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Deliverable DS1.1.3,1: Annual Report



SA1 Network Build and Operations: Task 1 Network Planning and Procurement Preparation

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Abstract

Annual report for SA1: Network Build and Operations, Task 1: Network Planning and Procurement Preparation.

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Executive Summary

Task 1 of Service Activity 1 is the network planning and procurement preparation work concerned with enhancing the GÉANT backbone, the cost-shared part of the Europe-wide research and education (R&E) network infrastructure operated by DANTE. It has been the objective of this Task to conduct a thorough review of the existing GÉANT network architecture, to assess whether factors such as the costs and technical capabilities of connectivity and of switching and routing hardware, or shared fibre, might challenge its assumptions about cost-effective structures. This document is an annual report on the progress of this work, covering architecture workshops, initial progress and current tasks.

Five architecture workshops have taken place up to the end of Year 1. The topics presented and discussed were wide-ranging, and included: service aspirations; forecasts of backbone capacity requirements; operational aspects; and experiences of trying to utilise customer/partner connectivity resources.

Because it took much longer for the architecture workshops to run their course than was originally anticipated, it took longer for the detailed analysis work of SA1 Task 1 to get fully started. One piece of work that was done during Year 1 was to draw up a list of potential new backbone service offerings and service features that could be used as the basis of the method by which many Task 1 analyses will be conducted.

SA1 Task 1's current work plan consists of two sets of sub-tasks focusing on:

- Information-gathering exercise. A Prior Information Notice was published in November 2009, a Request for Information (RFI) issued, and a series of meetings held with the 11 companies who submitted responses to the RFI. The findings from these meetings are currently being analysed.
- Current backbone studies – IP and physical layers. Investigations into optimising the current backbone IP layer design, the physical layer and the inclusion of cross-border fibre (CBF)-based transmission services, are under way.

The work plan is being executed under the supervision of a newly created supervisory committee. As the work has not yet been completed, production of the Task's first deliverable, DS1.1.1 Report on the Backbone Architecture Study, was delayed and is much less conclusive than was originally intended. Likewise, the results that were originally envisaged to be reported in this deliverable will now be reported in the newly introduced Year 2 deliverable DS1.1.1,2 Final GÉANT Architecture in Month 18.

The delay in establishing a definitive architectural blueprint for the GÉANT backbone could well prove to the project's advantage. The optical networking equipment sector currently stands at a crossroads, with significant technological paradigm shifts and associated products in development but still some time from being generally

available and with their cost as yet unknown. These are the kinds of products that are likely to play a significant role in the future upgrade and expansion of the GÉANT backbone. To make binding procurement decisions before a complete picture of the relevant parts of the equipment sector emerges is clearly something best avoided. Moreover, it has become apparent that interest levels among the project partners in many novel transport-related services and service features are dependent on knowing their affordability, and such information is not yet forthcoming.

1 Introduction

Task 1 of Service Activity 1 is the network planning and procurement preparation work concerned with enhancing the GÉANT backbone – that is, the cost-shared part of the Europe-wide research and education (R&E) network infrastructure operated by DANTE.

When the GN3 project was conceived and the plan was being developed, it was recognised that the preceding GN2 project had already implemented a hybrid network infrastructure on which GN3 could build. Nevertheless, this did not necessarily imply that the architecture and design of the network would remain unchanged during GN3. It was thought that considerations relating to the costs and technical capabilities of connectivity and of switching and routing hardware might challenge existing assumptions about cost-effective structures. There was also (and still is) the possibility of shared fibre acquisition and/or shared fibre use between National Research and Education Networks (NRENs) and GN3 as a means to realise potential cost savings. It was even thought that joint-lighting of routes between the project and connectivity suppliers might be possible.

It has therefore been the objective of this Task to conduct a thorough review of the GÉANT network architecture and analyse these factors. This document is an annual report on the progress of this work.

2 GÉANT Architecture Workshops

Preparatory work commenced before the GN3 project started. Specifically, the first of a series of consortium-wide “Architecture Workshops” was held towards the end of 2008. This was followed by another four during Project Year 1.

