Standardisation of eduroam Testing, Monitoring, Metrics and Support Tools

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Disclaimer: The views presented in this paper are those of the author based on eduroam administrative experience and Global eduroam Governance Committee (GeGC) participation and does not reflect the views of AARNet Pty Ltd or the Global eduroam Governance Committee (GeGC).

Abstract

NREN delivered global services’ value propositions are based on a compelling set of core functionality (for eduroam, access to wireless networks at participating institutions via federated authentication, avoiding the administrative burden of providing guest accounts). Global uptake of services is also influenced by service delivery capabilities such as ease of deployment and provision of efficient and effective operations, administration and maintenance. Such capabilities are the focus of this paper, and are delivered via mechanisms referred to collectively as ancillary services. From a holistic perspective, the following categorisation of ancillary services is considered comprehensive:

- service administration
- deployment testing and auditing
- operability monitoring
- usage metrics
- administrator and end-user support

This paper reviews the state-of-the-art of eduroam ancillary services, focusing on the above five capability areas. The contribution of eduroam ancillary services to date by the European eduroam Operations Team (OT) is duly acknowledged.

This paper suggests that delivery of a comprehensive suite of globally standardised and endorsed ancillary services is a valuable, if not necessary, facilitator of eduroam uptake for countries not yet participating. At the current stage of evolution and global uptake of eduroam, it is suggested as necessary to (1) identify requirements for and provide a comprehensive suite of ancillary services, (2) question whether development of ancillary services is currently appropriately resourced, and (3) establish means to share effort in development and delivery of eduroam ancillary services globally.

A globally representative technical body under the Global eduroam Governance Committee (GeGC), referred to as the Global eduroam Technical Advisory Group (GeTAG), is currently under consideration. This paper proposes that consideration be given to the GeTAG’s role in meeting the ancillary services demand, organised complementarily to and working with the European eduroam operations team (OT) on standardisation, global collaboration and delivery of ancillary services for eduroam.

NREN delivered global services requiring national infrastructure and administration have common requirements for ancillary services. It is suggested that there is potential to extend applicability of the principles and model of delivery of ancillary services described for eduroam to global services delivery in general.

Keywords

NREN global services, eduroam, operations administration & maintenance, deployment testing, auditing, monitoring, metrics, support.
1. Introduction

Global NREN services and delivery strategies are under consideration due to the strategic initiatives such as the Global NREN CEO Forum [AARNet, 2012] and the goal of expanding NRENs' role in ‘above-the-net’ global service delivery. Eduroam [TERENA, 2014], a widely used service delivered by NRENs globally (providing network access to roaming users by virtue of remote federated authentication) has been in operation for over a decade and provides a valuable case-study of global service delivery.

The term “ancillary services” is used in this paper to refer to tools and services facilitating participation in delivery of a global service (e.g. eduroam, the global service example referenced in this paper). In very broad terms, ancillary services deliver ease of deployment and minimize operation, administration and maintenance (OA&M) burden and cost to operators. This paper proposes that delivery of a comprehensive suite of standardised and globally endorsed ancillary services is a valuable facilitator of eduroam global uptake, and necessary in order that resource constrained NRENs may participate in global service delivery.

This paper examines the impact of availability of ancillary services on eduroam uptake, ancillary services required for the global eduroam service, and describes services that are currently available, in particular those delivered by the European eduroam Operations Team (OT) under GEANT funding [GEANT, 2014].

A comprehensive suite of ancillary services is considered to include the following capabilities:

- service administration (e.g. sharing and maintaining up-to-date service configuration and descriptive data);
- deployment testing & auditing (e.g. checking policy conformance prior to and during service participation);
- operability monitoring (e.g. regularly checking and providing information on participant operability);
- usage metrics (e.g. providing information on service usage to key institutional stakeholders);
- support & troubleshooting (e.g. providing mechanisms for effective and efficient troubleshooting by service administrators and institutional support staff).

It is proposed that global uptake of eduroam will be enhanced and expedited by the standardisation, global collaborative development and centralised provision of a comprehensive suite of ancillary services. It is suggested that this will facilitate uptake by countries otherwise overly resource constrained to participate in eduroam.

This paper aims to address the topic of ancillary services’ impact on global services delivery and uptake from a holistic perspective, using eduroam as a case-study. Global services requiring national infrastructure and administration have common requirements for ancillary services, hence there is potential for extending applicability of the principles described for eduroam to NREN global services delivery in general.

