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Deliverable D12.2
Videoconferencing Service Assessment and Future Development

Deliverable D12.2

Abstract
This document describes the GÉANT eduCONF videoconferencing service elements and the development work undertaken by the Real-Time Applications Task in GN4-1. A roadmap outlining recommended next steps and strategic goals is provided, as well as a specific value proposition for the Directory Sharing proof-of-concept and anticipated service. User-facing Directory, Testing and Monitoring services can be found at https://educonf.geant.org/.

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Executive Summary

This document describes the GÉANT eduCONF videoconferencing service elements and the development work undertaken by Service Activity 8, Real-Time Applications and Multimedia Management (SA8), Task 1, Real-Time Applications, in GN4-1. A roadmap outlining recommended next steps and strategic goals is provided, as well as a specific value proposition for the Directory Sharing proof-of-concept and anticipated service.

The three main eduCONF service elements are the Directory of H.323 videoconference endpoints, automated videoconference system testing, and the Global Dialling Scheme (GDS) Monitoring service. The service also supports a Directory API and NRENum.net registration.

An important objective has been achieved in GN4-1: to hand over eduCONF to GÉANT Operations. The transition has entailed server migration, training and arrangements for ongoing support, including provision of third-level support and Subject Matter Experts to advise the service and users.

The NRENum.net service – which provides lookup facilities and the global facility to connect with E.164 numbers – has benefited from maintenance and minor development work from SA8 Task 1, and seen an increase in uptake globally.

SA8 Task 1 has completed work to improve the usability of the eduCONF interface and service, including simplification of the landing/home page and the gatekeeper registration form, and linking to FAQs; the Task is now proceeding to recruit more users.

Initial work for the Directory Sharing proof-of-concept has included comparing the data schema of VC services' directories, defining a functional specification and common data model, and producing example XML schema. This work, together with planning effort, has produced early decisions to guide the project forward, in areas including centralised infrastructure and data model, data protection policy alignment, sharing options and data translation. The proof-of-concept has generated positive support for the potential Directory Sharing service, particularly in the context of next-generation WebRTC-based applications. A detailed value proposition for the service, clearly demonstrating its relevance and added value, is provided.

The report concludes with recommendations to reduce the amount of JRA resource allocated to the eduCONF service now that it is in production and the development phase is complete; to continue providing low-level support to NRENum.net; and to continue the Directory Sharing work in order to support WebRTC development.

1   Introduction

A key ongoing objective of GN4-1 Service Activity 8, Real-Time Applications and Multimedia Management (SA8), was to make videocalling easier within the research and education sector, both domestically and internationally.

Previous GÉANT project Tasks, under the service title eduCONF [eduCONF], have developed tools and services to support H.323/SIP videoconferencing. These tools and services support users and enable institution managers and National Research and Education Networks (NRENs) to manage their growing video estates and infrastructure services.

SA8 Task 1, Real-Time Applications, has been tasked with taking the eduCONF suite of services (as described in Section 2) and further developing and transitioning them into a sustainable production service fully supported by the GÉANT Operations team and Product Lifecycle Management team.

A major element of the eduCONF service is the Directory of endpoints. Although other elements of the service are currently focused on support for H.323, the Directory is a more general tool. Even as the use of videoconferencing migrates slowly towards software and desktop solutions and away from H.323, there is significant potential in maintaining and reusing the Directory feature, and even building on this to support the development of other video services, such as those being developed in SA8 Task 2, Web Real-Time Communications (WebRTC), using WebRTC.

SA8 Task 1 has taken important steps towards the wider standardising and sharing of video services Directory facilities. It has taken the lead in coordinating a small but global proof-of-concept to demonstrate Directory Sharing, which it is proposed will continue in the next phase of the GÉANT project.

SA8 Task 1 has also supported NRENum.net [NRENum.net] as an important and growing global GÉANT service to provide lookup facilities and the global facility to connect with E.164 numbers using DNS. Registration for NRENum.net is supported and embedded in the eduCONF site.

1.1   Task Objectives in GN4-1

The original objectives of Task 1 as stated in the SA8 Project Initiation Document (PID) were as follows:

- To continue the coordination and support of the existing eduCONF service components including:
  - eduCONF Directory service rollout.

- ○ eduCONF Room and Endpoint Validation and Testing service support.
  - ○ GnuGK Gatekeeper deployment support and Global Dialling Scheme (GDS) zone reachability monitoring service.
- To further develop these services, taking into account the state-of-the-art global video communication architectures and user requirements:
  - ○ Develop the Directory service towards interfacing with other directory services worldwide based on the API agreed by the Global Video Alliance (GVA) group.
  - ○ Evaluate and enhance the Room and Endpoint Validation and Testing service considering the consolidation of addressing and dialling options (SIP-URI/GDS/ENUM).
  - ○ Propose the extension of the monitoring service to cover the reachability of SIP endpoints and global NRENum.net service-based dialling.
- Investigate and assess the possibility of complying with and/or migrating towards a distributed Session Border Controller (SBC) or similar functional equipment-based unified communications infrastructure for GÉANT, such as proposed by the Global Real-Time Communications working group of the CEO Forum (GRTC).
- Take up the support and rollout of the global NRENum.net service in the GÉANT countries.
- Engage with the European NREN videoconferencing community to develop consensus on national and global policy and governance for this type of real-time communications services and liaise with global peers worldwide.
- Coordinate and actively collaborate with the Cloud Services Activity of GN4 in the areas of:
  - ○ SIP trunking service procurement for the GÉANT countries.
  - ○ Webconferencing service procurement for the GN4 project.
  - ○ Cost-sharing approach for a potential MCU Cloud service among NRENs.

To address these challenges, SA8 Task 1 proposed to:

- Continue and further develop the existing eduCONF service support components in the GÉANT service domain (Directory, Testing and Monitoring).
- Review the infrastructure aspects of video communications taking into account the global technology trends (H.323, GDS, SIP trunking, NRENum.net support, SBC, etc.).
- Coordinate with the Web Real-Time Communications Task (Task 2) and investigate the potential gateway implementation options between legacy SIP/H.323 and WebRTC.
- Liaise with global peers (Internet2, AARnet, APAN, RedCLARA, Ubuntunet, etc.) and related initiatives worldwide (GVA, GRTC, ELCIRA, etc.) regarding technical (i.e. infrastructure) and non-technical (i.e. policy and governance) matters.

As the project progressed, prioritisation in other Tasks and resource availability influenced the relative focus on the above objectives and the solutions selected. Progress is described in Section 3.2 "Enhancements Delivered During GN4-1" and the transitioned eduCONF services and tools are described in Section 2 "Production Service Description".

2 Production Service Description

Maintenance, development and management of the operational eduCONF service was a significant part of the work carried out by Task 1 in GN4-1. This section describes the operational production service as a whole, whilst the enhancements and changes carried out in GN4-1 are described in Section 3.2 "Enhancements Delivered During GN4-1".

2.1 eduCONF Service Elements

The eduCONF service is constructed from three main elements, all accessible via the eduCONF Directory web site [eduCONFDir]. Many services are available prior to authentication, but if a user wishes to manage any account details then authentication via eduGAIN is available.

The three main elements are:

- **Directory of H.323 videoconference endpoints**, enabling users to search for videoconference-equipped locations and connection details.
- **Automated videoconference system testing**, enabling users to launch test connections to and from their IP- or SIP-URI–addressed videoconference systems and increase their level of confidence in making a successful connection.
- **Global Dialling Scheme (GDS) monitoring service**, enabling GDS administrators within NRENs and globally to see the live status of the supporting gatekeeper system and receive email alerts if a section of the GDS is unavailable.

Other services supported via the eduCONF service are:

- Directory API.
- NRENum.net Registration.

Each of these is described below.

2.1.1 EduCONF Directory

The eduCONF Directory is provided as a web service supported by a database and APIs to enable third-party access. The service was previously hosted by CARNet and PSNC, but has now been transitioned to the GÉANT production infrastructure.

The Directory enables users to search for videoconference systems (also known as terminals, endpoints or rooms) that have been tested and registered. Users can search using keywords or

browse the map. Filters can be added to focus on a country, city or institution. Room profiles contain contact details for the administrators and technical contacts for the room, and optionally include photographs of the location and facilities.

The Directory can be used by NREN- or institution-level administrators as a management tool for their VC system estate and as a VC system or room catalogue.

2.1.2   Automated Videoconference System Testing

The eduCONF automated testing system can be used by any owner of a videoconference system to test their connection. From the eduCONF website, users can choose to test their connectivity via a Global Dialling Scheme (GDS), IP or SIP-URI address (or all of these) and a number is provided to perform the test call. After a successful connection, the test system saves the details of the VC system and returns the call, demonstrating two-way connectivity. The test also enables a user to confirm the quality of their incoming audio and video.

The results of a successful test are provided in a form, which the user can optionally complete and add the tested system to the eduCONF Directory.

The test system is the result of simplifying the more detailed previous eduCONF certification process. The test can be run independently, without authenticating to the site, maximising the availability of the service.

The test is independent of the Directory but also acts as a route for Directory registration. When adding a new VC system to the Directory, users then have the option to enter more details about the system, including location and support contact details.

The test can also be used as a diagnostic tool for NREN or institutional administrators' IT support when checking the connectivity or a system.

2.1.3   Monitoring the Global Dialling Scheme

The eduCONF Gatekeeper Monitoring service monitors the global network of H.323 gatekeepers that enable videoconferencing calls to connect via the Global Dialling Scheme (GDS).

The Monitoring service periodically performs scheduled calls between all participating gatekeepers (usually at national level). This means that a complete bi-directional path between every pair of gatekeepers is tested.

Virtual H.323 test endpoints, running on the GÉANT service infrastructure, are registered to the gatekeepers under test. Successful registration is a prerequisite for testing. Calls are then routed between the registered virtual endpoints. Exact call routing depends on the configured routing rules applied to the gatekeepers involved in the call. This may include the GDS infrastructure, ENUM-/NRENum.net-based routing and static peers.

Results are available on the eduCONF service website; optional email alerts can inform gatekeeper managers of any failed tests, and encourage them to investigate further.

The status of national gatekeepers, and the availability of GDS in a country, will appear on the Live Status map. The map can be viewed by any visitor to the site as a public service.

Managers of H.323 gatekeepers at world, national and regional level are all invited to register their gatekeepers and use the service.

2.1.4   Directory API

The Directory service currently provides an API to enable third-party services to use eduCONF Directory data. This feature is not yet used in any production services, but forms the basis of work on the Directory Sharing proof-of-concept (described in Section 3.2.2) to provide two-way sharing of data.

2.1.5   NRENum.net Registration

The NRENum.net service is an end-user ENUM service run by the GÉANT Association (formerly TERENA) and participating NRENs; it is aimed primarily at academia.

