

How To setup govroam for government organisations Cookbook

Setting up govroam is very similar to eduroam. The eduroam wiki itself may be used to configure for govroam. In general if an instruction states 'eduroam' for the govroam setup this must be 'govroam'.

Original source and credits:

<u>https://wiki.terena.org/display/H2eduroam/How+to+deploy+eduroam+on-</u> <u>site+or+on+campus#Howtodeployeduroamon-siteoroncampus-IdPandSPRADIUSinfratructure</u>

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1 govroam in a nutshell

1.1 General overview

govroam stands for governmental roaming. It offers users from participating govroam organisation secure Internet access at any other government participating location. The govroam architecture that makes this possible is similar to the eduroam (educational roaming) worldwide roll-out and over 15 years over experience. govroam as well as eduroam are based on a number of technologies and agreements, which together provide the govroam user experience: "open your laptop and be online".

The crucial agreement underpinning the foundation of govroam involves the mechanism by which authentication and authorisation works:

- The authentication of a user is carried out at their Identity Provider (IdP), using their specific authentication method.
- The authorisation decision allowing access to the network resources upon proper authentication is done by the Service Provider (SP), typically a Wi-Fi network or Wi-Fi hotspot.

In order to transport the authentication request of a user from the Service Provider to his Identity Provider and the authentication response back, a world-wide system of RADIUS servers is created. Typically, every Identity Provider deploys a RADIUS server, which is connected to a local user database. This RADIUS server is connected to a federation level RADIUS server, which is either in turn connected to the upstream RADIUS server infrastructure or can connect to other RADIUS servers dynamically (using the protocol RADIUS/TLS). Because users are using usernames of the format "user@realm", where realm is the IdP's DNS domain name often of the form institution.tld (tld=toplevel domain; both country-code TLDs and generic TLDs are supported), the RADIUS servers can use this information to route the request to the appropriate next RADIUS server until the IdP is reached. An example of the RADIUS hierarchy is shown in Figure 2.1, where Employee B is a guest in the network of Service Provider organisation A, which requests a check of the identity of Employee B over the govroam RADIUS infrastructure at the Identity Provider as configured within organisation B:



---- + 802.1x

To transfer the user's authentication information securely across the RADIUS-infrastructure to their IdP, and to prevent other users from hijacking the connection after successful authentication, the

access points or switches deployed by the SP use the IEEE 802.1X standard that encompasses the use of the Extensible Authentication Protocol (EAP). EAP is a container that carries the actual authentication data inside, the so-called EAP methods. There are many EAP methods an IdP can choose from.

govroam requires that the chosen EAP method must allow:

- mutual authentication (i.e. the user can verify that he is connected to "his" IdP whereever the user is
- encryption of the credentials used (i.e. only the user and his IdP will see the actual credential exchange; it will be invisible to the Service Provider and all intermediate proxies)

Some popular EAP methods in use in govroam are:

- PEAP ("Protected EAP") a Microsoft protocol that establishes a TLS tunnel, and sends usernames and passwords in MS-CHAPv2 hashes inside)
- TTLS ("Tunneled TLS") an IETF protocol that establishes a TLS tunnel, and sends usernames and passwords in multiple configurable formats inside)
- TLS ("Transport Layer Security") an IETF protocol that authenticates users and the IdP with two X.509 certificates
- FAST ("Flexible Authentication via Secure Tunneling") a Cisco protocol that establishes a TLS tunnel, and sends usernames and passwords in a custom way inside)

RADIUS transports the user's name in an attribute User-Name, which is visible in clear text to all intermediate hosts on the way. Some EAP methods allow to put a different User-Name into the RADIUS packet than in the EAP payload. In that case, the following terms are used:

- outer identity: this is the User-Name in the RADIUS packet and visible to all intermediate parties. It is recommended to configure this to not use the actual user identity, but <u>'anonymous@realm.tld'</u> instead
- inner identity: this is the actual user identification. It is only visible to the user himself and the Identity Provider

When using such EAP methods, and activating this option, the real username is not visible in RADIUS (it will only see the outer identity). Doing so will enhance the user's privacy, and is encouraged. Outer identities should be in the format "@realm" (nothing left of the @ sign, but the realm is the same as with the actual username). The realm part still must be the correct one as it is used to route the request to the respective Identity Provider. Once the IdP server decrypts the TLS tunnel in the EAP payload, it gets the inner identity and can authenticate the user.

The realm should end on a publicly available Top Level Domain (TLD). For the Netherlands, this is usually .nl.

After successful authentication by the Identity Provider and authorisation by the Service Provider, this SP grants network access to the user, possibly by placing the user in a specific VLAN intended for guests.