2. Background

2.1 Entities and Actors in eduroam Service Delivery

Delivery of the eduroam service involves interactions between governance, OA&M and support at global, regional, national and institutional levels. Eduroam is jointly operated by regional, national and institutional ‘roaming operators’ and is implemented by a hierarchy of RADIUS servers:

- a top-level roaming operator for a region (TLRO) operates top-level RADIUS server(s) (TLRS) to route authentication requests between countries i.e. to/from NRSs (see below) within its region, and from/to other TLRSs;
- a national roaming operator (NRO) operates national RADIUS server(s) (NRS) to route authentication requests between institutions i.e. to/from IRs (see below) within the country(ies) it represents, and from/to the TLRS(s) for the region it belongs to; and
- an institutional roaming operator (IRO) operates institutional RADIUS server(s) (IRS) to route authentication requests from its institutional networking infrastructure to NRSs (for visitors from other participating institutions), or to authenticate local users (via the home institution’s identity store) as a result of authentication requests for local users from institutional networking infrastructure or from the NRS.

Institutional IT Support staff are responsible for providing support to end-users (both the institution’s own users and visitors), and NRS administration/support staff are responsible for providing support to institutional IT support staff.
The current governance and hierarchy of eduroam administrators, operators and RADIUS servers and their acronyms used in this paper, are depicted in Figure 1.

![Diagram of eduroam governance hierarchy]

Figure 1: Entities and actors in current eduroam service delivery

2.2 Global Uptake of eduroam

Eduroam started as a pilot service under TERENA’s TF-Mobility in 2003 [Wierenga, 2003]. From September 2004, operations and development of European eduroam has been funded by GEANT. The European eduroam Confederation policy was agreed and the European eduroam Operations Team (OT) was formed in 2007. Support services were developed and delivered for European eduroam, with the production service starting from Sept 2008 [TERENA, 2009].

Eduroam extended to countries in the APAN region, led by AARNet’s eduroam Project which commenced in 2006. AARNet commenced delivery of “eduroam AU” as a pilot service in 2008, with transition to an operational service in 2011. AARNet initially provided eduroam for New Zealand institutions; however in 2014 REANNZ took over operation of eduroam NZ. As a result of the APAN eduroam initiative, NROs also commenced operation in Hong Kong, Japan, Macao and Taiwan, with APAN top-level RADIUS Servers provided by Hong Kong Polytechnic University and AARNet. There is no overarching APAN eduroam policy for APAN participants; hence these countries do not constitute a ‘Confederation’ from a policy perspective. Two countries in the APAN region (Singapore and India) connect to the European TLRS.

Eduroam is in widespread use in Canada, and participation is growing steadily, albeit slowly, in the US. Canada joined eduroam in 2010 (initially under BCNet, then CANARIE from 2011). Internet2 announced plans to offer the eduroam service to US institutions in 2012. Canada and US national RADIUS servers peer with European and APAN top-level RADIUS servers.

Countries from other regions, such as South America and Africa, have recently commenced participation in eduroam, connecting via the European TLRS.

In order to provide global governance for eduroam, TERENA established the Global eduroam Governance Committee (GeGC) [TERENA-GeGC, 2013] in 2011. The GeGC created a global eduroam policy [GeGC-CS, 2011] and require signature of compliance by NROs in order to participate in eduroam. The GeGC membership includes 1 or 2 representatives nominated by each region.

2.3 Uptake of eduroam Ancillary Services

To date the OT, under GEANT funding, has been responsible for delivery of eduroam ancillary services for European eduroam. The OT has developed and deployed the Global eduroam Database which is a core shared resource for existing OT provided eduroam ancillary services:
• eduroam Monitoring Service (https://monitor.eduroam.org)
• eduroam Federation Ticker System (F-Ticks, https://monitor.eduroam.org/f-ticks)
• eduroam Configuration Assistant Tool” (CAT, https://cat.eduroam.org/)

The OT (in collaboration with other eduroam community members) has provided and maintained eduroam deployment documentation [OT, 2014]. GEANT has funded surveys and studies aimed at improving the eduroam service [GEANT-RoamDev1, 2010][GEANT-RoamDev2, 2011][GEANT-RoamDev3, 2013]. The OT’s focus is on serving the European region, however it also provides support globally in response to global issues e.g. the recent OpenSSL Heartbleed bug [Dekkers, 2014].