The eduCONF service supports NRENum.net by providing service descriptions and an online delegation form. The representative of an NREN wanting to participate in NRENum.net can fill out the Delegation Request Form on the eduCONF website [eduCONFDelForm] to obtain E.164 country code delegation.

SA8 Task 1 also contributed additional maintenance and development work to the NRENum.net Crawler. A description of this work is given in Section 3.2.3 "NRENum.net Enhancements".

2.2   Service Architecture

Until very recently the eduCONF service and associated gatekeepers were hosted on CARNet and PSNC VM infrastructure. Now, all elements of the eduCONF service, and the alpha software required by the Directory Sharing proof-of-concept, are hosted on GÉANT's production VM infrastructure. The service uses the standard robust GÉANT VM server development and production model, consisting of three layers of servers for Development, User Testing and Production.

2.3   Engagement and Marketing

The eduCONF service is represented online in many locations, including archived service sites from previous GÉANT projects that are still accessible via a Google search. The service elements are hosted at [eduCONFDir], and this main landing page has recently been redesigned to clearly communicate the three major user functions of the service: Directory, Testing and Monitoring (shown in Figure 3.4 on page 15).

A recently completed video describing the three functions of eduCONF is hosted on the GÉANT TV channel of YouTube and acts as a pull back to the website. The video can be viewed at [eduCONFVideo].

In order to encourage use of the Monitoring service, a focused telephone campaign was begun in May 2015 to contact NRENs (who had previously expressed an interest in eduCONF) and ask them to

register. This effort was put on hold and completed in March 2016 following usability improvements to the gatekeeper registration process.

3 GN4-1 Achievements

3.1 Overview of Work Packages

Practical activities and work packages in Task 1 were designed around the objectives described in Section 1.1 "Task Objectives in GN4-1". This enabled the team to define four areas of work and conduct more detailed planning and delegation. The areas of work identified were:

1. Service transition to production.
2. Directory Sharing proof-of-concept.
3. NRENum.net enhancements.
4. Recruitment of NRENs to use the Monitoring service.

Work Package 4 was begun but, as mentioned in Section 2.3, quickly identified a number of usability issues with the Monitoring service and in other minor areas of the administrator's pages of the website. It was therefore decided that the work package should be refocused to conduct a rapid usability review and implement enhancements before continuing the recruitment campaign. This work is described in Section 3.2.4 "Usability Improvements".

The progress made by each of these work packages is described below. These areas are also discussed and expanded upon in the following section, Section 4 "Proposed Roadmap for Future Development".

3.2 Enhancements Delivered During GN4-1

3.2.1 Service Transition to Production

The migration of the eduCONF service to GÉANT Operations and Product Management was carried out to establish longer term stability for the eduCONF suite of services following more changeable periods of development over GN3plus and GN4-1.

The transition will have numerous longer term benefits, including:

- Provide a professional Operations Service Level Agreement (SLA) response time for first- and second-line support.
- Integrate user requests and enquires into the GÉANT ticketing system.

- Provide centrally managed infrastructure and maintenance.
- Provide centrally managed development and test environments.
- Avoid dependence on any NREN-managed infrastructure.
- Provide third-level Subject Matter Experts (SME) and (minimal) service support described in the Operations Level Agreement (OLA).

The transition process can be broken down into three main areas of activity: server migration, Operations training and ongoing support. Each of these is described below.

3.2.1.1 *Server Migration*

The server migration task was started as a priority and the Task 1 team regularly liaised with the GÉANT Operations team to help ensure a smooth transition.

Server migration was attempted once before, in the GN3plus project, and was abandoned due to complexities and restrictions on the OS available.

Challenges and delays encountered during the migration in GN4-1 included the following:

- The only OS distribution option available for the GÉANT VM environment is Linux Red Hat, but the eduCONF service was originally hosted in Debian. This meant that many pieces of supporting software had to be replaced for the service to work. For example, the Monitoring software Icinga had to be replace by an alternative, Nagios, which took time to test and integrate into the system.
- Due to the enforced OS, a larger amount of code rewriting was required than expected, which added time to the migration.
- The robust Operations VM hierarchy structure of three VMs – Development, User Acceptance Testing and Production – was not fully communicated or understood during the initial process. Development work is conducted in an access-controlled test environment which uses Puppet OS Manager to revert back to a standard setting every day. This caused difficulties and delays in the process of configuring the new server, and as the extent of the resetting was not fully understood in advance, much of the configuration was carried out and then removed.
- The GÉANT VM infrastructure exists behind three layers of GÉANT firewalls, which are not managed by the same team. This was also not fully explained or understood in advance, so the request for the opening of ports required for VC test traffic took much longer than anticipated.

Despite delays, the server migration was successfully completed, with DNS transferred to the new address, on 5 April 2016. From this point the service will be managed and hosted by GÉANT Operations.

3.2.1.2 *Operations Training*

A one-day training event will be conducted in April 2016 with the GÉANT Operations team at Cambridge. The training is aligned with the handover date and will transfer responsibility for first- and second-line support to the GÉANT Operations, with the help of IT and Security sub-teams, if needed. The training will cover the main eduCONF service elements of Directory, Testing and Monitoring, common user tasks, FAQs (a draft version is provided in Appendix A), common issues and recommended responses.

3.2.1.3 *Ongoing Support*

The first-line support and responding to email and telephone enquiries will be managed by GÉANT Operations (partly as an outsourced function). Further second-line support, on service operations, VM infrastructure management, security patches, etc., will also be managed by GÉANT Operations.

Nominal third-line support and Subject Matter Expert enquires will be referred to the relevant development task group in GN4-1. It should be assumed that this will be taken over by the equivalent group in the next phase of the GÉANT project.

3.2.2 Directory Sharing Proof-of-Concept

3.2.2.1 *Overview*

Video services all have service directories of some sort, containing information on users, video systems, resources, conferences, organisations, and often much more. Sharing of information between video services has many potential applications and benefits to the users of the services. The rationale behind this direction of development is discussed in more detail in Section 5 "Directory Sharing Value Proposition". The present section describes the progress towards a global proof-of-concept of Directory Sharing that SA8 T1 has led as part of GN4-1.

3.2.2.2 *Achievements in GN4-1*

Prior work on the Directory Sharing concept in GN3plus delivered a comparison of videoconference services that contained a directory, looking for similarities and common approaches. This important piece of work enabled the team to take significant steps towards the proof-of-concept in GN4-1. In preparation for the proof of concept, the SA8 T1 team prepared the following required resources:

- Comparison of directories' data schema.
  The team compared the features that each service supported and the resulting data fields that they used. Common data fields were identified, grouped into functional objects, and set as mandatory or optional for an object.

- Directory Sharing module functional specification.
  The team defined the main functions for a software module to manage data-sharing and policy management (see Appendix B.1).

- Common data model.
  The team proposed a common data model to be used as a standard for the sharing of data (see Appendix B.2). Each directory must translate their own data into the standard model to enable consumption by other directories. The model was proposed to other global NREN groups and presented at conferences and discussion forums to raise awareness and to gather a consensus. A small amount of feedback was received and this was worked into the model.

- XML schema.
  XML schema example files were produced for each Object (see Appendix B.3).

All the above resources are provided in Appendix B "Directory Sharing Working Documents".

The proof of concept work was originally intended to involve three NRENs and their directories or videoconference services:

1. GÉANT (eduCONF Directory).
2. Jisc (Vscene).
3. RedCLARA (SIVIC).

In the event, Jisc was unable to participate (for reasons to do with national data protection regulations, subsequently taken into account and addressed by the design of the Directory Sharing module), so work progressed with only the GÉANT eduCONF Directory and the RedCLARA SIVIC videoconference service.

Regular and ongoing meetings between the eduCONF Directory development team have provided a venue to discuss all aspects of the proof-of-concept. Some early areas of discussion have led to decisions as detailed below.

- Centralised infrastructure and data model.
  A centralised data hub, initially hosted on GÉANT VMs, will handle data storage and access management for all the participating directories' data. Contributing directories will perform regular uploads to ensure the data is live. Consuming directories will request updated data either on a regular schedule or in response to a notification of new data.
  Figure 3.1 below shows the proposed Directory Sharing infrastructure and functionality, with distributed directories and a centralised policy and data hub. Translation modules are also shown, as each directory converts data into the standard format.
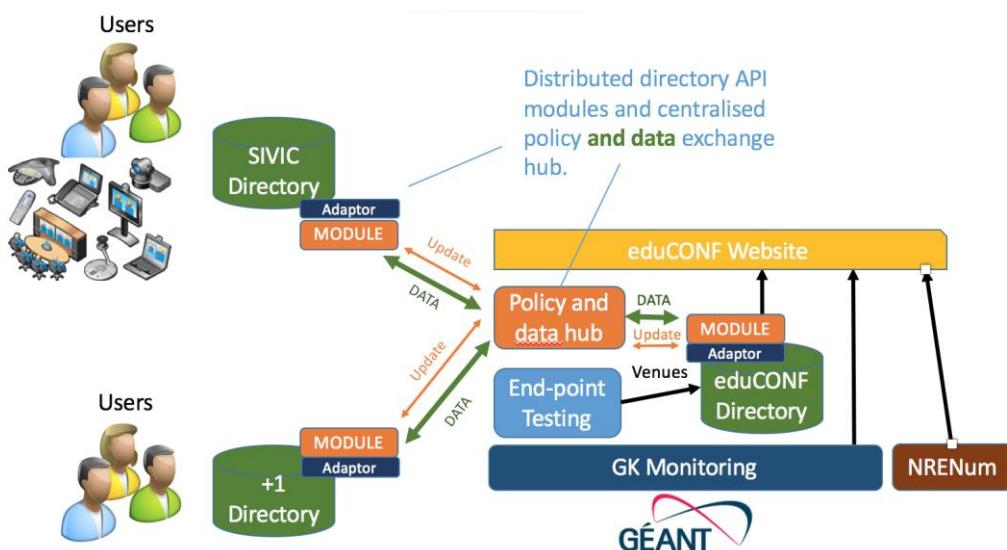
Figure 3.1: Data Sharing infrastructure and functionality

- Data protection policy alignment.
  To ensure data protection laws and good practice are maintained internationally, a standard policy must be used by any pilot or eventual directory sharing service to ensure that users are aware that their data is being used. All participating services must ask permission from existing and new users for their data to be shared in this way and describe how the data will be used. Users must have the ability to opt out of sharing their data. To avoid complications during the proof-of-concept, ahead of any official policy, dummy user data has been created to exchange in both directions.

- Sharing options.
  Each participating directory must have the ability to choose which other directories can access their data. For legal, political and data security reasons, a contributing directory must agree to share data with all the other participating directories individually to allow for differing standards of data protection and hence trust.

- Devolved responsibility for data translation.
  Each participating contributing directory is responsible for the translation of their own data structure into the agreed standard data schema. Advice on how to achieve this could be provided, and, at a later stage, translation software could also be provided if demand is sufficient.