In the next chapter the various elements of this architecture and their functions is described.

1.2 Elements of the govroam infrastructure

1.2.1 Confederation top-level RADIUS Server (TLR)

The confederation top-level RADIUS Servers, at the time of writing, are located in the Netherlands and Denmark for the European confederation, and Australia and Hong Kong for the Asian and Pacific region. Each have a list of connected country domains (.nl, .dk, .au, .cn etc.) serving the appropriate National Roaming Operators (NROs). They accept requests for federation domains for which they are authoritative, and subsequently forward them to the associated RADIUS server for that federation (and transport the result of the authentication request back). Requests for federation domains they are not responsible for are forwarded to the proper confederation TLR.

1.2.2 Federation-Level RADIUS servers (FLRs)

A federation RADIUS server has a list of connected IdP and SP servers and the associated realms. It receives requests from the confederation servers and IdP/SP it is connected to and forwards them to the proper server, or in case of a request for a confederation destination to a confederation server.

1.2.3 IdP and SP RADIUS infrastructure

govroam IdPs operate a RADIUS server which is responsible for authenticating its own users, by checking the credentials against a local identity management system.

govroam SPs operate RADIUS capable equipment like Access Points or switches (see below). Large SPs typically also deploy an own RADIUS server, which is then responsible for forwarding requests from visiting users to the respective federation RADIUS server. Upon proper authentication of a user the SP RADIUS server may assign a VLAN to the user. Small SPs which do not require VLAN assignments can connect their RADIUS equipment directly to their FLR server, if the FLR permits that mode of operation.

Institutions which opt to be govroam IdP and govroam SP at the same time can have one RADIUS server that fulfils both roles simultaneously. This is the most popular deployment model in govroam.

Note that the IdP RADIUS server requires more configuration than the SP-part of the RADIUS server. Whereas the other RADIUS servers merely proxy requests, the IdP server also needs to handle the requests, and therefore needs to be able to terminate EAP requests and perform identity management system lookups.

1.2.4 Identity Management System

The Identity Management System of govroam IdPs contains the information of the end users; i.e. usernames and passwords. They must be kept up to date by the responsible IdP. An IdP RADIUS server will query the Identity Management system to perform the actual authentication for a user as he tries to log in.

1.2.5 Supplicants

A supplicant is a piece of software (often built into the Operating System but also available as a separate program) that uses the 802.1X protocol to send authentication request information using EAP. Supplicants are installed and operate on end-user computing devices (e.g. notebooks, PDAs, WiFi-enabled cell phones, and so on).

1.2.6 Access Points

Access Points are Wireless LAN access devices conformant to IEEE 802.11 (wireless) networking protocols and need to be IEEE 802.1X capable. Support for commonly available frequency bands, current ones and those standardised and licensed appropriately, is strongly advised. They must be able to forward access requests coming from a supplicant to the SP RADIUS server, to give network access upon proper authentication, and to possibly assign users to specific VLANs based on information received from the RADIUS server. Furthermore, Access Points exchange keying material (initialisation vectors, public and session keys, etc.) with client systems to prevent session hijacking.

Please note that sometimes the shortcut "802.11x" is used for the set of wireless IEEE protocols like 802.11b, 802.11ac and so on. This shortcut is not to be confused with the 802.1X protocol that focuses solely on access control.

1.2.7 Switches

Switches need to be able to forward access requests coming from a supplicant to the SP RADIUS server, to grant network access upon proper authentication and to possibly assign users to specific VLANs based on information received from the RADIUS server.

1.2.8 VPN

The RADIUS protocol combined with EAP provides a safe way to tunnel authentication requests. To add additional security, the RADIUS packets can be encrypted by radsec on the RADIUS level, or sent over a pre-setup VPN tunnel towards the national govroam servers (upon request during the onboarding)

1.2.9 Firewalls and other infrastructure

Although a firewall should be simply configured to allow for the RADIUS traffic to pass to the govroam servers and back, from experience, a couple of recommendations are given:

- The firewall should be configured to allow both incoming as well as outgoing connections (of course)
- The firewall should, if it is 'application aware', be checked to allow the detected 'application'
- The firewall should not block segments of fragmented packets

If NAT is used to connect the RADIUS server(s) to the internet, please be aware that the NAT-address should have a fixed mapping to the public IP-address. Also make sure that the mapping is symmetrical, so the same public IP address is used for both incoming as well as outgoing RADIUS traffic (the might, if not explicitly configured, default to a different public IP address).

2 govroam set up on government location: IdP and SP

The following sections provide detailed information for the two roles govroam IdP and govroam SP, respectively.