The major uptake in use of the GEANT funded tools has been in European countries, as reflected in the following statistics for eduroam (National Roaming Operators (NRO’s) are typically NRENs):

| Number of independent sovereign states in the world | 195 |
| Number of countries listed by GeGC | 84 |
| Number of signatory NROs globally* | 67 |
| Number of NROs in global database | 66 |
| Number of NROs being monitored by monitor.eduroam.org | 46 (all under European TLRS except CA) |
| Number of NROs using F-Ticks | 36 (all under European TLRS except CA) |
| Number of institutions using CAT | 587 |

* NRENs having signed the GeGC Global Compliance Statement

Being a signatory does not reveal how much eduroam is actually used by an NREN

Table 1. Use of OT developed ancillary services

The above statistics indicate that currently available ancillary services are not used by NROs outside Europe, with the exception of the Canadian NRO.

3. Role of Ancillary Services in Global Service Delivery

3.1 Impact On eduroam Uptake

In the APAN region, eduroam uptake has been much lower than in the Europe. Significantly, several countries have investigated eduroam participation but have not progressed to actual participation (including CN, FJ, KR, LK, MY, PG, PH, TH). The author has received requests from APAN countries seeking assistance to participate in eduroam, with referral being provided to global eduroam deployment information resources.

At least in the APAN region, it appears likely that the perception exists of a high barrier of entry to participate in eduroam and high ongoing OA&M costs. This paper suggests that a contributing factor to this perception is a lack of a comprehensive set of ancillary services to assist in delivery of the eduroam service.

It is the author’s view that a globally standardised, comprehensive, collaboratively delivered set of ancillary services, to which countries seeking to participate can be referred to assist eduroam deployment and OA&M, would contributed significantly to the uptake of eduroam in the APAN region.

3.2 Proposal for Ancillary Services Delivery

At the current stage of evolution and global delivery of eduroam, it is suggested as appropriate that the global eduroam community (represented by the GeGC) consider the importance of identifying requirements for and providing a comprehensive suite of ancillary services to countries already participating and wishing to participate in eduroam, to question whether development of ancillary services is appropriately resourced, and to discuss means to share effort in development and delivery of eduroam ancillary services globally.

Ancillary Services’ demand for development effort and developer ‘feet on the ground’ is increasing as eduroam uptake extends globally, as eduroam technology evolves, and as use of RADIUS infrastructure is extended to areas such as SAML over RADIUS [JISC, 2014]. It is anticipated that globally shared ancillary services for eduroam will require a mix of globally centralised and national delivery of services and storage of data, with some services and resources requiring protected access. It is suggested that access to ancillary services leverage inter federation technologies (e.g. eduGAIN [GEANT-eduGAIN, 2014]). Considerable technical effort will be required for ancillary services secure deployment. In short, there is a large amount of work required to establish ancillary services and to promote and provide for eduroam global uptake in the future.
The GeGC is currently considering establishment of a Global eduroam Technical Experts Group (GeTAG), and is in the process of determining its roles and responsibilities. The author proposes that consideration be given to the GeTAG’s role in delivery of ancillary services, organised complementarily to and working with the European eduroam Operations Team, and potentially other regional operation teams, on standardisation, global collaboration and distribution of ancillary services for eduroam. A candidate organisational structure is depicted in Figure 2.

Figure 2: Candidate eduroam entities and actors including ancillary services delivery

It is proposed that the GeTAG and OT work together to coordinate development and quality assurance, endorse and promote, and provide the distribution point for a standard set of ancillary services. In practice, this would involve collaborative review of currently available tools; assessment of additional requirements, data models, and need for additional tools; implementation of required functionality; undertaking quality assurance (including ensuring an adequate standard of documentation); provision of demonstration or test environments; and support for eduroam administrators in uptake of ancillary services.

3.3 Role of GeGC and Global Policy

Provision of a standard set of ancillary services is closely related to global governance and policy. Operational goals facilitated by ancillary services must be supported by global policy. This paper suggests a small but important set of additional policy items would be required to support operational goals of a comprehensive eduroam ancillary services suite.