At the time of writing, data has been successfully shared between the eduCONF Directory and SIVIC. Work is now progressing towards integrating this newly available data into the user workflow in a useful format and context.

It is recommended that the proof-of-concept be continued in the next phase of the GÉANT project.

3.2.3   NRENum.net Enhancements

NRENum.net has shown encouraging growth in membership in 2015, with nine new countries requesting delegation of their country code.

Resource from Task 1 was contributed to support enhancement to the NRENum.net project and specifically to the NRENum.net Crawler to improve stability and efficiency. This contribution recognises the importance of the NRENum.net service to videoconferencing users and services. Some eduCONF service interface changes were also added to link the two services together.

The role of the NRENum.net DNS Crawler is to crawl through the NRENum.net domain looking for Name Authority Pointer (NAPTR) records in order to resolve the NRENum.net tree.

Improvements to the NRENum.net Crawler made in GN4-1 include:

- The PHP library has been migrated from the deprecated Net_DNS to NET_DNs2 [NetDNS2]. This change includes new facilities:
  - DNSSeC validation.
  - IPv6 resolvers.
  - Source IP selection.
- Numerous back-end PHP script bug fixes have been applied.
- A new local resolver has been implemented for serving DNS queries more efficiently and the results. This, along with other minor changes, has solved the high-level CPU usage from the Crawler database. Figure 3.2 below shows the reduction in CPU usage following the resolver's implementation in August 2015.
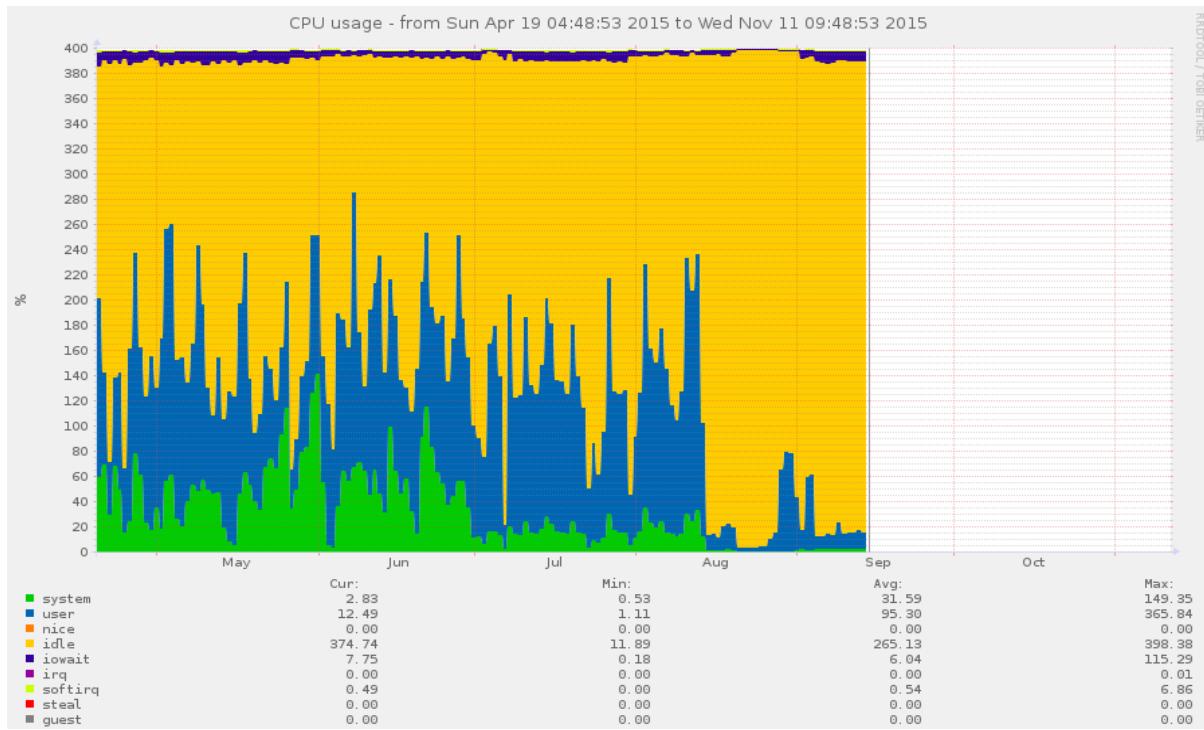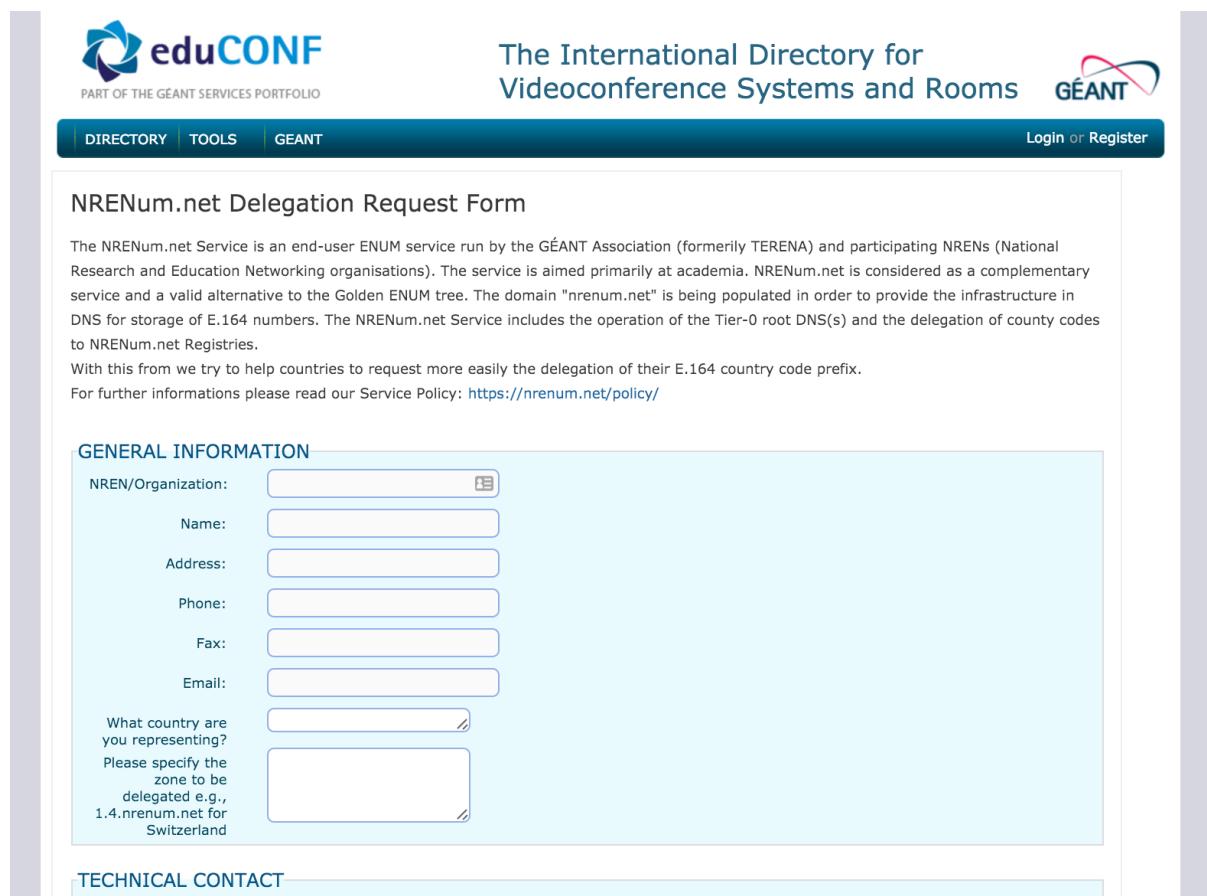
Figure 3.2: Reduction in CPU usage by NRENum.net Crawler database

Improvements to the eduCONF service to support NRENum.net include:

- When the eduCONF test is conducted on a VC system, and the address (IP, E.164 or SIP) is identified, the test results page also consults NRENum.net and indicates whether the tested address appears in the NRENum.net tree or not.
- The eduCONF service supports NRENum.net by hosting a registration form enabling national NREN representatives to request that they be delegated the right to manage their national country code (E.164 prefix) in the NRENum.net domain. The NRENum.net Delegation Request Form hosted on the eduCONF service is shown in Figure 3.3.

Figure 3.3: NRENum.net Delegation Request Form hosted on the eduCONF service

3.2.4 Usability Improvements

An initial SA8 T1 work package described a task to recruit more institutions and NRENs to use the GDS Monitoring service. This work was begun but usability issues were discovered relating to the gatekeeper registration process, and other linked areas. It was decided that the service reputation and eventual uptake would benefit if a rapid internal usability review was conducted and improvements made before continuing the recruitment process.

The review focused on the user processes of adding a gatekeeper to the Monitoring service and using the administration pages. The objective of most of the recommendations for change was to simplify, provide more descriptions in context, and ensure the process flow through a task followed intuitively.

Although many minor changes have been made, and are still in progress at the time of writing, the major areas of change are:

1. Simplification of the landing/home page to clearly identify the three main functions of the service (shown in Figure 3.4).