The govroam IdP section explains the administrative obligations for an govroam IdP, the setup of several popular RADIUS servers, and means to provision configuration details of supplicants to end users.

The govroam SP section explains general basics of wireless LAN deployment, the administrative obligations for an govroam SP, and the setup of several popular vendor Wi-Fi environments for use in govroam.

2.1 govroam SP

Basic deployment considerations for wireless LANs.

A govroam wireless network is a wireless network. This sounds trivial, but it is important to keep in mind that

- a poorly managed Wireless LAN won't magically become better by naming it govroam. Before diving into govroam -specific configuration, make sure you understand how to manage
 - Wi-Fi coverage
 - o bandwidth requirements
 - o enough DHCP addresses to accommodate all clients
- by naming the network govroam, you are becoming part of a recognised brand. Arriving users
 will think of this being an govroam network, with a set of expectations for such networks. If your
 wireless network fails to deliver in the points mentioned above, users will consider this an
 govroam failure and your installation will hurt the (global) brand govroam, not only your own
 site and users.

This section provides general advice regarding wireless LAN deployment. It is not meant as a replacement for further literature; there are many books and online publications regarding good wireless LAN planning, and you are encouraged to familiarise yourself with this topic.

Please note that the technologies that govroam authentication relies on (802.1X, RADIUS), stem from the world of wired connectivity, also summarised as 'Network Access Control' (NAC), and can be used for the purpose of providing safe access to wired networks as well.

2.1.1 Set up of Wi-Fi hotspots (Cisco)

All of the solutions presented below support the basic requirements for a govroam SP: support for IEEE 802.1X authentications, WPA2/AES or WPA3 support. When deploying govroam, deployers often want to make use of additional features such as multi-SSID support, dynamic VLAN assignment and others. Every section contains a table with a short overview of their support of such additional useful features.

Cisco (controller-based solutions)

Feature

supported?

Multi-SSID	yes
VLANs	yes
dynamic VLAN assignment	partial; not with Ipv6

The example configuration shown in this chapter was obtained from a Cisco 4400 Series Wireless LAN Controller.

2.1.2 Initial settings and defining the IP address

In the first phase the controller must be accessed through the Command Line Interface (CLI). When an IP address has been assigned to the controller, further configuration can be done using the web interface, but the CLI can be continued to be used.

Establish access to the controller by using a serial console and configure the initial settings for example as follows.

Welcome to the Cisco Wizard Configuration Tool Use the '-' character to backup System Name [Cisco b2:e2:83]: <your system name> Enter Administrative User Name (24 characters max): <your username> Enter Administrative Password (24 characters max): <your password> Re-enter Administrative Password : <your password> Service Interface IP Address Configuration [none] [DHCP]: DHCP Enable Link Aggregation (LAG) [yes][NO]: NO Management Interface IP Address: esim. Xxx.yyy.zzz.1 Management Interface Netmask: <your_network_mask> Management Interface Default Router: <your router's IP address> Management Interface VLAN Identifier (0 = untagged): <0 or 1> Management Interface Port Num [1 to 2]: 1 Management Interface DHCP Server IP Address: esim. Xxx.yyy.zzz.2 AP Transport Mode [layer2][LAYER3]: <layer2 if controller and access points are on same subnet; layer3 if routing in between> AP Manager Interface IP Address: esim. Xxx.yyy.zzz.3 AP-Manager is on Management subnet, using same values AP Manager Interface DHCP Server (xxx.yyy.zzz.2): Virtual Gateway IP Address: xxx.yyy.zzz.www Mobility/RF Group Name: <choose a suitable name if you have more than one controller. Otherwise, don't care> Enable Symmetric Mobility Tunneling [yes][NO]: NO Network Name (SSID): <Define a test SSID at first> Allow Static IP Addresses [YES][no]: no Configure a RADIUS Server now? [YES][no]: no #Will be done later Warning! The default WLAN security policy requires a RADIUS server. Please see documentation for more details. Enter Country Code list (enter 'help' for a list of countries) [US]: <your country abbreviation> Enable 802.11b Network [YES] [no]: no Enable 802.11a Network [YES] [no]: YES Enable Auto-RF [YES] [no]: YES Configure a NTP server now? [YES] [no]: no #Will be done later Configure the system time now? [YES][no]: no #Will be done later Warning! No AP will come up unless the time is set.

Please see documentation for more details.