4. Ancillary Services Requirements

4.1 Overview

For a global service such as eduroam, that is, those requiring substantial infrastructure and OA&M involvement by participating countries and institutions, ancillary services are required for:

- service administration (enabling self-administration of institutions and a data feed to the global database);
- deployment testing (checking that a new participants’ operability meets policy requirements);
- deployment auditing (checking existing participants operability and policy compliance on request or as a result of observed operational issues);
- operability monitoring (regular checking of operability of top-level, national or institutional servers and providing real-time operability information to participants);
- usage metrics (capturing usage logs and publishing statistical information for stakeholders e.g. institutional management);
- administrator and end-user support (delivery of efficient support to administrators at various levels, and institutional support for end-user support, including effective troubleshooting).
For eduroam, a comprehensive set of ancillary services facilitates the following deployment and OA&M tasks:

**GeGC / GeOT / TLRO / TLRS Administrator**

- Assist a new NRO to deploy eduroam and commence participation
- Assess whether a new NRO is operationally ready to participate (global policy compliant)
- Assess whether an existing NRO is policy compliant
- Identify operational issues globally and regionally and take appropriate action
- Determine global, regional and national usage, track service growth and uptake
- Assist NRS admins resolve operational issues

**NRO / NRS Administrator**

- Assist a new IRO to deploy eduroam and commence participation
- Assess whether a new IRO is ready to participate
- Assess whether an existing IRO is policy compliant
- Identify operational issues nationally and institutionally and take appropriate action
- Determine national and institutional service usage, track service growth and uptake
- Assist IRS admins resolve operational issues

**IRO / IRS Administrator**

- Assist end-users use eduroam
- Perform self-assessment of IRO readiness to participate
- Perform self-assessment of IRO policy compliance
- Identify operational issues institutionally and take appropriate action
- Determine institutional service usage, publish to institutional stakeholders, track service growth and uptake
- Assist institutional IT Support to provide eduroam support to end-users

**Institutional IT Support**

- Provide support to end-users efficiently and perform effective troubleshooting

**Institutional Management**

- Observe service usage and patterns of usage
- Determine and deliver appropriate eduroam resourcing

### 4.2 Eduroam Administration

Eduroam administration involves providing deployment configuration and descriptive data, populating a NRO or global database in order to share data with other eduroam participants. Institutional data includes general information and links for the institution, campus locations, eduroam RADIUS servers, realms handled, network access characteristics, eduroam informational and policy URLs, and eduroam contacts (technical, security, management).

General requirements of an eduroam NRO administration service include:

- Enable the NRO to define operational parameters of the national federation and register institutional participants and IRO/IRS administrators
- Enable institutional administrators to securely add their own institution data
- Enable institutional administrators and end-users served by the NRO to view institutional data
- Generate a data feed in the required format for population of the global database
- Generate NRO RADIUS server configuration automatically

### 4.3 Deployment Testing and Auditing

Deployment testing (prior to participation) and auditing (during participation) is required to confirm deployment and OA&M activities are in accordance with the relevant policies (Global eduroam Compliance Statement for NROs, National eduroam Policies for IROs).

The general requirements of an eduroam deployment testing and auditing service include:
4.4 Operability Monitoring

Monitoring of RADIUS servers participating in the eduroam service (TLRS, NRS, IRS) is important in order to take timely action in case of server or networking outages, and isolating the source of service interruptions. Monitoring enables eduroam administrators to confirming operability of their RADIUS servers in real time, with provision of alarms or alerts in case of server outage, as well as identifying other institutions’ operability in order to advise local users or assist in troubleshooting.

Operability Monitoring involves issuing authentication requests to RADIUS servers and observing the outcome. IRSs operate as both eduroam “Identity Providers” (IdPs, authenticating users for authentication requests originating locally or proxied from the NRS) and “Service Providers” (SPs, proxying authentication requests for visitors to the NRS). Monitoring from both perspectives should be undertaken. Monitoring from the IdP perspective requires provision of a test account. Monitoring from the SP perspective requires that the IRS be configured to trust a dedicated monitoring server hosted by the NRO.

General requirements of an eduroam Operability Monitoring service include:

- Secure storage of monitored RADIUS server configuration and monitoring credential information
- Active monitoring of both the IdP and SP operability of eduroam RADIUS servers
- Triggering local authentications at regular to confirm IdP operability
- Triggering proxied authentication requests to confirm SP operability
- Capturing and storing monitoring logs to enable current and historical operability analysis
- Provision of a web-page displaying current and historical operational status
- Generating alarms and alerts to RADIUS server administrators in case of operability issue

4.5 Usage Metrics

Metrics provide information on how the service is actually being used. If it is identified as being under-utilised, action can be taken to identify and address the cause. Metrics associated with both successful and unsuccessful authentication attempts should be provided, the latter informing NROs of possible issues or need for service education. Institutional management also have interest in detailed information on service usage patterns (aggregated at an institutional level).