2. All references to "certification" removed, to avoid confusion and unclear terminology.

3. Links to FAQs added throughout the service (still in production). Draft FAQs are provided in Appendix A.

4. Simplification of the gatekeeper registration form (reduced down from several pages) to encourage more use (shown in Figure 3.5).
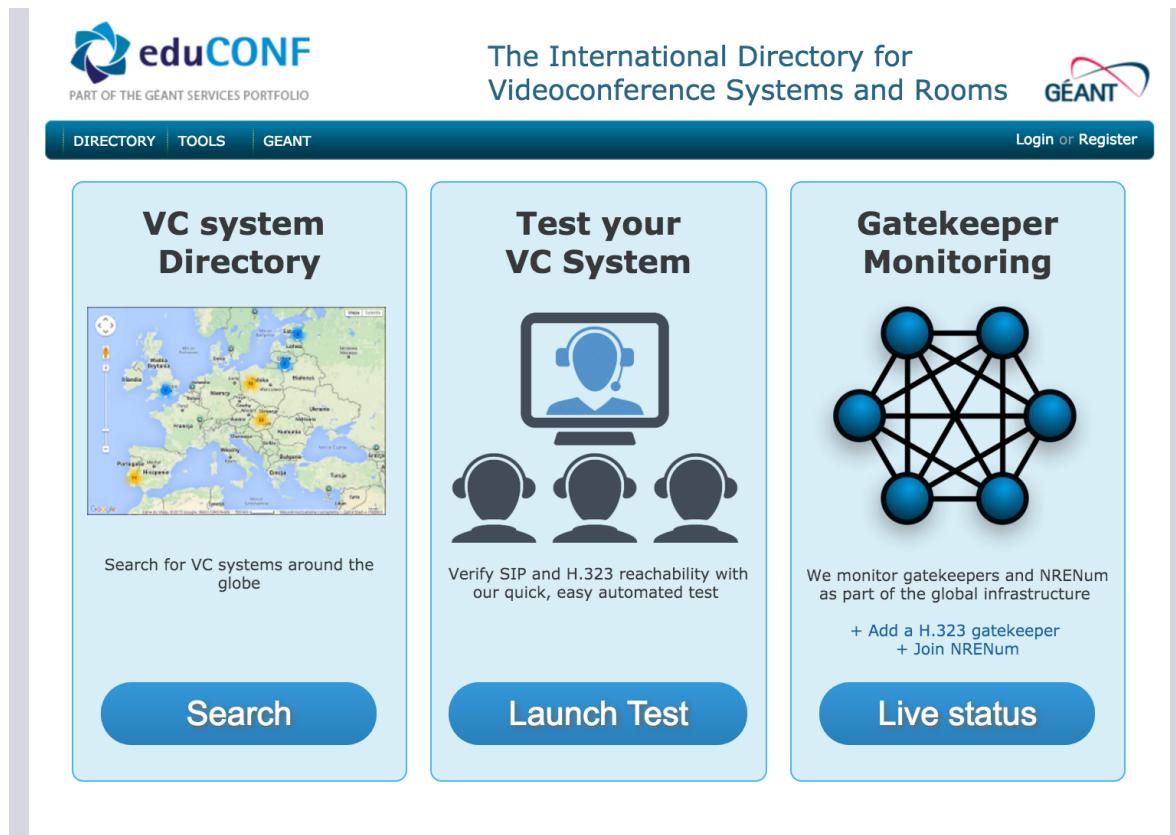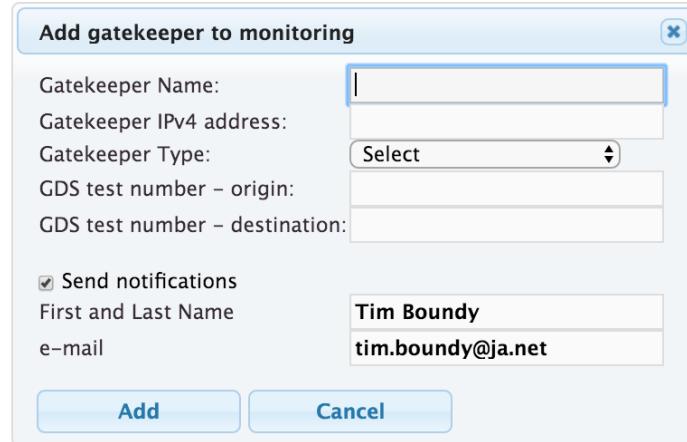
Figure 3.4: Simplified landing page clearly showing the three main service features

Figure 3.5: Simplified form to add a gatekeeper to the Monitoring service

4 Proposed Roadmap for Future Development

This section outlines recommendations for longer-term actions and strategic goals, for future projects to consider and adopt as appropriate. They cover the eduCONF service, Directory Sharing for WebRTC services and NRENum.net.

4.1 eduCONF Service

The eduCONF service is now entering a period of development stability in order that use and take-up can grow, and no significant development is expected in the near future. The service should be maintained to enable growth and promoted, particularly to encourage the Gatekeeper Monitoring service to become more widely used.

It is recommended that:

- The eduCONF Directory be supported by the GÉANT Operations team, providing first- and second-line support as described in the OLA document; only minimal effort is expected.
- Subject Matter Experts be provided by the appropriate development group in the next phase of the GÉANT project to support the service managed by GÉANT Operations, when required.
- Minimal service support work for the software be conducted by the appropriate development group in the next phase of the GÉANT project, sufficient to ensure the service software is kept up to date and any security concerns are addressed.

In the event that the Operations team and/or the Product Lifecycle Management team considers the service to be no longer relevant or not sufficiently used by the community, they may recommend that the service level be reduced.

4.2 Directory Sharing for WebRTC Services

It is expected that work done in GN4-1 will be continued in the next phase of the GÉANT project to support the development of collaboration services, specifically using WebRTC in the NREN community.

The two technology areas that can support WebRTC are a centrally managed STUN/TURN service for WebRTC implementations, and directory features to add contacts and dial-out or invite functionality to WebRTC services.

Relevant to the Directory Sharing work started by SA8 Task 1, it is anticipated that directory functionality will become an important feature of anticipated WebRTC services developed by GÉANT, NRENs or others. The facility for GÉANT to act as a central directory sharing service for multiple services aligns very well with the expectations for WebRTC to be used in multiple contexts and embedded in multiple sites and services.

To avoid the fracturing effect of so many disparate embedded services, it is expected that users will appreciate a single contact list of people and places to follow them between their various encounters with WebRTC services in the research and education community.

It would greatly ease development in WebRTC collaboration services if a commonly accepted or standard solution for directory functionality in WebRTC tools were to be built. This could come from many fronts, including commercial, but due to the wide variety of small-scale services expected to embed WebRTC, an open standard with fee-free access to a shared directory would be appreciated by most development groups.

The Directory Sharing approach, in tandem with the NRENum.net service, will also act to support discovery and addressing of the global network of VC systems, by strengthening the reliability of directory information on VC systems.

For these three main reasons – to provide easy-to-access directory services for WebRTC innovations, to develop a common standard for directory sharing, and to support discovery and addressing – it is recommended that the Directory Sharing proof-of-concept and additional pilot work be continued in the next phase of the GÉANT project.

4.3   NRENum.net

The NRENum.net service is essential to many NREN collaboration services for lookup of H.323 and SIP addressing for both voice and video.

To support the ongoing growth and popularity of the NRENum.net service it is recommended that GÉANT continue to contribute effort to administer the service. The service is run by the GÉANT community in a distributed fashion as state-of-the-art DNS. The low level of resource consumed by the development in GN4-1 has produced significant efficiencies and stability in the service that should enable better scalability for the future.

5 Directory Sharing Value Proposition

This section presents the value proposition for a potential GÉANT Directory Sharing service, clearly demonstrating its relevance and the added value it delivers. It covers reason to act, customer experience, benefits, alternatives and advantages (in the context of a SWOT analysis).

5.1 Background

There are numerous directories, linked to collaboration or videoconferencing services and systems, containing information on users, video endpoints or resources, conferences or events, and organisations.

The services can differ in their primary use model or raison d'être, but even so, the information required is very similar, and the users participating have the same overall requirement to collaborate. It is therefore an obvious value-adding technology that can offer the facility to create links between services and directories so that users of one service can access information sources from another.

Various international groups have discussed possible solutions, and the requirements for this work were jointly identified within the GÉANT eduCONF team and the CEO Forum working groups (now merged under one title, the Global Real-Time Communications working group (GRTC)). eduCONF – that is, Task 1 in SA8 – has taken the lead in development towards delivering a Directory Sharing service.

The initial requirement described by the global groups was solely to support H.323 services, and this directive has focused the practical objectives of the Directory Sharing proof-of-concept work being undertaken towards H.323 NREN services. However, future work does not need to be limited to H.323 or to a specific type of collaboration environment; the proof-of-concept has great potential to be used as a general solution for directories for a much wider variety of collaboration services using any technology for the actual collaboration, as discussed above in Section 4.2 "Directory Sharing for WebRTC Services".

5.2   Reason to Act

5.2.1   Outcomes of Acting

Acting to develop and deliver a global Directory Sharing service would have many advantages and would play to the strengths of the NREN global community. The trusted circle of NRENs is well placed to collaborate globally and the members of this same group can leverage their other complementary services, such as connectivity and federated identity, to support development in directory sharing.

The outcomes of acting in this area are:

- Support for development of new services (as expected in WebRTC) and an advantage given to NREN-grown services that can use the Directory Sharing service.
- NREN community further cemented in the role of a trusted central core for managing identity.
- Creation of a global group of NRENs with relevant services to protect user interests and who will not use data about the users' collaboration for commercial gain.

5.2.2   Consequences of Not Acting

Not acting to support the development of Directory Sharing would probably mean that no other non-commercial groups would provide a similar service. Users may be able to achieve similar results by using Facebook or Google federated access services, but this would be inconsistent across the global education community, and would not necessarily provide the same set of user details as the more education- / profession-oriented contacts used in institutional collaborations.

The consequences of not acting in this area are:

- Continued fragmentation and isolation of groups using different collaboration tools.
- Delayed development and take-up of WebRTC services as developers would need to create their own communities of users rather than benefit from existing ones.

5.3   Customer Experience

The key customer and service provider experiences are:

- **For students/researchers:** ease of transition between collaboration tools through the use of a single directory of VC systems and users or colleagues with whom they learn, work and collaborate, and access to a much wider pool of potential collaborators.
- **For professors:** better access to collaborators' and students' details across multiple collaboration services and video environments, and the ability to use the collaboration tools or services that closely match the specific use-case with confidence that the users will be able to access it.

- **For service developers and providers:** huge increase in potential users who can easily access any service and a much more populated collaboration environment to attract new users, even if the service provided is niche.

5.4 Benefits

The benefits are mainly due to increases in user confidence and usage of video services, namely:

- Increase in usage across all participating services, as users find it easier to collaborate with anyone from their chosen service.
- More collaboration in the research and education community globally, as technical or user perceived barriers are removed.
- Cost reduction on collaboration services, as the directory functionality is hosted independently and usage grows at scale.
- Migration of directory data between services is standard, reducing the issue of manufacturer lock-in for any institution.
- Increase in the quality and feature set of collaboration services, as users become more mobile and user choice is an important factor in the success of a service. Services compete to keep users.
- Increase in user confidence of being able to successfully collaborate remotely with a colleague.

5.5 Alternatives

There are no known direct alternatives that offer a potentially global service to share service directory data. Manufacturers have often found that giving users freedom to use any service is counter to their traditional business model of attempting to secure as much market share as possible. For the same reason, interoperability of collaboration services, e.g. Skype with H.323, has been slow to develop and is usually provided by third parties, rather than by the manufacturers themselves.

Many collaboration services offer the facility to connect an institution's existing LDAP directory or to peer with Exchange servers to utilise the institution's existing user directories. This can seem to populate a service directory with many collaborators, but it does not account for the external groups and global network that can frequently exist within a professional field. This approach can exacerbate the effects of non-interoperable islands of collaborators, which the Directory Sharing service aims to remove by merging the groups' directory data.

5.6 Advantages

Table 5.1 below presents the advantages of the Directory Sharing approach in the context of a Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis.