Configuration correct? If yes, system will save it and reset. [yes] [NO]: yes

#When the system has rebooted, familiarize yourself with the CLI by defining (Cisco Controller) >config time ntp server 1 xyz.zyx.zzy.wyz (Cisco Controller) >config time ntp server 2 xyz.zzz.zzy.wyz

2.1.3 Access Control Lists

After the initial setup, the access control (ACL) list needs to be configured, in order to prohibit unauthorized access to the controller. Choose SECURITY and then Access Control Lists | Access Control Lists and create an ACL by pressing New... The ACL shoud include at least

- the networks from which maintenance is carried out
- the address(es) of the monitoring server(s)
- the network(s) from which the Aps and the WLAN clients get their addresses
- the address(es) of the RADIUS server(s)
- a rule to always answer ping commands

An example of an ACL is shown below. Inbound means packets towards the controller and outbound means packets towards the WLAN

uluilu cisco	MON	itor <u>n</u>	<u>/L</u> ANs	<u>C</u> ONTRO	ller w <u>i</u> reless	<u>S</u> ECURITY	MANAGEMENT	C <u>O</u> MMANDS	HELP				Sa <u>v</u> e Configuration	<u>P</u> ing Lo
Security	Acc	ess Con	ntrol Li	sts > Ed	it								< Back	Add New
General	Gen	eral												
Authentication Accounting Fallback TACACS+ LDAP Local Net Users MAC Filtering Disabled Clients User Login Policies AP Policies	Access List Name acl_mgmt Deny Counters 158618 Eco. Action. Source 10 / Mack.		Destination			Source Dest				Number				
	Seq	Action	Sourc	e IP/Mas	k	IP/Mask		Protocol	Port	Port	DSCP	Direction	of Hits	
	1	Permit	193.	.1.0	/ 255.255.255.0	0.0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
	2	Permit	193.	.2.0	/ 255.255.255.0	0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
Local EAP	_3	Permit	193.	.4.225	/ 255.255.255.255	0.0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
Priority Order	4	Permit	193.	.4.238	/ 255.255.255.255	0.0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
Certificate	5	Permit	193.	.254.61	/ 255.255.255.255	0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
Accord Control Lists	_6	Permit	193.	.187.10	/ 255.255.255.255	0.0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
Access Control Lists	7	Permit	193.	.4.128	/ 255.255.255.192	0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
CPU Access Control	_8	Permit	0.0.0.	0	/ 0.0.0.0	0.0.00	/ 0.0.0.0	ICMP	Any	Any	Any	Inbound		
Wireless Protection Policies	9	Permit	193.	.163.0	/ 255.255.255.0	0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
	10	Permit	193.	.0.155	/ 255.255.255.255	0.0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
Web Auth	11	Permit	193.	.0.222	/ 255.255.255.255	0.0.0.0	/ 0.0.0.0	Any	Any	Any	Any	Inbound		
 Web Auth Advanced 									MORES.	Read Pr				

After you have specified the ACL you need to take it into use by first selecting Access Control Lists from the side bar and by choosing your ACL and specifying the CPU ACL Mode to *Wired* or *Both*.

2.1.4 Access Point configuration: Cisco

If the access points are connected to the same subnet as the controller, they will automatically find the controller and connect to it. If this is not the case, the IP address of the controller must be find from the name server by the name CISCO-LWAPP-CONTROLLER. Once the access point has found the controller, it stores the IP of the controller, and it can connect to it from any network, as long as the network allowed access in the ACL (see previous section).

The next step is to define the wireless network, which has to be done separately for 2,4 GHz and 5 GHz. First, choose WIRELESS and then 802.11b/g/n | Network. Enabling the 802.11b-standard will result in less available capacity on your network and therefore it is recommended to enable only the standards 802.11g and 802.11n. Enable 802.11g according to the figure shown below. If you want to support also the 802.11-b standard, set _Mandatory_ for the lowest 802.11b-rate that you want to

support (1 Mbps, 2 Mbps, 5.5 Mbps or 11 Mbps), set _Supported_ for all data rates higher than this rate and _Disabled_ for all rates lower than this rate. If 802.11b needs to be supported, it may pay off to disable the lowest rates, in order to avoid clients being attach to an AP far away, unwilling to roam.