A primary source of raw data for metrics NRS logs. Metrics should be presented on the basis of ‘unique’ users, typically per day for detailed metrics, also unique users per month to reveal service growth at a more course-grained usage level. Due to the secure protocols used for eduroam, and in consideration of data protection and privacy legislation, delivering logs based on unique users requires that an opaque, persistent, unique identifier be available in authentication request logs, specifically Chargeable-User-Identifier. Additionally the originating institution identifier for a particular authentication request needs to traverse multiple RADIUS server proxies using a RADIUS attribute “Operator-Name”.

Institutional metrics should also differentiate usage from an IdP perspective and an SP perspective. Institutions are often interested to differentiate between national users (authentications/network access by visitors from institutions in the same country) and international users in trend metrics, with detailed institutional usage information provided on a month-by-month or yearly basis.

General requirements for eduroam usage metrics include:

- Public access to aggregate metrics
- Protected access to detailed metrics for institutions
- Metrics based on unique users per time period (i.e. based on a unique user identifier)
- Institutional metrics divided into eduroam role (IdP or SP)
- Information on visited institution retained (e.g. Operator-Name)
- Provision of a standard set of annotations to aid in understanding the metrics
4.6 Administrator and End-user Support

There are three areas that have attracted significant attention due to their impact on the end-user experience and reputation of eduroam:

- Provision of clear and targeted eduroam information to end-users via a dedicated web-site (providing information to end-users on configuring devices to authenticate via eduroam, and eduroam coverage and operational status, is seen as a means of reducing demand on institutional support staff). This information should be available from eduroam administration services.

- Assisting end-users in device configuration by providing an automated generation of scripts or profiles, hence reducing configuration errors. It is also important that such a service enables users to test their connectivity while on their home campus, prior to travelling and using eduroam to access visited institutions’ networks.

- Eduroam policy states that end-users should, if possible, request support from the IT support staff at their home institution. Otherwise they should contact IT support staff at the visited institution. Regardless of which IT support is contacted, support staff need to be able to effectively troubleshoot end-user issues. A service should be provided via NROs enabling support staff to issue authentication requests (either using a user’s credentials or test credentials) and obtain access to information (e.g. logs) allowing troubleshooting to be performed. Similar requirements exist for monitoring, that is, provision of test accounts and configuration of trust for the NRO dedicated test and monitoring server.

4.7 Policy Requirements

Delivering operational goals of ancillary services implies deployment requirements that should be supported by global policy. For eduroam these include:

- delivery of RADIUS attributes Chargeable-User-Identifier (an opaque, persistent, unique identifier for a user) and Operator-Name (a unique identifier for an institution the authentication request is being made from);
- provision of institutional test accounts; and
- configuration of trust of dedicated test and monitoring server hosted by the NRO.

4.8 Generic Requirements

In addition to specific requirements corresponding to the five ancillary service categories, implementation of ancillary services should be assessed in terms of generic requirements, including:

- open source implementation, with source available via a readily accessible revision control system e.g. github
- protected access using of federated authentication and group-based access if appropriate
- extensibility (e.g. in order that NROs can include their own data elements, or to encourage community contributed development)
- localisability (ancillary services are also global)

The proposed quality assurance (QA) role of the GeTAG associated with development of ancillary services would involve undertaking activities to assure fitness for purpose. QA goals include delivery against agreed requirements, adequate documentation, functional correctness, and delivery against the above generic requirements.

5. Ancillary Services Currently Available for eduroam

Tools and services have been developed and continue to be maintained by the OT addressing several of the ancillary service requirements. These services, described below, provide monitoring (monitor.eduroam.org), aggregate metrics (F-Ticks) and end-user support in terms of generating device configuration scripts or profiles (eduroam CAT).

The Global eduroam Database [OT-DB, 2014], created by the European eduroam Operations Team under GEANT funding, is the central eduroam data resource used by monitoring, F-Ticks, and CAT. The Global eduroam database also is used for provision of information resources such as the global eduroam coverage maps [OT-MAP, 2014]. The iPhone/android mobile application (eduroam Companion) [JANET, 2014], developed under JISC funding, also uses data from the Global eduroam Database.
The Greek NREN, GRNET, has funded development of a web-based service (DjNRO) [GRNET, 2014] to be deployed by NROs which delivers automated, institutional self-administration of eduroam configuration and descriptive data. DjNRO is being used by various NROs, e.g. NZ and AU, for national and institutional eduroam deployment administration, and generates NRO data as required for feeding into the global database, allowing participating NROs and its institutions to be included in the global eduroam coverage maps.