Strengths	Weaknesses
• Potentially global service governed and operated by NRENs • Data managed by agreements between trusted non-commercial NRENs • Important building block for other GÉANT and NREN development areas, e.g. WebRTC	• Work and commitment required by existing directory owners to implement sharing • Early concept requiring communication, dissemination and exploitation effort • Global group will require strong coordination and drive to solidify • Policy and governance decisions still outstanding
Opportunities	**Threats**
• Of great potential use for WebRTC collaboration service developments • Ability to participate in global standardisation movement • Build a global leadership role for NRENs in the area of directories	• Competitors coming from outside the GÉANT community • Data protection risks, or perceived risks

Table 5.1: SWOT analysis of the Directory Sharing approach

6 Conclusions

The development work undertaken by the Real-Time Applications Task in GN4-1 and described in this deliverable can be summarised as follows:

1. Work carried out to simplify the eduCONF service is largely complete and recruitment of additional users is ongoing. Now in production, the eduCONF service can be maintained at low cost. Hosting and first- and second-line support can be provided by GÉANT Operations, with minimal third-line support and Subject Matter Experts provided by the appropriate development group in the next phase of the GÉANT project.

2. Refinements to the NRENum.net Crawler have been successfully completed and the service is continuing to prove useful to NRENs, growing globally at a healthy rate. Low-level support should be continued.

3. The Directory Sharing proof-of-concept work shows great potential for the service to be useful both for existing collaboration and videoconference services and in future development of WebRTC collaboration tools. Support for this work should be continued, the proof-of-concept completed and a pilot service developed in the next phase of the GÉANT project.

Appendix A eduCONF Service Draft FAQs

This Appendix reproduces the set of draft frequently asked questions (FAQs) that will be provided to end-user visitors to the eduCONF site.

Testing

What is the eduCONF VC system test?

The test is an easy way to check whether your VC system is reachable from another external VC system (in this case, an eduCONF test system) and whether you are able to call outside (in this case, back to the eduCONF test system). You will receive an overview of the details of your system, which you can pass to your collaborators so they can call you. You can also review the reasons for any partial failures and learn how to make sure your system is as accessible as possible.

Who can use it?

The service is provided by GÉANT for the use of Research and Education Networks worldwide, but the test can be performed by anyone with an H.323 videoconference system with an IP, GDS or SIP-URI address.

H.323 or SIP – which test should I choose?

You can choose to run one test or both tests. Your VC system will have been configured by your system administrator to have either an H.323 address or a SIP address, or sometimes both. You may be able to identify which type of test is required for your system, but if in doubt, just try both tests and see which one works.

H.323

If your videoconference system uses H.323 then it can be called on an IP address (which looks like four groups of numbers with full stops between them, e.g. 193.198.203.999) or an E.164 number (which looks like a long international telephone number, e.g. 003857580949999), and you should choose the H.323 test.

SIP

If your VC system uses SIP (many modern desktop systems do) then you will have a SIP-URI address (which looks like an email address and includes an @ symbol, e.g. VCsystem@educonf.net) and you should choose the SIP test. To do the SIP test you will need to dial letters, which can be difficult from some controllers.

Pass or Fail – what do the results mean?

If your VC system passes all the tests it means that the eduCONF test system has been able to successfully connect to your VC system by either IP, GDS or SIP. You will then have the option to set a location for your VC system and add the details to the eduCONF Directory for others to find.

If your VC system fails any part of the test, this is often because the eduCONF test virtual endpoints did not receive a call from your system on the address provided, or cannot call your system back on the address detected. It is often best to contact your institution's IT Support, who will be able to advise you further, but some common reasons for failure will be made available in the user-accessible Known Error Database. If you believe that there may be an issue with the eduCONF testing service, then please inform us immediately.

What is an eduCONF Certificate?

An eduCONF Certificate is offered following a successful test of a videoconference system. The Certificate is available on the final page of the testing process, or from your VC system details page if you return to edit the details. You can download the Certificate as a PDF and print it.

Directory

What are the benefits of adding a tested VC system to the Directory?

As soon as your VC system has passed the test you can choose to add it to the Directory. This makes your system visible to other Directory users.

What can I use the Directory for?

You can use the Directory to search for available VC systems either in your location, to be able to participate in a meeting, or distant systems used by your partners, to reach them or invite them to a call.

Which systems appear in the eduCONF Directory?

The Directory includes VC systems (preferably meeting room units) added either by their users or imported from collaborating directories. Systems added directly to the eduCONF Directory must pass the test to be sure that they are reachable.

Help

Who do I contact for help?

Use the email educonf-support@geant.net or the contact form on the web page to send your request.

NRENum.net

What is NRENum.net?

From a technology point of view, NRENum.net is a DNS ENUM tree that allows translation of telephone numbers to H.323 or SIP URIs that are used to reach IP telephony and VC systems. The NRENum.net service is an end-user ENUM service run by the GÉANT Association (formerly TERENA) and participating National Research and Education Network (NREN) organisations. The service is aimed primarily at academia.

If you are the representative of an NREN willing to participate in NRENum.net you can fill out a Delegation Request Form to obtain your E.164 country code delegation.

If you are representing an institution willing to participate in NRENum.net, check the list of members to see whether your country has joined and who you should contact to obtain prefix delegation.

Monitoring

What is Gatekeeper Monitoring?

The eduCONF Gatekeeper Monitoring service monitors the global network of H.323 gatekeepers that enable videoconferencing calls to connect via the Global Dialling Scheme (GDS).

The Monitoring service periodically performs scheduled calls between all participating gatekeepers (usually at national level). This means that a complete bi-directional path between every pair of gatekeepers is tested. Virtual H.323 test endpoints, running on the GÉANT service infrastructure, are registered to the gatekeepers under test.

The first stage of each test is endpoint registration on each gatekeeper. Successful registration is a prerequisite for testing. Calls are then routed between the registered virtual endpoints. The same rules will apply to real calls. Exact call routing depends on the configured routing rules applied to the gatekeepers involved in the call. This may include the GDS infrastructure, ENUM-/NRENum.net-based routing and static peers.

Results are available on the eduCONF service website; optional email alerts can inform gatekeeper managers of any failed tests, and encourage them to investigate further.

The status of national gatekeepers, and the availability of GDS in a country, will appear on the Live Status map.

Who is eligible to use the Gatekeeper Monitoring service?

Managers of H.323 Gatekeepers at world, national, and regional level are all invited to use the service. Managers should represent an organisation in the research or education sector. GÉANT will manually approve requests to join the Monitoring service, and retains the right to select participants.

How do I add a gatekeeper to the Gatekeeper Monitoring service?

To add a gatekeeper to the Monitoring service:

1. Log in and from your profile page request an account upgrade to Gatekeeper Manager.

   This is a manual authorisation process managed by GÉANT to ensure the appropriate management. Once authorisation is granted you will receive an email informing you of this.

2. You can then choose "+ Add a H.323 gatekeeper", from the eduCONF home page or once you have logged in.

3. Fill in information about your gatekeeper(s): Name; IP address; two GDS numbers; and contact details.

   Two GDS numbers are needed to register test virtual endpoints at your gatekeeper. One number is used as the origin for outgoing calls and one for the destination for incoming calls. Be sure that there are no limits on your side, on either a network or call-admission level, and that the numbers will not be used by any other endpoints.

4. You can also choose whether to receive email notifications about any failed tests.

Appendix B Directory Sharing Working Documents

As outlined in Section 3.2.2.2, this Appendix contains:

1. eduCONF Directory Sharing module functional specification.
2. Common data model.
3. XML schema example.

B.1 eduCONF Directory Sharing Module Functional Specification

1. Introduction
    1.1. eduCONF intends to support a group of NREN service providers who host videoconferencing directories to mutually share directory data.
    1.2. Shared data could be any information associated with users, video systems and scheduling to enable users to view information about video systems and other users from within the environment/service/directory that they are registered with and used to using.
    1.3. It would be the responsibility of each directory to provide suitable user processes to enable search, and display results within their service.
    1.4. Data sharing would be controlled by a data conversion module. Each directory would go via the module to issue and accept requests and to convert the host DB formatting and structure into a standard sharing format (GVA Standard), which is described in a separate document.
    1.5. Directory administrators would download and install the module as an API data entry point to the system, and configure it appropriately to translate and issue or accept requests for data.
    1.6. Administrators can choose to share or not share any data fields and opt in to sharing with other directories registered with the core system.

2. Goal
    2.1. Provide a low-maintenance solution to enable directories to share information between other trusted partners.
    2.2. Perform a proof-of-concept pilot by enabling data to be shared between three or more directories.

3. Pilot scope
    3.1. The pilot module is initially designed for use globally by National Research and Education Networks (NRENs) and other not-for-profit public sector bodies.
    3.2. The pilot data shared does not describe resources' availability for MCUs, virtual rooms, or video systems, but this may be added to the scope at a later date.

4. Functional capabilities
    4.1. Incoming data request (suggested process):
        4.1.1. Authenticate requesting module for data from external service.
        4.1.2. Log request and assign ID to request.
        4.1.3. Respond to external service with request acceptance or denial.
        4.1.4. Perform transform from GVA standard request into internal service data request.
        4.1.5. Pass request to internal service via APIs.
        4.1.6. Process request result and transfer into GVA standard response.
        4.1.7. Route results from request to external requestor.
        4.1.8. Confirm results received by external requestor.
    4.2. Data request to external module (suggested process):
        4.2.1. Receive user request and translate into GVA standard via translations set by admin.
        4.2.2. Send request and authentication details to external module(s) (EM) as set by admin-approved shortlist of EMs.
        4.2.3. Receive and log assigned request ID from each EM.
        4.2.4. Log and deal with denial of request from each EM.
        4.2.5. Log and deal with acceptance of request from each EM.
        4.2.6. Receive results from each EM and send confirmation of receipt.
        4.2.7. Time-out non-responding EMs (cancel request?).
        4.2.8. Translate results into host directory terms.
        4.2.9. Timestamp results with TTL for host to process.
        4.2.10. Provide results to host directory interface.
    4.3. Administrator functionality:
        4.3.1. Each directory/module administrator must be able to:
        4.3.2. Download the module libraries and install the software.
        4.3.3. Set information about their directory, e.g. name, country, contact details, small icons/logos.
        4.3.4. Register the module details with the central list.
        4.3.5. Configure translation between the data objects in the host DB that they are willing/able to share and the GVA standard terminology. This must work with a variety of DB formats, e.g MySQL, Postgres, etc.
        4.3.6. Configure the address of the module for incoming requests.
        4.3.7. View the list and details of other directories and EMs (possibly on web/wiki).
        4.3.8. Opt in to each individual external directory for separately sending and/or receiving requests.
    4.4. Module update features:
        4.4.1. Each module should periodically and automatically check for updates from the core.
        4.4.2. Updates may include:
            4.4.2.1. Update to modules file – new or changed details describing other modules, e.g name or address change.
            4.4.2.2. Software version updates.
    4.5. Service reporting:
        4.5.1. Modules should report basic statistics of use monthly back to central DB, e.g. number of requests issues. Number of requests received. Types of data requested and received, etc.