	<u>M</u> ONITOR <u>W</u> LANS <u>C</u> ONTR	OLLER WIRELESS	SECURITY	MANAGEMENT	Save Configuration Ping COMMANDS HELP	Logout <u>R</u> efresh
Wireless	802.11b/g Global Parame	eters				Apply
Access Points All APs	General			Data Rates**		
 802.11a/n 802.11b/g/n Global Configuration Mesh HREAP Groups 802.11a/n 802.11b/g/n Network RRM RF Grouping TPC DCA Coverage General Pico Cell Client Roaming Voice Video 	802.11b/g Network Status 802.11g Support Beacon Period (millisecs) Short Preamble Fragmentation Threshold (bytes) DTPC Support. CCX Location Measureme Mode	Enabled Enabled Enabled 2346 Enabled Enabled Enabled		1 Mbps 2 Mbps 5.5 Mbps 6 Mbps 9 Mbps 11 Mbps 12 Mbps 18 Mbps 24 Mbps 36 Mbps 48 Mbps 54 Mbps	Disabled V Disabled V Mandatory V Supported V Supported V Supported V Supported V Supported V Supported V Supported V	
Video EDCA Parameters High Throughput (802.11n) Country Timers QoS	** Data Rate 'Mandatory' imp specific rate will not be able to implies that any associated of may communicate with the A, that a client be able to use th associate. The actual data rat channel selected as different bandwidths. The reason is the to select the data rates. But in data rate allowed for that cha supported.	lies that clients who do o associate. Data Rate lent that also supports to Using that rate. But it e rates marked support es that are supported d channels may have diff it we show data rates a n reality, the AP will piot nnel if the chosen data	not support tha Supported' hat same rate de in order to epend on the erent nd alow the use to the next lowe rate is not	er r		

Next, switch to enable the standard 802.11a for 5 GHz by selecting 802.11a/n | Network. Configure the settings according to the figure below.

	<u>M</u> ONITOR <u>W</u> LANS <u>C</u> ON	TROLLER WIRELESS	<u>S</u> ECURITY	MANAGEMENT	Sa <u>v</u> e Configuration Ping C <u>O</u> MMANDS HELP) Logout <u>R</u> efresh
CISCO Wireless All APs All APs Radios 802.11a/n 802.11b/g/n Global Configuration Mesh HREAP Groups 802.11a/n Network RRM RF Grouping TPC DCA Coverage General Pico Cell Client Roaming Voice Video EDCA Parameters DFS (802.11h) High Throughput (802.11b/g/n Network	MONITOR WLANS CON 802.11a Global Parame General 802.11a Network Status Beacon Period (millisecs) Fragmentation Threshold (bytes) DTPC Support. 802.11a Band Status Low Band Mid Band High Band ** Data Rate 'Mandatory' in specific rate will not be able implies that any associated may communicate with the that a client be able to use associate The actual data r	TROLLER WIRELESS	SECURITY support the supported hat same rate s not required of in order to spend on the arent	Data Rates** 6 Mbps 9 Mbps 12 Mbps 14 Mbps 24 Mbps 36 Mbps 48 Mbps 54 Mbps CCX Location Mode	COMMANDS HELP Mandatory V Supported V Supported V Supported V Supported V Supported V Supported V Supported V Supported V	Αρρίγ
(802.11n) • 802.11b/g/n Network • RRM RF Grouping TPC DCA Coverage General	may communicate with the that a client be able to use associate The actual data r channel selected as differe bandwidths. The reason is to select the data rates. Bu data rate allowed for that o supported.	AP using that rate. But it it the rates marked support ates that are supported de that channels may have diffe that we show data rates ar t in reality, the AP will pick hannel if the chosen data	is not required ed in order to opend on the arent ad alow the use the next lowe rate is not	er r		

Wireless 802.11a Global Parameters Apply • Access Points All APs • Radios 802.11a/n 802.11a/n 802.11a/n 802.11a Network Status Beacon Period (millisecs) 100 9 Mbps Supported ▼ Beacon Period (millisecs) 100 9 Mbps Supported ▼ Pragmentation Threshold (bytes) DTPC Support. ▼ RaM RF Grouping TPC DCA Coverage General Pico Cell Bo2.11a Band Status Low Band Enabled Band Enabled Supported Support
Client Roaming Mode Enabled Voice Video EDCA Parameters ** Data Rate 'Mandatory' implies that clients who do not support that DFS (802.11h) specific rate will not be able to associate. Data Rate 'Supported' implies that any associated client that also supports that same rate (802.11n) implies that any associated client that also supports that same rate may communicate with the AP using that rate. But it is not required * 802.11b/g/n that a client be able to use mrked supported in order to associate that arates that are supported depend on the Network channel selected as different channels may have different * RRM bandwidths. The reason is that we show data rates and alow the user to select the data rates. But in reality, the AP will pick the next lower RF Grouping TPC

The only standard left to enable is the standard 802.11n. You can choose to enable it for either 2,4 GHz or 5 GHz. It has been suggested that 802.11n is enabled only on the 5 GHz band, in order to utilise the radio resources effectively, see for example the (eduroam) Campus Best Practice document on "WLAN network planning and setup" Chapter

6.3.<u>http://www.terena.org/activities/campus-bp/pdf/gn3-na3-t4-wlan-network-planning.pdf</u>. However, newer 802.11 standards like 802.11ax (Wifi6) improve bandwidth and performance in the 2.4GHz bands significantly, continuing the usefulness of the 2.4GHz band. To enable 802.11n in the network select 802.11a/n | High throughput (802.11n) and/or 802.11b/g/n | High throughput (802.11n) and configure the settings according to the figure below.

