and agree to provide connectivity and services together. The potential benefits of federation include cost savings, increased service availability and resiliency as well as improved user experience. The main challenges related to the common management of federated PoP are technological differences, shared monitoring and management, missing standards, cost model and the federation-independent presentation of services.

Generic models for the federated network architecture have been developed as a result of analysing existing projects, processes and services that are either potential users of a federated network or that feature some elements of federation. It defines the structure, relationships and dependencies between particular elements of the architecture [1]. The next analysis of different technological possibilities for interconnection of NRENs was done in order to distinguish simple configuration options for building a federated PoP that are depending on available networking equipment. Proposed configuration options include [2]:

- Lightweight (optical only)
- Switching (optical, and switching)
- Routing (optical and routing)
- Full service (optical, switching and routing)

In case of switching and routing there is also a possibility that one of the parties comes into the federated PoP with a managed service instead of a leased dark fibre. Depending on the configuration, a different set of network services can be provisioned due to different capabilities of hardware.

A federated PoP in Hamburg

To date, the Hamburg PoP involves four NRENs: DFN, NORDUnet, PIONIER and SURFnet. NORDUnet, PIONIER and SURFnet are already present in two nearby colocation centres while DFN is arranging their connectivity to join to the PoP.

Taking advantage of NREN's Cross Border Fibre and given their presence in Hamburg it was decided to set up an experimental federated PoP to interconnect these NRENs and to verify concepts described within JRA1 Task 3.

Since all NRENs were connected at only the optical layer, a solution based on an Ethernet switch was proposed. A switch with four 10 GbE interfaces was installed in Hamburg by NORDUnet. This choice was driven by available hardware and it corresponds to the 'switching' configuration option described earlier.

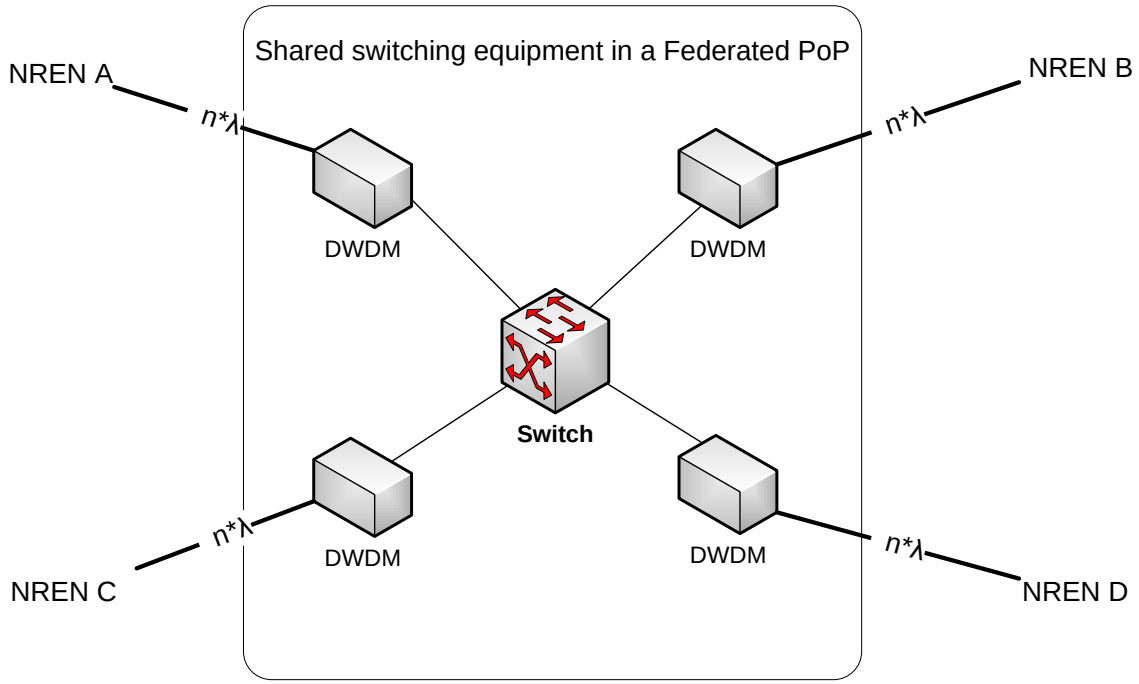

Figure 1: Switching federated PoP (optical and switching equipment, sharing the switch with all connectors) with 4 parties [2]

Each NREN covers the cost of establishing and maintenance of own connection to the colocation centre in Hamburg. Additionally NORDUnet covered costs of installation and maintenance of switch in their rack. The switch management is in-band and initially is performed by PSNC. A decision to deploy AutoBAHN to support dynamic allocation of connections between NRENs was made and PSNC as one of the main developers is responsible for deployment and maintenance of AutoBAHN instance that is managing the switch. In particular, the following steps were needed to establish federated PoP in Hamburg:

- A strong will to interconnect with other NRENs
- Establishing connectivity (either via dark fibre or through a managed service) between NREN's network and Hamburg colocation centre
- Deployment of the new networking hardware (switch)
- Overcoming formal and technical difficulties – finding a technology that suit needs of all participants as well as installation of switch and patching
- Allocation of resources that are required to maintain the connection. As NRENs were already present in Hamburg responsibility for maintenance of federated PoP connectivity was added to groups of people who already are dealing with NREN's connectivity to Hamburg
- Selection of services to be deployed in the federated PoP. This is strictly related to the hardware installed in the federated PoP.
- Allocation of resources and necessary manpower to run, manage and monitor the services. An agreement on sharing responsibilities is also needed.
- Agreement on operation of federated PoP

Apart from costs related to connectivity and deployment of necessary hardware establishment of federated PoP in Hamburg does not seem to require many additional efforts in terms of manpower since operation is handed over to people in NRENs who already are taking care of maintenance of the infrastructure and services.