These currently available ancillary tools (DjNRO, monitor.eduroam.org, F-Ticks, CAT) are described below under the appropriate ancillary service category.

5.1 Service Administration (DjNRO)

DjNRO is an open-source eduroam administration tool for NROs implemented in Python/Django. DjNRO by the NRO allows the NRO to configure basic national eduroam data, including countries served and participating institutions. Institutional administrators access DjNRO, nominate the institution for which they are responsible, and register. The NRO administrator activates the IRS administrator access. The IRS administrator is then able to add institutional, campus location, RADIUS server, eduroam realm, monitoring and contact information, and self-administer their institutional information and eduroam configuration data. Institutional administrators access DjNRO via federated authentication.

DjNRO provides institutional data & information pages for public viewing, and provides a data feed for the global eduroam database.

![DjNRO IRS Administrator Homepage](image)

Figure 3. DjNRO IRS Administrator Homepage.

5.2 Operability Monitoring (monitor.eduroam.org)

The GEANT funded, OT developed and operated site [http://monitor.eduroam.org](http://monitor.eduroam.org), displays result of TLRS and NRS monitoring undertaken using this service. It was developed for and is being used mainly within the European eduroam federation; however it can be used to monitor eduroam participating NRS and TLRS servers globally.

Information for including NRO and TLRS RADIUS servers in global monitoring is included in eduroam deployment instructions [OT-MON, 2014].
5.3 Eduroam Usage Metrics (F-Ticks)

The F-Ticks service ([https://monitor.eduroam.org/f-ticks/](https://monitor.eduroam.org/f-ticks/)) developed under GEANT funding by the OT provides aggregate TLRS, NRS and IRS metrics. The F-Ticks service is being used mainly within the European confederation. Information on contributing correctly formatted logs to F-Ticks is included in eduroam deployment instructions [OT-FTICKS, 2014].

Total successful and unsuccessful authentication requests based on unique MAC address are provided. For IRS, separate metrics are provided for operation as an IdP or SP. Statistical information is visible either as a graph, table or ‘communications matrix’, as shown over page.
5.4 End-user and Administrator Support Tools

5.4.2 Institutional eduroam Information Webpage

The DjNRO tool provides for display of institutional information via the DjNRO website.

5.4.3 End-User Device Configuration

The challenge of automating configuration of end-user devices has been met by the GEANT funded, OT developed service, eduroam Configuration Assistant Tool (CAT). CAT is deployed by the NRO, and is made available to institutions in order to generate institution specific configuration scripts or network connection ‘profiles’ (xml files) for various platforms based on parameters provided by the IRS administrator.

Platform coverage is comprehensive (Linux, Windows, MacOSX, IOS and Android mobile devices).

![eduroam CAT IdP Configuration and Device Configuration Download pages](image)

5. Ancillary Services Not Yet Available for eduroam

The capabilities not well served by currently available ancillary services for eduroam include:

- Operability Testing and Auditing
- Detailed Institutional Usage Metrics
- Administrator and End-user Support

High-level requirements of these services are proposed below (however this paper proposes that requirements should be collaboratively analysed and specified and globally endorsed by GeTAG and OT).

5.1 Deployment Testing & Auditing

Currently deployment testing is ad-hoc and does not adequately address the global, transactional nature of eduroam. For example, a basic challenge of eduroam, as a globally distributed transactional client-server service, is optimal handling of non-responsive peers, including mid-transaction request or response interruptions. Identification of non-responsiveness is performed by means of timers, and identification of peer resumption of operation is performed by timers and/or polled requests. Coupled with service resilience measures such as redundant server fail-over and load-balancing, optimal configuration of chains of RADIUS servers is complex. Test scenarios which cover this and other requirements should not be undertaken by individual institutions.

It is proposed that a collaborative effort be undertaken to design the appropriate test suite and knowledge shared globally. Ideally, a centralised, shared set of test procedures with automated execution via an ancillary service should be established.
A related requirement is that of comprehensive **deployment auditing**. It is proposed that a standard checklist be provided, including role of automation and ancillary services, for example to deliver a report on attributes released, and to generate a report of deployment operability identifying specific omissions.