									Say	e Configuration	<u>P</u> ing Logout <u>R</u> efres
CISCO		MONITOR	<u>W</u> LANs		r W <u>I</u> RELESS	<u>S</u> ECURITY	MANA	GEMENT	C <u>O</u> MMANDS	HELP	
Wireless	^	802.11n (5 GHz) H	igh Throug	hput						Apply
 Access Points All APs Radios 202 115/6 		General					MCS	(Data R	ate ¹) Setting	s	
802.11b/g/n Global Configuration		11n Mode			Enabled		0	(7 ME	ops) 🔽	Supported	
Mesh							1	(14 Mb	ips) 🔽	Supported	
HREAP Groups							2	(21 Mb	ops) 🔽	Supported	
▼ 802.11a/n							3	(29 Mb	ips) 🔽	Supported	
Network							4	(43 Mb	ops) 🔽	Supported	
♥ RRM RF Grouping							5	(58 Mb	ops)	Supported	
TPC							6	(65 Mb	ips)	Supported	
DCA Coverage							7	(72 Mb	ops)	Supported	
General Dist Call							8	(14 Mb	ops)	Supported	
Client Roaming							9	(29 MF	uns)	Supported	
Voice							10	(43 ME	(eq.	Supported	
EDCA Parameters							10	(45 140	(ps)	Supported	
DFS (802.11h) High Throughput							11	(58 M	ips)	Supported	
(802.11n)							12	(87 Mb	ops)	Supported	
▼ 802.11b/g/n							13	(116 Mb	ops) 🔽	Supported	
Network							14	(130Mb	ops) 🔽	Supported	
RF Grouping							15	(144Mb	ops)	Supported	
TPC			10 10								
Coverage		1 DataRates 2 WMM and	are calcula open or AE	ited for 20 MHz S security shou	Channel width Id be enabled to :	support higher	11n rate	s			
General Pico Cell											

At this point you have enabled the radios, but you have not yet defined any network, so don't try to use the access points just yet.

2.1.5 Defining the RADIUS server

Define the RADIUS server to be used in the govroam network by selecting SECURITY and then AAA | RADIUS | Authentication. Define the IP address, the shared secret and the other parameters according to figure. Please note that your first server will naturally have a server index of one.

ahaha					Sa <u>v</u> e	Configuration Ping	Logout <u>R</u> efresh
cisco	MONITOR <u>W</u> LANS <u>C</u> O	NTROLLER W <u>I</u> RELESS	SECURITY	MANAGEMENT	C <u>O</u> MMANDS	HELP	
Security	RADIUS Authenticatio	on Servers > New				< Back	Apply
 AAA General RADIUS Authentication Accounting Fallback TACACS+ LDAP Local Net Users MAC Filtering Disabled Clients User Login Policies AP Policies 	Server Index (Priority) Server IP Address Shared Secret Format Shared Secret Confirm Shared Secret Key Wrap Port Number	2 V XXX.yyy.z.w ASCII V (Designed f 1812	••• ••• or FIPS custom	ners and requires	a key wrap comp	liant RADIUS server)	
Local EAP	Server Status	Enabled 💌					
Priority Order	Support for RFC 3576	Enabled 😽					
Certificate	Server Timeout	3 seconds	5				
Access Control Lists	Network User	🗹 Enable					
Wireless Protection	Management	🗹 Enable					
Web Auth Advanced	IPSec	Enable					

2.1.6 Defining a wireless network

Select WLANs and then WLANs | WLANs from the sidebar. Create a new network and name it as shown in the figure below.

ahaha					Sa <u>v</u> e	Configuration	2ing Logout	<u>R</u> efresh
cisco	MONITOR	<u>W</u> LANs		W <u>I</u> RELESS	<u>S</u> ECURITY	M <u>A</u> NAGEMENT	C <u>O</u> MMANDS	HELP
WLANs	W	/LANs >	New			< Back	Appl	Y
WLANS		Туре		WLAN	~			
Advanced		Profile Na	me	aovroam				
		SSID		govroam				
		ID		3 💌				

After defining the govroam network, click on the WLAN ID number to start defining the settings for the network. Set the General settings according to the figure below, then click the Security tab.