5. Performance levels
    5.1. High availability and fast recovery times.
    5.2. Need to work out bottlenecks on simultaneous request capacity for receiving and requesting module.
    5.3. Low response time.
    5.4. Low transform time between external and internal formats.
    5.5. Fast de/encryption.

6. Reliability
    6.1. Expected high level of stability of the module software.

7. Security/Privacy
   7.1. All data should be appropriately encrypted between modules without compromising the speed of request from the encryption and decryption.

8. Quality
   8.1. Code must be reviewed by the appropriate GÉANT software security audit group (SA4 Task 1 in GN4-1, SA2 Task 1 in GN4-2) to test for security and suggest more efficient or secure methodology.

B.2   Common Data Model, Structure and Objects

The objects needed to support the data are:

- Room.
- Terminal.
- User.
- Group.

The Room object will gather all the information about the room, its location, features, scheduling and all the relevant information for the "user level".

The Terminal object will hold the information for the "management level" as it holds technical information about the terminal itself.

The User object will hold information for the user within the directory, either as user, manager or technical contact.

The Group object aggregates users within groups.

With regard to existence, the fields within an object can be:

- Mandatory – must exist or else the object should not be considered valid.
- Group Optional – all, or none, of the fields within the group must exist.
- Optional – field that may, or may not exist within the object.

The Room object is mandatory and must follow the following schema:

Name	Existence	Type	Date Domain
ID	**Mandatory**	**String**	**ID Algorithm**
LASTUPDATE	**Mandatory**	**Datetime**	**ISO8601 Timestamp**
SOURCE	**Mandatory**	**String**	**Service Realm ID**
address.building	Optional	String	Name of the building where the room is located
address.city	Optional	String	City where the room is located
address.country	Optional	String	Country code
address.county	Optional	String	County where the room is located
address.department	Optional	String	Department within the organisation
address.door_number	Optional	String	Door number within the building
address.floor	Optional	String	Floor within the building

Name	Existence	Type	Date Domain
address.postcode	Optional	String	Postal code
Address.state	Optional	String	State where the room is located
address.street	Optional	String	Street where the room is located
contact.admin.id	Optional	String	Person ID that is the administrative contact for the room
contact.admin.email	Group Optional	String	Administrative contact email
contact.admin.name	Group Optional	String	Administrative contact name
contact.admin.phone	Optional	String	Administrative contact phone
contact.scheduling.id	Optional	String	Person ID that is the scheduling contact for the room
contact.scheduling.email	Optional	String	Scheduling contact email
contact.scheduling.name	Optional	String	Scheduling contact name
contact.scheduling.phone	Optional	String	Scheduling contact phone
contact.support.id	Optional	String	Person ID that is the technical support contact for the room
contact.support.email	Optional	String	Local session setup support email
contact.support.name	Optional	String	Local session setup support name
contact.support.phone	Optional	String	Local session setup support phone
institution.name	Optional	String	Name of the institution in native language
institution.name_english	Optional	String	Name of institution in English language
institution.url	Optional	String	URL to institution website
location.latitude	Optional	Float	Latitude WGS84 coordinate
location.longitude	Optional	Float	Longitude WGS84 coordinate
photo.toaudience	Optional	String	URL to image facing audience
photo.building	Optional	String	URL to image of building
photo.toscreen	Optional	String	URL to image of room facing the screen
photo.room	Optional	String	URL to image of room
room.additional_equipment	Optional	String	Free text description about extra equipment available in the room
room.area	Optional	Float	Square meters
room.description	Optional	String	Room general description
room.english.description	Optional	String	Room general description in English
room.english.name	Optional	String	Room local name in English
room.has.access_for_handicapped	Optional	Boolean	Is the room accessible for handicapped people?

Name	Existence	Type	Date Domain
room.has.wired_internet_access	Optional	Boolean	Does the room have wired internet access available?
room.has.wireless_internet_access	Optional	Boolean	Does the room have wireless internet access available?
room.is_private	Optional	Boolean	Room for private use?
room.name	**Mandatory**	**String**	**Room name on location**
room.number_of_seats	Optional	Integer	Number of seats the room can hold using the videoconference system
room.phone	Optional	String	Phone number
room.status	Optional	Enum	Enabled / Disabled
room.type	Optional	Enum	Meeting room / Auditorium / Office / Class room
room.url	Optional	String	URL to room description
scheduling.after_hours.available	Optional	Boolean	Can the system be scheduled outside working hours, if requested
scheduling.after_hours.information	Optional	String	Conditions in which after hours scheduling is available
scheduling.afternoon.end	Optional	Time	Local time at end of day the system is schedulable
scheduling.afternoon.start	Optional	Time	Local time after lunch when the system may be schedulable
scheduling.guests_allowed	Optional	Boolean	Can the scheduling be done by unregistered users?
scheduling.morning.end	Optional	Time	Local time before lunch up to when the system may be schedulable
scheduling.morning.start	Optional	Time	Local time in the morning when the system may be schedulable
scheduling.need_confirmation	Optional	Boolean	Confirmation must be agreed by scheduling manager
scheduling.on_line_available	Optional	Boolean	Is the system scheduled either by phone/email or via the web?
scheduling.timezone	Optional	Timezone	Timezone of scheduling
scheduling.url	Optional	String	URL to room scheduling system
scheduling.weekend.available	Optional	Boolean	Can the system be scheduled during the weekend, if requested?
scheduling.weekend.information	Optional	String	Conditions in which weekend usage is available
usage.pricing	Optional	String	General information about pricing
terminal.main	Optional	Terminal ID, String	Terminal ID used in this room, by default
terminal.list	Optional	List of Terminal IDs, String	List, space separated, of terminal IDs that can be used in this room

The Terminal object is optional, but if it exists, it must follow this schema:

Name	Existence	Type	Date Domain
ID	**Mandatory**	**String**	**ID Algorithm**
LASTUPDATE	**Mandatory**	**Datetime**	**ISO8601 Timestamp**
SOURCE	**Mandatory**	**String**	**Service Realm ID**
address.h323.dns	Optional	String	H323 DNS address of terminal
address.h323.gatekeeper.e164	Optional	String	H323-E164 identifier on terminal
address.h323.gatekeeper.ip	Optional	String	IP of the gatekeeper where the terminal is registered
address.h323.gds	Optional	String	Full GDS number where the terminal can be reached
address.h323.gatekeeper.id	Optional	String	H323-ID string
address.h323.gatekeeper.zone	Optional	String	H323 zone of terminal
address.ipv4	Optional	String	IPv4 address of terminal
address.ipv6	Optional	String	IPv6 address of terminal
address.sip.dns	Optional	String	DNS address of terminal
address.sip.uri	Optional	String	SIP URI address of terminal
capabilities.camera	Optional	String	"Fixed" or "PTZ"
capabilities.has.h239	Optional	Boolean	Has H.239 capabilities?
capabilities.has.mcu	Optional	Boolean	Has MCU capabilities?
capabilities.mcu.ports	Optional	Integer	Number of ports supported by terminal
capabilities.quality	Optional	String	Max quality supported: CIF, 4CIF, HD, FullHD, …
capabilities.screens	Optional	Integer	Number of screens
capabilities.supports.h323	Optional	Boolean	Supports H323?
capabilities.Supports.sip	Optional	Boolean	Supports SIP?
manager.technical.users	Optional	List of Users IDs, String	List, space separated, of user IDs that are technical managers of this terminal
manager.administrative.users	Optional	List of Users IDs, String	List, space separated, of user IDs that are administrative managers of this terminal
manager.support.users	Optional	List of Users IDs, String	List, space separated, of user IDs that support this terminal in its daily operation
policy.contact_tech_before_calling	Optional	Boolean	If true, tech contact should be called before calling as the terminal needs assistance
policy.call_in	Optional	Boolean	Terminal security policy about calling in: "allow", "prefer", "unable"

Name	Existence	Type	Date Domain
policy.call_out	Optional	Boolean	Terminal security policy about calling out: "allow", "prefer", "unable"
room.main	Optional	Room ID, String	Room ID used by this terminal, by default
room.list	Optional	List of Rooms IDs, String	List, space separated, of room IDs where this terminal can be used
user.allowed.list	Optional	List of Users IDs, String	List, space separated, of user IDs that are allowed to use this terminal
group.allowed.list	Optional	List of Group IDs, String	List, space separated, of group IDs that are allowed to use this terminal
system.brand	Optional	String	Terminal brand
system.description	Optional	String	Terminal description
system.url	Optional	String	Terminal URL information
system.model	Optional	String	Terminal brand
system.name	**Mandatory**	**String**	**Unique system name**
system.status	Optional	String	Current status: enabled, disabled, in use, …
system.type	Optional	String	Round About, Fixed, Portable, Telepresence, …
tech_contact.email	Optional	String	Technical contact phone email
tech_contact.name	Optional	String	Technical contact phone name
tech_contact.phone	Optional	String	Technical contact phone number
terminal.is_mobile	Optional	Boolean	True if this system is portable and can be relocated on request
terminal.is_personal	Optional	Boolean	True if this is a personal system
terminal.is_reservable	Optional	Boolean	True if the terminal can be reserved or scheduled its use

The User object is optional, but if it exists, it must follow this schema:

Name	Existence	Type	Date Domain
ID	**Mandatory**	**String**	**ID Algorithm**
LASTUPDATE	**Mandatory**	**Datetime**	**ISO8601 Timestamp**
SOURCE	**Mandatory**	**String**	**Service Realm ID**
ep.eduPersonAffiliation	Optional	String	eduPerson Object Class definition
ep.eduPersonNickname	Optional	String	eduPerson Object Class definition
ep.eduPersonOrgDN	Optional	String	eduPerson Object Class definition
ep.eduPersonOrgUnitDN	Optional	String	eduPerson Object Class definition