### 5.2 Detailed Institutional Usage Metrics

Generation of detailed institutional usage metrics by AARNet and provision to individual eduroam AU institutions (protected access as commercially sensitive data) indicates that eduroam authentication and network access metrics are perceived as a valuable by-product of the eduroam service.

A standard service for NROs for generation of detailed logs, derived from NRS logs, providing comprehensive and detailed metrics for institutions, would be of benefit to all NROs. The tools used to deliver such a service may also be offered to institutions for their own deployment if they wish to obtain metrics based on their IRS logs.

![Whole of life trend for AU Institutions as eduroam 'service providers' (visitors accessing network at AU institutions via eduroam authentication)](chart1)

![Visitors accessing network via eduroam at AU institutions during 2013 (au)](chart2)

Figure 7. eduroam AU Detailed Institutional Metrics

### 5.3 End-User and Institutional Administrator Support

A critical shortcoming of eduroam currently is the inability of institutional end-user support to effectively troubleshoot eduroam issues. Anecdotally, institutional IT support perceive themselves as being ‘completely in the dark’ when it comes to eduroam troubleshooting. Eduroam institutional customers often refer end-users requesting support to the NRS administrator, which increases the NRS support burden.

There is a clear need for an ancillary service enabling institutional support to deliver effective end-user support which requirements including:

- Trigger a test authentication with either the user’s credentials or test credentials
- Access logs corresponding to that test authentication in real time at various levels of detail
• Obtain historical NRS logs from the NRO for a specified user within a certain time window

It is envisaged that requirements would include providing REST interfaces via services hosted by NROs to enable institutional support staff to trigger authentication. Such ’trouble-shooting’ authentications would use institutional test accounts or providing an interface for users to enter their own credentials, and to obtain logs from the NRS resulting from the authentication transaction.

NROs would be required to deploy service elements providing the required REST interfaces, and perhaps add additional RADIUS infrastructure to support delivery of different levels of log information (from summary to verbose RADIUS server logs, also packet captures).

Access to logs could be performed via a REST interface, and implemented using available software tools such as JISC’s Raptor [JISC-Raptor, 2014].

6. Issues for Global Ancillary Services Delivery for eduroam

Not-with-standing and with appropriate acknowledgement of the excellent GEANT funded work by the OT in delivering the Global eduroam Database and the majority of the currently available eduroam ancillary services, this paper seeks to pose a number of questions:

• How important are ancillary services to global service uptake?
• How good a handle does the eduroam community have on what ancillary service requirements are? and what form of consensus is workable?
• What can be learnt from current state of ancillary services for eduroam? and can lessons from eduroam be applied to other global services?
• Is current resourcing and organisation for delivery of ancillary services adequate in light of demands?
• What role can the GeGC and perhaps GeTAG play in resolving any perceived issues?
• Are there seen to be intractable issues that render these considerations moot?

This paper proposes that consideration be given to the role of the GeTAG working collaboratively with OT for global delivery of ancillary services. It is acknowledged that difficulties exist in achieving this goal, as outlined below.

Hence appropriate preliminary considerations are recommended to be undertaken by the GeGC:

• Can we at least progress some way to deliver global ancillary services that will have a positive impact on eduroam global uptake (for example, creating a catalogue of eduroam ancillary services developed in different countries, or a compendium of current development initiatives)?
• Will global representation and coordination (e.g. via the GeTAG) aimed at putting ‘more feet on the ground’ contribute a constructive outcome?

The following is a superficial analysis of issues which make delivery of a comprehensive, standard global eduroam ancillary services suite difficult:

• **Global Collaborative Development**: Coordinating services development and harnessing development globally is difficult. Defining collaborative roles and processes, identifying requirements, defining services, proposing project and prioritisation, identifying ‘lead development organisations’ is difficult enough nationally, let alone globally. There are several large-scale development cases studies to draw from, including Shibboleth by Internet2, OpenConext by SURFNet, Moonshot by JANET.

• **Global Governance**: Ancillary services themselves will require a level of global governance, i.e. to determine an ongoing roadmap for development responding to changing operational goals and policy aspects of the eduroam service.

• **Funding**: Final decisions on requirements are typically the prerogative of those who fund it. One aspect yet to be determined for ancillary services for eduroam is the funding model. It there an appetite for establishment of new funding models to transition from siloed development to becoming more globally equitable?