 cısco	MONITOR	<u>W</u> LANs <u>C</u>	ONTROLLER	W <u>I</u> RELESS	<u>S</u> ECURITY	Sa <u>v</u> e Configura M <u>A</u> NAGEMENT	tion <u>P</u> ing C <u>O</u> MMANDS	Logout <u>R</u> efres HE <u>L</u> P
WLANs	WLANs >	Edit					< Back	Apply
WLANS	General	Security	QoS	Advanced				
Advanced	Profile I Type	govroan WLAN	1					
	SSID Status		govroan	n ibled				
	Security	y Policies	[WPA2 (Modifica][Auth(802.1X) itions done unde)] r security tab	will appear after a	pplying the cha	nges.)
	Radio P Interfac Broadca	olicy ce ast SSID	All manage I Ena	ement 💙				

In order to enable only WPA2-AES, fill in the security settings as shown in the figure below.

cisco	MONITOR WLANS CONTROLLER WIRELESS SECURITY	Save Configuration <u>P</u> ing Logout <u>R</u> efres M <u>A</u> NAGEMENT C <u>O</u> MMANDS HELP
WLANs	WLANs > Edit	< Back Apply
WLANS	General Security QoS Advanced	
Advanced	Layer 2 Layer 3 AAA Servers	
	Layer 2 Security Z WPA+WPA2	
	WPA+WPA2 Parameters	
	WPA Policy	
	WPA2 Policy	
	WPA2 Encryption AES TKIP	
	Auth Key Mgmt 802.1X	

After this, click on the AAA Servers tab and select the RADIUS server that you defined earlier to be used in govroam.

ululu cisco	Saye Configuration <u>P</u> ing Log MONITOR <u>WLANS CONTROLLER WIRELESS SECURITY MANAGEMENT COMMANDS HELP</u>	gout <u>R</u> ef
WLANs	WLANs > Edit < Back	Apply
WLANS	General Security QoS Advanced	
 VLANS Advanced 	Layer 2 Layer 3 AAA Servers Radius Servers LDAP Servers Authentication Servers Server 1 Instant Instant Server 2 None V Server 3 None V Server 3 None V Server 3 None V Local EAP Authentication Instant Local EAP Authentication Instan	
	Not Used Order Used For Authentication	

Next, click on the QoS tab and make sure that you have set the WMM Policy to either Required or Allowed. Otherwise, the higher transmission rates associated with the 802.11n-standard will not work. Then select the Advanced tab and adjust the settings as shown in the figure below. By choosing the parameter P2P Blocking Action to have the value Forward-UpStream, you can prevent WLAN clients to communicate directly, without involving the AP, as recommended in the Campus Best Practice document on "WLAN Information Security" Chapter 2.2 and 2.3. MFP Client Protection is known to have caused problems and can be disabled.

.ılı.ılı. cısco	Sage Configuration Ping Logout <u>R</u> efree MONITOR WLANS CONTROLLER WIRELESS SECURITY MANAGEMENT COMMANDS HELP
WLANS WLANS MLANS Advanced	WLANS > Edit < Back Apply General Security QOS Advanced Allow AAA Override Enabled DHCP Coverage Hole Detection Enabled DHCP Server Override Aironet IE Enabled DHCP Addr. Assignment Required Aironet IE Enabled DHCP Addr. Assignment Required Override Interface ACL None Management Frame Protection (Global MFP Disabled) MFP Client Protection f Disabled DIMP Protection f Disabled MEAP Enabled State Enabled HREAP Enabled Enabled State Enabled

At this stage, click Apply. In the Advanced-tab, the Client Exclusion timeout value was set to 60s. While this is a suitable value, the rules for client exclusion are a bit too strict. Hence, it pays off to adjust the rules by selecting SECURITY and then Wireless Protection Policies | Client Exclusion Policies from the sidebar and uncheck all other options except for "IP Theft or IP Reuse".

These are the basic settings for the Cisco controller. More advanced settings can be found from the upcoming Campus Best Practice document on "WLAN infrastructure", to be published in the first half of 2011.

2.1.7 Cisco (stand-alone Aps with IOS)

Feature	supported?
Multi-SSID	yes
VLANs	yes
dynamic VLAN assignment	yes

The following equipment was used for this section:

Cisco AP 1200 Series (802.11g Radio).