The suggested model for the solution that is implemented for the federated POP in Hamburg is modular and scalable. By its design it opens the option to include any national, pan-European or even world-wide network whose infrastructure passes through Hamburg into the federated PoP architecture.

Summary

The model for Federated POP that has been examined and described in previous work of GEANT 3 JRA1 T3 group has been used as a starting point in establishment of the federated POP in Hamburg. Initially, three NRENs have already been present in Hamburg with their network infrastructure and a participation in the federated POP was seen as an opportunity to increase efficiency, decrease costs and use the advantages of multi-domain services for network operations and monitoring. The federation has been established through interconnection and the first service that has been provided is a switching service, enabled on the Ethernet switch provided by NORDUnet. The benefits of multi-domain services has been proven with the introduction of AutoBAHN, configured on the equipment by PSNC. With efficient coordination, technology examination and operational accordance most main challenges have been overcome.

In addition the paper presents the list of necessities that should be defined and fulfilled in order to establish an F-POP that can be used as a guideline for any further federated POP case projects-.

Before TNC2012 some experiments with the established federated PoP are planned and the need for other services will be evaluated. Therefore we expect to provide more details about experiences from running a federated PoP in the form of full paper for the conference.

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Author Biographies

Maribel Cosin works in the Network department at RedIRIS, which is responsible for designing, building and managing the RedIRIS network. She completed her B.Sc. in Telecommunications Engineering in 1996, at the Universidad Politécnica de Madrid, and joined RedIRIS thirteen years ago. She has participated in the deployment of the previous network infrastructure (RedIRIS-10) and also in the design and putting in service of the new one (RedIRIS-NOVA), based on dark fibre. Since January 2005 Maribel has been responsible for the Level 1 Operations Team at RedIRIS. She is also responsible for the Address Assignment service and the RedIRIS Réseaux IP Européens (RIPE) interface.

Paul van Daalen joined SURFnet in January 2009 as a Senior Network Planner. Prior to this he was Director of the Information group at Leiden University for 8 years. During the last 25 years Paul has worked with various kinds of telecommunication and IT systems and structures. As an IT professional he was employed for 17 years by Delft University, where he was responsible for Network Development and Operations.

Ivana Golub is a Deputy CEO at CARNet, in charge of the Network Infrastructure Department, which is responsible for designing, building and maintaining the CARNet network, network and multimedia services. She received her B.Sc. and M.Sc. degrees in Electrical Engineering at FESB, the University of Split. During the last more than 10 years Ivana has worked in networking, in areas ranging from LAN to WAN, and in positions ranging from architect to manager.

Dr. Peter Kaufmann is technical manager in the branch office of DFN-Verein (Deutsches Forschungsnetz). He has been responsible for the planning of advanced projects within DFN. Currently he is involved in several EU-funded projects. He received his Ph.D. in 1980 in Theoretical Nuclear Physics from the Free University Berlin.

Gerben van Malenstein received his M.Sc. degree in System and Network Engineering from the University of Amsterdam in 2007, to date he works as Network Manager within SURFnet's Network Services department. Within his roles as project manager and technical product manager, his focus is on the development of Open Lightpath Exchanges, such as NetherLight, SURFnet's GLIF Open Lightpath Exchange (GOLE) in Amsterdam. Alongside this work, he is involved in automated bandwidth-on-demand provisioning, both within SURFnet and internationally through NetherLight.

Jari Miettinen is a service manager for the Funet services in CSC, the Finnish IT Center for Science. Jari received his M.Sc. degree from the Helsinki University of Technology department of technical physics in 1998. He is a long-time employee at the CSC with experience on several layers of service management, production and development. His roles and positions have varied from an expert to a development manager. During the recent years his special interests have been public-private partnerships and the development of the inter-NREN services.

Darko Paric is a Service Manager at the Network Infrastructure Department in CARNet. Darko is involved in designing, building and maintaining the network and networking services in CARNet network. Darko received his B. Sc. in Electrical Engineering Faculty – FESB at the University of Split. During the work in CARNet Darko has actively participated in many projects such as building and maintaining the infrastructure for broadband access services, building optical cable networks and many others.

Ralf Paffrath received his diploma in computer science and computational linguistics at University of Koblenz (Germany) in 1993. He is working with the DFN e.V. (Deutschen Forschungsnetz) since 1996. From 1996 until 2002 he was in charge of about 20 advanced DFN teleteaching and telelearning projects on high speed networks. In 2002 he planned, implemented and managed a new service called DFNRoaming/eduroam within DFN. His main interests are focusing on advanced network technologies, network security and novel network services.

Milosz Przywecki received an M.Sc. degree in Electronics and Telecommunications from Poznan University of Technology in 2003 and joined the Network Division of Poznan Supercomputing and Networking Centre as a Networking Systems Analyst in 2005. His main interests are in advanced networking technologies, network protocols and services.