Name	Existence	Type	Date Domain
ep.eduPersonPrimaryAffiliation	Optional	String	eduPerson Object Class definition
ep.eduPersonPrincipalName	Optional	String	eduPerson Object Class definition
ep.eduPersonEntitlement	Optional	String	eduPerson Object Class definition
ep.eduPersonPrimaryOrgUnitDN	Optional	String	eduPerson Object Class definition
ep.eduPersonScopedAffiliation	Optional	String	eduPerson Object Class definition
ep.eduPersonTargetedID	Optional	String	eduPerson Object Class definition
ep.eduPersonAssurance	Optional	String	eduPerson Object Class definition
p.audio	Optional	String	eduPerson Object Class definition
p.cn (commonName)	**Mandatory**	**String**	**eduPerson Object Class definition**
p.description	Optional	String	eduPerson Object Class definition
p.displayName	Optional	String	eduPerson Object Class definition
p.facsimileTelephoneNumber	Optional	String	eduPerson Object Class definition
p.givenName	Optional	String	eduPerson Object Class definition
p.homePhone	Optional	String	eduPerson Object Class definition
p.homePostalAddress	Optional	String	eduPerson Object Class definition
p.initials	Optional	String	eduPerson Object Class definition
p.jpegPhoto	Optional	String	eduPerson Object Class definition
p.localityName	Optional	String	eduPerson Object Class definition
p.labeledURI	Optional	String	eduPerson Object Class definition
p.mail	Optional	String	eduPerson Object Class definition
p.manager	Optional	String	eduPerson Object Class definition
p.mobile	Optional	String	eduPerson Object Class definition
p.o (organizationName)	Optional	String	eduPerson Object Class definition
p.ou (organizationalUnitName)	Optional	String	eduPerson Object Class definition
p.pager	Optional	String	eduPerson Object Class definition
p.postalAddress	Optional	String	eduPerson Object Class definition
p.postalCode	Optional	String	eduPerson Object Class definition
p.postOfficeBox	Optional	String	eduPerson Object Class definition
p.preferredLanguage	Optional	String	eduPerson Object Class definition
p.sn (surname)	**Mandatory**	**String**	**eduPerson Object Class definition**
p.st (stateOrProvinceName)	Optional	String	eduPerson Object Class definition
p.street	Optional	String	eduPerson Object Class definition
p.telephoneNumber	Optional	String	eduPerson Object Class definition
p.title	Optional	String	eduPerson Object Class definition

Name	Existence	Type	Date Domain
p.uid	Optional	String	eduPerson Object Class definition
p.uniqueIdentifier	Optional	String	eduPerson Object Class definition
p.userCertificate	Optional	String	eduPerson Object Class definition
p.userPassword	Optional	String	eduPerson Object Class definition
p.userSMIMECertificate	Optional	String	eduPerson Object Class definition
p.x500uniqueIdentifier	Optional	String	eduPerson Object Class definition
room.preferred.list	Optional	String	List, space separated, of room IDs that the user prefers. Ordered by preference, first the preferred room.
terminal.preferred.list	Optional	String	List, space separated, of terminal IDs that the user prefers. Ordered by preference, first the preferred terminal.

The Group object is optional, but if it exists, it must follow this schema:

Name	Existence	Type	Date Domain
ID	Mandatory	String	ID Algorithm
LASTUPDATE	Mandatory	Datetime	ISO8601 Timestamp
SOURCE	Mandatory	String	Service Realm ID
g.name	Mandatory	String	Name of the group

B.2.1 Special Attributes

ID

The ID must be computed on each site as a unique identifier based on local IDs and prefixed by the unique realm of the site and then hashed using the md5 function.

As an example, the educonf directory (educonf.geant.org) service should prefix the room information with internal ID "23" using the following code:

```
$id = md5("educonf.geant.org" + 23)
```

Source

To define the source of the information and allow later track-back of the data source, the service should provide its own FQDN as the "SOURCE" value. More information about FQDN can be found at [FQDN].

LastUpdate

LastUpdate should have the date of the last update of the object. If unable to send actual last update date, should send the current date and time.

Country

In order to reduce confusion between country names in different languages, countries must be referenced by their ISO 2-alpha identifier as described in "ISO 3166-1 alfa-2" [ISO3166_ISO; ISO3166_Davros].

{*}ID

The ID-suffixed attributes create a relationship between objects. The ID given should exist and be able to be searched on request.

{*}.list

The .list-suffixed attributes list IDs that are related to the current object. The list of identifiers should be space ('') separated and each ID should be searchable on request.

B.2.2 API Definition

The data schema proposal is to be used within an architecture that can take many forms:

- Star based – unique, central repository where applications submit and search data.
- Hierarchical – layered repositories across the world. Applications submit and search data at their nearest repository and it will push and pull data within the hierarchy to keep all the data updated and consistent.
- Full distributed – local repositories connect directly to other repositories in a peer-to-peer manner in order to submit and search data. Applications can contact one or more repositories, based on their needs.

Whatever architecture becomes the chosen one, an API must be defined to allow the automatic data flow between repositories. This document proposes that the API should be constructed based on a REST interface, using verbs to execute the several functions needed by the different elements of the architecture (repositories, scheduling and managing applications, end-user applications).

Queries will be done using HTTP protocol over GET or POST as usually used by other protocols; the response will be JSON reply with "text/json" content-type.

The queries will have a "verb" that will identify the action to be taken and a set of parameters that are dependent on the verb used. The format will be:

```
http::://<server>:<port>/<path>/?verb=<verb>&<param1>=<param
value2>&<param2>=<param value2>&…
```

B.2.2.1 API Verbs

The API should implement the following functions:

- Repository identification (Identify)
- List objects within the repository (ListRecords)
- Get object within the repository by ID (GetRecord)
- Get a set of objects within the repository present on an ID list (GetRecords)
- Request to Submit to repository (GetSession)
- Set or update object within the repository (SetRecord) [Optional]

Identify

This verb will be issued every time a client application or repository needs to access repository information.

The request has no parameters.

The response will be the current identification of the repository with the following parameters:

- RepositoryID – unique ID that should be created using the unique ID algorithm[1]
- RepositoryName – human readable string that identifies the repository
- Entity – human readable string that describes the entity owner of the repository
- Manager – user object that references the person that is responsible for the repository
- PublicKey – RSA public key for peers to use to cipher data when sending or receiving data using the SetRecord. Only required if the SetRecord verb is implemented.
- CurrentTime – server current time using ISO8601 Timestamp format
- MaxRecords – maximum number of results provided by this server. Returns "0" if not implemented.

Example:

Request:

```
http://server/api?verb=Identify
```

Response:

```
{
  "RepositoryID" : "e50d8da64a59908432da45f1e469ff96",
  "RepositoryName" : "Educonf Directory",
  "Entity" : "GÉANT Association – Educonf Service",
  "Manager" : {
    "ID" : "e50d8da64a59908432da45f1e469ff96",
    "LASTUPDATE" :"2015-02-10T12:20:50+00:00",
    "SOURCE" : "server.somewhere.org",
    "p.sn" : "Ribeiro",
    "p.cn" : "Rui",
    "p.mail" : "rui.ribeiro@fccn.pt",
    "p.telephonenumber" : "+351300005136"
  },
  "PublicKey" : ** PUBLIC KEY **
  "CurrentTime" : "2015-04-10T12:20:50+00:00",
  "MaxRecords" : 20
}
```

ListRecords

Verb that lists all the IDs of a set of objects within the criteria set. As input parameters:

- Object – name of the object to search for
- {field} – fields to lookup with exact text
- {fields}-regex – fields to lookup using regular expressions[2]
- {fields}-gt – fields to lookup that have a value higher than the defined
- {fields}-lt – fields to lookup that have a value lower than the defined

---

[1] md5({Institution Name} + " " + {RepositoryName} + " " + {sequential number})
[2] REGEX expressions. On PHP using "preg_match" function.

- next-page-hash – after the first query and if more records available

It will return an indexed list of objects with their unique IDs and the fields matched with their values. All the criteria are matched together on an "and" expression. If the application needs to make an "or", it must make a specific query for each part of the query.

Example:

Request:

```
http://server/api?verb=ListRecords&object=room&room.name-regex=(.*)
```

Response:

```
{
  "Rooms": [
    {"ID" : "e50d8da64a59908432da45f1e469ff96",
     "room.name" : "Center City University Main room"
    },
    {"ID" : "259e142ffc4496053072ff36347364aa",
     "room.name" : "New University Main room"
    }
  ],
  "CurrentTime" : "2015-04-10T12:20:50+00:00",
  "RemainingRecords" : 0
}
```

GetRecord

Verb that retrieves the record data of an object based on its ID.

- Object=[user|room|terminal|group]
- ID={ID}

Returns the object requested using JSON, unique object.

Example:

Request:

```
http://server/api?verb=GetRecord&object=room&ID=259e142ffc4496053072ff363
47364aa
```

Response:

```
{
  "Room" : {
     "ID" : "e50d8da64a59908432da45f1e469ff96",
     "LASTUPDATE" :"2015-02-10T12:20:50+00:00",
     "SOURCE" : "server.somewhere.org",
     "room.name" : "Center City University Main room"
  },
  "CurrentTime" : "2015-04-10T12:20:50+00:00"
}
```

GetRecords

Verb that retrieves the record data of an object based on its ID.

- Object=[user|room|terminal|group]

- IDList=[{ID}, {ID}, …]

Returns the object requested using JSON, array of objects.

Example:

Request:

```
http://server/api?verb=GetRecord&object=room&IDList=259e142ffc4496053072f
f36347364aa, 259e142ffc4496053072ff36347364aa
```

Response:

```
{
  "Rooms": [
    {"ID" : "e50d8da64a59908432da45f1e469ff96",
     "LASTUPDATE" :"2015-02-10T12:20:50+00:00",
     "SOURCE" : "server.somewhere.org",
     "room.name" : "Center City University Main room"
    },
    {"ID" : "259e142ffc4496053072ff36347364aa",
     "LASTUPDATE" :"2015-02-10T12:20:50+00:00",
     "SOURCE" : "server.somewhere.org",
     "room.name" : "New University Main room"
    }
  ],
  "CurrentTime" : "2015-04-10T12:20:50+00:00"
}
```

SetRecord

Verb that sets or updates the record data of an object based on its ID. Data should be sent to the server using POST method as a JSON structure on "data" field.

- SOURCE={Source ID}
- Data={doubled encrypted data JSON Object}

The SourceID will be used by the destination to identify which key to use from its own key ring repository. The data is first encrypted with the public key from the destination and then with the private key of the origin. To decode the data, the receiver first has to decrypt using the origin public key, then decrypt with the destination private key. This double step prevents data tampering and guarantees the identity of the issuer of the data.

The response will present the result of the action in two different variables:

- StatusID – Result status of the operation
- ResultID – Operation result

Status ID

StatusID	Status	Observation
0	Success	Operation was successful.
100	Failure	Operation was unsuccessful.
900	Unimplemented	Operation not implemented.

ResultID

ResultID	Result	Observation
10	Inserted	Operation succeeded, Item inserted
15	Updated	Operation succeeded, Item existed and was updated
20	Deleted	Operation succeeded, Item Deleted
100	Bad request	Operation failed, the request wasn't compliant
110	Bad keys	Operation failed, bad keys
120	Unauthorized	Operation failed, unauthorised

Example:

Request:

```
http://server/api?verb=SetRecord
```

Post Data:

```
SOURCE=server.somewhere.org
Data=**Encripted Data**
```

Response:

```
{
  "StatusID" : 0,
  "ResultID" : 15
}
```

An implementation of the API that does not implement the setRecord verb must return the following return:

```
{
  "StatusID" : 900,
  "ResultID" : 100
}
```

B.3   XML Data Schema

Examples of data schema are provided below for 4 objects: User, Terminal, Room and Group. In this terminology a Room represents a VC system.