The topics presented and discussed in these workshops were wide-ranging, and included: service aspirations; forecasts of backbone capacity requirements; the state of play of a number of relevant telecommunications and networking technologies; operational aspects; the possibilities for exploiting “IP peerings” with Internet content and service providers; global connectivity; and experiences of trying to utilise customer/partner connectivity resources. Details of the workshops and a summary of some of the conclusions that were drawn can be found in deliverable DS1.1.1 Report on the Architecture Backbone Study [DS1.1.1].

3 Initial Progress of SA1 Task 1

It took much longer for the architecture workshops to run their course than was originally anticipated. One consequence of this was that it took longer for the detailed analysis work of SA1 Task 1 to get fully started.

In addition, the optical networking equipment sector is currently at a major crossroads. Key technologies that represent significant paradigm shifts and which will clearly play an important role in the evolution of the GÉANT backbone over the next few years have taken a long time to develop, to the point where they are only just starting to become commercial and operational realities (e.g. 40 G transmission, Optical Transport Network (OTN) switching, carrier Ethernet, etc.). Other likely technologies have emerged in the meantime as well (e.g. 100 G transmission and Packet Optical Transport Service (P-OTS)) but these are still about 1-2 years from becoming commercially and operationally realistic possibilities – even for early adopters in the R&E networking sector. Recent deliverables from JRA1 [DJ1.1.1, DJ1.2.1] summarise the current state-of-the-art with respect to these technologies, and the current Request for Information (RFI) exercise being conducted within SA1 (see Section 4 below) is intended to augment this market intelligence.

One piece of work that was done during Project Year 1 within SA1 Task 1 was to draw up a list of potential new backbone service offerings and service features that could be used as the basis of the method by which many Task 1 analyses will be conducted. This was required partly because there were only limited indications from the project partners about what kind of new services they would expect the backbone to support by the end of the GN3 project.

What became apparent was that, in the presence of the uncertainties indicated above, interest levels among the project partners in many novel transport-related services and service features were themselves going to be dependent on being able to establish up front the affordability of such services. A good example is restorable (or “mesh protected”) wavelength services. For these to work on a large long-haul network such as GÉANT will likely require significant up-front investment in the infrastructure, e.g. one or more of the following:

- Introduction of wavelength-selective switching capability at many or all nodes.
- Installation of strategically located electrical signal regeneration capabilities.
- Adoption of equipment capable of supporting longer unregenerated transmission than has hitherto been possible.
- Introduction of advanced control plane and management software capabilities.
- Adoption of greater levels of meshing of the fibre transmission medium.
- Changes to the physical characteristics of some of the fibre transmission media.

Likewise, the analysis of the projected affordability of 100 Gbps transmission is going to be difficult. An example of one of the difficulties is as follows. The modulation scheme being adopted by many transmission vendors (based on polarisation-multiplexed Quadrature Phase Shift Keying (QPSK) with coherent receivers) does not lend itself well to certain conditions that tend to prevail in long-haul transmission networks today (including in GÉANT). Examples of these conditions are the presence of bulk in-line dispersion compensation (necessary to support the many discrete 10 Gbps channels with their simpler modulation schemes based on Non-Return-to-Zero On-Off Keying (NRZ OOK)), the presence of dispersion-shifted transmission fibre (in line with the ITU-T recommendation G.655 [ITU-T G.655]) and the presence of filter-based (de)multiplexers. Eliminating some or all of these conditions is certainly going to improve the viability of 100 Gbps wavelengths in so much as transponder reaches will be longer than would otherwise be the case and less Optical-Electrical-Optical (O-E-O) regeneration would be required. However, an up-front and one-off (“big bang”) adjustment of these conditions is likely to be prohibitively costly and disruptive. On the other hand, such an adjustment may turn out to have a lower total cost of ownership (TCO) if that were to be calculated over a long period of time (i.e. well beyond the end of the GN3 project) and if sufficiently high levels of utilisation with certain geographical distributions were realised during that same period. Clearly, further non-trivial analysis will be required in the light of findings from the RFI so far – for example, looking at alternative options for migration (rather than the “big bang” approach).

4 Current SA1 Task 1 Activities

During the second half of Year 1 a detailed work plan was drawn up for SA1 Task 1, covering the first three quarters of 2010 and relying on substantive participation from some project partners outside DANTE. In summary, this work plan (which is described in [DS1.1.1]) consists of two sets of sub-tasks focusing on:

- Information-gathering exercise.
- Current backbone studies – IP and physical layers.