• **Sustainability**: Ancillary services need to be sustainable, i.e. have identified ownership and ‘perpetual’ roadmap, while enabling contribution by the global development community effort, with moderation by the
global technical bodies. Implementations should be extensible, with contribution to development encouraged by international collaborators. Keeping collaborative development ‘neat and tidy’ is difficult even without providing support for community contributions.

- **Requirement for Policy Support**: Several of the proposed eduroam ancillary services require change to eduroam global policy. Due to difficulty in gaining consensus on global policy, and getting institutions to sign up to policy, it will be difficult to implement policy changes required to support the operational goals of those ancillary services.

- **Differences in Data Protection and Privacy Laws**: Consistent application of ancillary services requires a uniform policy regarding release of logs, provision of test accounts, use of institutional credentials for troubleshooting, etc. Having uniform application across national borders may be restricted due to differences in national data protection and privacy laws, also differences with regard to limitations of liability and indemnity.

One point of unanimous agreement hopefully is that eduroam in its current form is a valuable service, and it currently plays an important role in education and research. The strength of eduroam is in the uptake, the number of users. Metcalfe’s law applies. And in the future, the more countries that partake in federated authentication, having both nationally supported SAML and RADIUS IdPs installed across R&D institutions, the more valuable federated authentication will become.

### 7. Conclusion

This paper has described the role of delivering a standard, comprehensive set of ancillary services in order to promote uptake of global services such as eduroam. Availability of ancillary services is important in terms of minimising cost of deployment and OA&M of the service, and contributes to delivery of a consistently well-engineered service to end-users.

The leadership provided by TERENA and GEANT in this area has been acknowledged, including service outcomes which have seen widespread use particularly in the European eduroam Confederation.

This paper has acknowledged the achievements of the European eduroam Operations Team, and has aimed at taking a holistic perspective and examining what constitutes a comprehensive set of ancillary services, providing a categorisation and detail regarding their purpose. We’ve reviewed the state-of-the-art of ancillary services for eduroam (the majority contributed by the OT), and identified those services that are not yet available.

For eduroam, to complement the work undertaken by the OT, and with the vision of further global representation and ‘putting more feet on the ground’ in provision of ancillary services for eduroam, the recommendation has been made for consideration the role of a Global eduroam ‘Technical Advisory Group’ (GeTAG) which is proposed to be formed by the GeGC.

This paper has not defined how the GeTAG would collaborate with the OT but assumes a workable arrangement could be found to collaboratively identify requirements for, coordinate implementation, ‘quality assure’ (across a broad range of agreed requirements for documentation, adherence to soft characteristics of localisation, extensibility, open-sourced, federated identity etc.), endorse and distribute ancillary services.

In taking a holistic perspective, we have also discussed potential issues in achieving global coordination, endorsement and delivery of eduroam ancillary services, and have identified strategic goals relevant to eduroam.

If it can be achieved, a standard set of ancillary services would enable new countries to join eduroam with the most comprehensive operational outcome and minimal administrative and maintenance cost burden. Standardisation of such tools would also enhance interoperability between participating countries by delivering improved testing and troubleshooting (e.g. for eduroam, feeding back into recommendations for optimal configuration of RADIUS servers).

This paper suggests that eduroam, as the most widely used ‘above-the-net’ service provided by NRENs, provides a valuable case-study in ancillary services and importance of standardised services for testing, monitoring, metrics and support for federated services. This paper suggests too that the principals of providing a comprehensive set of ancillary services can be applied to NREN global services which share common characteristics with eduroam (those requiring deployment of national infrastructure and ongoing OA&M, and those relying on federated access).
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Author Biography

Neil Witheridge is AARNet’s Manager, Authentication and Authorisation Services. He has worked in the Australian HE&R sector for the past 10 years, involved in federated identity projects at Macquarie University introducing Internet2’s Shibboleth federated identity infrastructure to Australia & establishing a pilot federation, then the Australian Research Collaboration Services (ARCS) project, integrating federated identity and access with ARCS services (e.g. Grid & Data Services). Neil is currently responsible for the “eduroam AU” service operated by AARNet, as well as providing technical support for federated services and contributing to AARNet’s services strategy, recently focusing on SURFnet’s OpenConext. Neil has Bachelors degrees in Engineering (Electrical) & Science (Psychology) and Master of Engineering Science degree from The University of Sydney.