User Data Schema

```
<?xml version="1.0" encoding="UTF-8"?>

<User>
  <ID>str1234</ID>
  <LASTUPDATE>2012-12-13T12:12:12</LASTUPDATE>
  <SOURCE>str1234</SOURCE>
```

```xml
      <ep>
        <eduPersonAffiliation>str1234</eduPersonAffiliation>
        <eduPersonNickname>str1234</eduPersonNickname>
        <eduPersonOrgDN>str1234</eduPersonOrgDN>
        <eduPersonPrimaryAffiliation>str1234</eduPersonPrimaryAffiliation>
        <eduPersonPrincipalName>str1234</eduPersonPrincipalName>
        <eduPersonEntitlement>str1234</eduPersonEntitlement>
        <eduPersonPrimaryOrgUnitDN>str1234</eduPersonPrimaryOrgUnitDN>
        <eduPersonScopedAffiliation>str1234</eduPersonScopedAffiliation>
        <eduPersonTargetedID>str1234</eduPersonTargetedID>
        <eduPersonAssurance>str1234</eduPersonAssurance>
      </ep>
      <p>
        <audio>str1234</audio>
        <cn>str1234</cn>
        <description>str1234</description>
        <displayName>str1234</displayName>
        <facsimileTelephoneNumber>str1234</facsimileTelephoneNumber>
        <givenName>str1234</givenName>
        <homePhone>str1234</homePhone>
        <homePostalAddress>str1234</homePostalAddress>
        <initials>str1234</initials>
        <jpegPhoto>str1234</jpegPhoto>
        <localityName>str1234</localityName>
        <labeledURI>str1234</labeledURI>
        <mail>str1234</mail>
        <manager>str1234</manager>
        <mobile>str1234</mobile>
        <o>str1234</o>
        <ou>str1234</ou>
        <pager>str1234</pager>
        <postalAddress>str1234</postalAddress>
        <postalCode>str1234</postalCode>
        <postOfficeBox>str1234</postOfficeBox>
        <preferredLanguage>str1234</preferredLanguage>
        <sn>str1234</sn>
        <st>str1234</st>
        <street>str1234</street>
        <telephoneNumber>str1234</telephoneNumber>
        <title>str1234</title>
        <uid>str1234</uid>
        <uniqueIdentifier>str1234</uniqueIdentifier>
        <userCertificate>str1234</userCertificate>
        <userPassword>str1234</userPassword>
        <userSMIMECertificate>str1234</userSMIMECertificate>
        <x500uniqueIdentifier>str1234</x500uniqueIdentifier>
      </p>
      <room.prefered.list>str1234</room.prefered.list>
      <terminal.prefered.list>str1234</terminal.prefered.list>
    </User>
```

Terminal Data Schema

```xml
    <?xml version="1.0" encoding="UTF-8"?>

    <Terminal>
      <ID>str1234</ID>
      <LASTUPDATE>2012-12-13T12:12:12</LASTUPDATE>
      <SOURCE>str1234</SOURCE>
```

```
        <terminal_identifier>
          <h323>
            <uri>str1234</uri>
            <alias>str1234</alias>
            <e164>str1234</e164>
          </h323>
          <sip>
            <uri>str1234</uri>
            <e164>str1234</e164>
          </sip>
        </terminal_identifier>
        <addresses>
          <IPv4>10.10.10.10</IPv4>
          <IPv6>str1234</IPv6>
          <FQDN>str1234</FQDN>
        </addresses>
        <primary_gatkeeper>
          <IPv4>10.10.10.10</IPv4>
          <IPv6>str1234</IPv6>
          <FQDN>str1234</FQDN>
        </primary_gatkeeper>
        <alternative_gatkeeper>
          <IPv4>10.10.10.10</IPv4>
          <IPv6>str1234</IPv6>
          <FQDN>str1234</FQDN>
        </alternative_gatkeeper>
        <capabilities>
          <camera>Fixed</camera>
          <secondary_video>true</secondary_video>
          <has_mcu>true</has_mcu>
          <mcu_ports>1234</mcu_ports>
          <quality>CIF</quality>
          <screens>1234</screens>
          <h323_support>true</h323_support>
          <sip_support>true</sip_support>
        </capabilities>
        <manager>
          <technical_users>str1234</technical_users>
          <administrative_users>str1234</administrative_users>
          <support_users>str1234</support_users>
        </manager>
        <policy>
          <call_in>true</call_in>
          <call_out>true</call_out>
        </policy>
        <room>
          <main>str1234</main>
          <list>str1234</list>
        </room>
        <user_allowed_list>str1234</user_allowed_list>
        <group_allowed_list>str1234</group_allowed_list>
        <system>
          <brand>str1234</brand>
          <description>str1234</description>
          <url>str1234</url>
          <model>
            <Ipv4>10.10.10.10</IPv4>
            <IPv6>str1234</IPv6>
```

```
      <FQDN>str1234</FQDN>
    </model>
    <name>str1234</name>
    <status>enabled</status>
    <type>Round About</type>
  </system>
  <tech_contact>
    <email>str1234</email>
    <name>str1234</name>
    <phone>str1234</phone>
  </tech_contact>
  <is_mobile>true</is_mobile>
  <is_personal>true</is_personal>
  <is_reservable>true</is_reservable>
</Terminal>
```

Room Data Schema

```
<?xml version="1.0" encoding="UTF-8"?>

<Room>
  <ID>str1234</ID>
  <LASTUPDATE>2012-12-13T12:12:12</LASTUPDATE>
  <SOURCE>str1234</SOURCE>
  <location>
    <building>str1234</building>
    <city>str1234</city>
    <country>str1234</country>
    <county>str1234</county>
    <department>str1234</department>
    <door_number>str1234</door_number>
    <floor>str1234</floor>
    <postcode>str1234</postcode>
    <state>str1234</state>
    <street>str1234</street>
    <latitude>3.14159</latitude>
    <longitude>3.14159</longitude>
  </location>
  <contact>
    <admin.id>str1234</admin.id>
    <admin.email>str1234</admin.email>
    <admin.name>str1234</admin.name>
    <admin.phone>str1234</admin.phone>
    <scheduling.id>str1234</scheduling.id>
    <scheduling.email>str1234</scheduling.email>
    <scheduling.name>str1234</scheduling.name>
    <scheduling.phone>str1234</scheduling.phone>
    <support.id>str1234</support.id>
    <support.email>str1234</support.email>
    <support.name>str1234</support.name>
    <support.phone>str1234</support.phone>
  </contact>
  <institution>
    <name>str1234</name>
    <name_english>str1234</name_english>
    <url>str1234</url>
  </institution>
  <photo>
    <toaudience>str1234</toaudience>
```

```
        <building>str1234</building>
        <toscreen>str1234</toscreen>
        <room>str1234</room>
      </photo>
      <scheduling>
        <after_hours.available>true</after_hours.available>
        <after_hours.information>str1234</after_hours.information>
        <afternoon.end>12:12:12</afternoon.end>
        <afternoon.start>12:12:12</afternoon.start>
        <guests_allowed>true</guests_allowed>
        <morning.end>12:12:12</morning.end>
        <morning.start>12:12:12</morning.start>
        <need_confirmation>true</need_confirmation>
        <on_line_available>true</on_line_available>
        <timezone>str1234</timezone>
        <url>str1234</url>
        <weekend.available>true</weekend.available>
        <weekend.information>str1234</weekend.information>
      </scheduling>
      <additional_equipment>str1234</additional_equipment>
      <area>3.14159</area>
      <description>str1234</description>
      <english.description>str1234</english.description>
      <english.name>str1234</english.name>
      <has.access_for_handicapped>true</has.access_for_handicapped>
      <has.wired_internet_access>true</has.wired_internet_access>
      <has.wireless_internet_access>true</has.wireless_internet_access>
      <is_private>true</is_private>
      <name>str1234</name>
      <number_of_seats>1234</number_of_seats>
      <phone>str1234</phone>
      <status>Enabled</status>
      <type>Meetingroom</type>
      <url>str1234</url>
      <usage.pricing>str1234</usage.pricing>
      <terminal.main>str1234</terminal.main>
      <terminal.list>str1234</terminal.list>
    </Room>
```

Group Data Schema

```
    <?xml version="1.0" encoding="UTF-8"?>

    <Group>
      <ID>str1234</ID>
      <LASTUPDATE>2012-12-13T12:12:12</LASTUPDATE>
      <SOURCE>str1234</SOURCE>
      <name>str1234</name>
    </Group>
```

References

[eduCONF]   http://services.geant.net/educonf/Pages/Home.aspx
[eduCONFDelForm]   https://educonf.geant.org/delegationform.php
[eduCONFDir]   https://educonf.geant.org/
[eduCONFVideo]   https://www.youtube.com/watch?v=F9yiJx5vtu0
[FQDN]   http://en.wikipedia.org/wiki/Fully_qualified_domain_name
[ISO3166_ISO]   http://www.iso.org/iso/home/standards/country_codes.htm
[ISO3166_Davros]   http://www.davros.org/misc/iso3166.html
[NetDNS2]   http://pear.php.net/package/Net_DNS2
[NRENum.net]   https://nrenum.net/

Glossary

AARnet	Australia's Academic and Research Network
APAN	Asia Pacific Advanced Network
API	Application Programming Interface
CPU	Central Processing Unit
DB	Database
DNS	Domain Name System
DNSSeC	Domain Name System Security Extensions
E.164	ITU-T recommendation that defines a numbering plan for the worldwide public switched telephone network and other data networks
ELCIRA	Europe Latin America Collaborative e-Infrastructure for Research Activities
EM	External Module
ENUM	Telephone number mapping
FQDN	Fully Qualified Domain Name
GDS	Global Dialling Scheme
GRTC	CEO Forum Global Real-Time Communications working group
GVA	Global Video Alliance
H.323	ITU-T recommendation that defines the protocols to provide audiovisual communication sessions on any packet network
HTTP	Hypertext Transfer Protocol
IP	Internet Protocol
ITU-T	International Telecommunication Union Telecommunication Standardisation Sector
JRA	Joint Research Activity
JSON	JavaScript Object Notation
LDAP	Lightweight Directory Access Protocol
MCU	Multipoint Control Unit
NAPTR	Name Authority Pointer
NAT	Network Address Translation
NREN	National Research and Education Network
OLA	Operations Level Agreement
OS	Operating System
PID	Project Initiation Document
PHP	PHP Hypertext Preprocessor
REST	Representational State Transfer
RSA	Rivest-Shamir-Adleman cryptosystem
SA	Service Activity

SA8	GN4-1 Service Activity 8, Real-Time Applications and Multimedia Management
SBC	Session Border Controller
SIP	Session Initiation Protocol
SLA	Service Level Agreement
SME	Subject Matter Expert
STUN	Session Traversal Utilities for NAT
TTL	Time-to-Live
TURN	Traversal Using Relay NAT
URI	Uniform Resource Identifier
VC	Videoconference
VM	Virtual Machine
WebRTC	Web Real-Time Communications
XML	eXtensible Markup Language