4.1 Information-Gathering Exercise

An initial set of sub-tasks focuses on conducting an information-gathering exercise (through issuing a Request for Information (RFI)) between Q4 of Year 1 and Q2-3 of Year 2. The objective of the RFI is to gather sufficient technical and as much indicative commercial information as possible to facilitate drafting a realistic architecture (or small number of options thereof) of an enhanced backbone transmission and switching platform for the GÉANT backbone. These architecture options will then be used in the formal procurement phase, the idea being that the more specifically prescribed the architecture options are, the more rapidly the procurement process itself will be executed.

Since the creation of DS1.1.1 and the definition of the work plan, the RFI exercise has made significant progress. Out of the 20 companies that originally expressed interest in the Prior Information Notice (PIN) published in the Official Journal of the EU (OJEU) in November 2009, 11 submitted written responses to the RFI document. All except one were from equipment vendors or their value-added resellers (VARs, also known as channel partners) and one was from an operator. This resulted in 10 meetings with these companies (two of the companies, an equipment vendor and one of its VARs, attended the same meeting), each lasting 3-4 hours. Four of the companies insisted on DANTE signing an explicit non-disclosure agreement (NDA) before they would supply any information.

At the time of writing (May 2010), the findings from these meetings (and the supporting documentation provided by the companies in advance) are being analysed. The analysis is currently being done by DANTE staff only, until further clarification regarding the dissemination of certain aspects of the findings outside DANTE (but still within the project) has been received. Further engagement with many of the companies is expected.

4.2 Current Backbone Studies – IP and Physical Layers

Alongside the RFI process (and interacting with it), another set of sub-tasks has been focusing on studying optimisations of the current backbone IP layer design (especially with a view to supporting traffic distribution changes that will occur as the result of GÉANT establishing presence at European Internet Exchanges (IXs), as discussed in [DS1.1.1]) and studying the physical layer. The purpose of the latter is to identify resilience issues and propose mitigating actions, and also to identify new opportunities (i.e. locations) for facilitating additional access to the backbone (e.g. second per-country access points).

Related to the work on the physical layer, further work is under way on facilitating the inclusion of cross-border fibre (CBF)-based transmission services; specifically, evaluation criteria and an associated process are being drafted.

5 Conclusion

At the time of writing (May 2010), the SA1 Task 1 work plan (summarised above and described in more detail in [DS1.1.1]) is being executed under the supervision of a newly created supervisory committee (for GÉANT Network Architecture, Design and Implementation). As the work has not yet been completed, production of the Task's first deliverable, DS1.1.1, was delayed and the report is much less conclusive on the subject of GÉANT backbone architecture than was originally intended. Likewise, the more conclusive results that were originally envisaged to be reported in this deliverable, the first annual report for SA1 Task 1, will now be reported in the newly introduced Year 2 deliverable DS1.1.1,2 Final GÉANT Architecture in Month 18.

Finally, it is worth noting that the delay in establishing a definitive architectural blueprint for the GÉANT backbone could well prove to the project's advantage. As described above and in [DJ1.1.1, DJ1.2.1], the networking equipment sector currently stands at a crossroads, with significant technological paradigm shifts and associated products in development but still some time (1-2 years) from being generally available. It is these kinds of products (expected to be based on carrier class packet transport and high-capacity transmission capabilities with more integration than has hitherto been the case) that are likely to play a significant role in the future upgrade and expansion of the GÉANT backbone. To make binding procurement decisions before a complete picture of the relevant parts of the equipment sector emerges is clearly something best avoided.

References

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Glossary

CBF	Cross-Border Fibre
IP	Internet Protocol
JRA1	GN3 Joint Research Activity 1 Future Network
NDA	Non-Disclosure Agreement
NREN	National Research and Education Network
NRZ	Non-return-to-Zero
O-E-O	Optical-Electrical-Optical
OJEU	Official Journal of the EU
OOK	On-Off Keying
OTN	Optical Transport Network
PIN	Prior Information Notice
P-OTS	Packet Optical Transport Service
QPSK	Quadrature Phase Shift Keying
R&E	Research and Education
RFI	Request for Information
SA1	GN3 Service Activity 1 Network Build and Operations
TCO	Total Cost of Ownership
VAR	Value-Added Reseller