The configuration examples used in this document were tested and made on a Cisco Series 1200 with an 802.11g Radio Module and with the following Cisco software:

```
IOS Version:
Cisco IOS Software, C1200 Software (C1200-K9W7-M), Version 12.3(8)JA2,
RELEASE SOFTWARE (fc1)
Bootloader:
C1200 Boot Loader (C1200-BOOT-M) Version 12.2(8)JA, EARLY DEPLOYMENT RELEASE
SOFTWARE (fc1)
```

2.1.8 Setting the Name and IP address

First, an IP address on the BVI interface (the IP address that this Access Point will have for accessing resources like the RADIUS server) needs to be configured. Also a unique name for this Access Point (ap1200) will be configured.

```
Ap#configure terminal
ap1200(config)#hostname ap1200
ap1200(config)#interface BVI 1
ap1200(config-if)# ip address 192.168.10.200 255.255.255.0
```

2.1.9 RADIUS/AAA section

In the authentication, authorisation and accounting configuration parameters (AAA), at least one group needs to be defined (radsrv), which will be assigned later for the several AAA operations. More groups can be defined if needed for various purposes; one for authentication, another for accounting, and so on. In this example the

RADIUS server has the IP address 192.168.10.253.

```
ap1200(config)#aaa new-model
ap1200(config)#radius-server host 192.168.10.253 auth-port 1812 acct-port 1813 key
<secret>
ap1200(config)#aaa group server radius radsrv
ap1200(config-sg-radius)#server 192.168.10.253 auth-port 1812 acct-port 1813
ap1200(config-sg-radius)#!
Ap1200(config-sg-radius)#aaa authentication login eap_methods group radsrv
ap1200(config)#aaa authorization network default group radsrv
ap1200(config)#aaa accounting send stop-record authentication failure
ap1200(config)#aaa accounting session-duration ntp-adjusted
ap1200(config)#aaa accounting update newinfo periodic 15
ap1200(config)#aaa accounting network default start-stop group radsrv
ap1200(config)#aaa accounting network acct methods start-stop group radsrv
```

2.1.10 Configuring the SSIDs

For each SSID one dot11 ssid <SSID NAME> must be configured. In this section the default VLAN for the SSID will be configured as well as the authentication framework, the accounting and, if desired, the SSID to be broadcast (guest-mode).

Ap1200 (config) #dot11 ssid eduroam ap1200 (config-ssid) #vlan 909 ap1200 (config-ssid) #authentication open eap eap_methods ap1200 (config-ssid) #authentication network-eap eap_methods ap1200 (config-ssid) #authentication key-management wpa optional ap1200 (config-ssid) #accounting acct_methods ap1200 (config-ssid) #guest-mode

More SSIDs can be configured. An open SSID for giving information about the institution and/or how to connect to the govroam SSID:

ap1200(config)#dot11 ssid guest ap1200(config-ssid)#vlan 903 ap1200(config-ssid)#authentication open ap1200(config-ssid)#accounting acct_methods

2.1.11 The Radio Interface

Now the configured SSID's will be mapped to the radio interface, and it will be specified what ciphers will be used/allowed on each VLAN. If dynamic VLANs are planned, the ciphers for those VLANs must also be configured even if there is no direct mapping on any SSID (this example shows the usage of the VLANs 906 and 909 for eduroam users)

```
ap1200(config)#interface Dot11Radio 0
ap1200(config-if)# encryption vlan 906 mode ciphers aes-ccm tkip wep128
ap1200(config-if)# encryption vlan 909 mode ciphers aes-ccm tkip wep128
ap1200(config-if)#ssid eduroam
```

To bind extra SSID's the previous command, for each SSID to be bound, needs to be repeated. The following command sets the maximum time (e.g. 300 seconds, which is recommended) for rekeying/reauthentication:

dot1x reauth-period 300

2.1.12 VLAN interfaces

For each VLAN to be used for wireless clients, two virtual interfaces need to be defined: one on "the air" (DotRadio) and another on the "wire" (FastEthernet) then they need to be bridged together with the same bridge group. These VLANs are always tagged with the proper VLAN identifier.

An administrative VLAN needs to be configured as well (for maintenance/management and authentication/accounting traffic). This VLAN is usually untagged (the command defining the VLAN has to be suffixed with the keyword "native") and belongs to bridge-group 1. The Radio virtual interface for this VLAN does not need to be defined since the default will keep the physical interface (Dot Radio 0) in bridge-group 1.

Because VLANs can be from 1 to 4094 and bridge-groups from 1 to 255, it is not necessary to have the same bridge-group id as the vlan id.

```
Ap1200(config)#interface dot11Radio 0.903
ap1200(config-subif)#encapsulation dot1Q 903
ap1200(config-subif)#bridge-group 3
ap1200(config)#interface fastEthernet 0.903
```

```
ap1200(config-subif)#encapsulation dot1Q 903
ap1200(config-subif)#bridge-group 3
ap1200(config)#interface dot11Radio 0.909
ap1200(config-subif)#encapsulation dot1Q 909
ap1200(config-subif)#bridge-group 9
ap1200(config)#interface fastEthernet 0.909
ap1200(config-subif)#encapsulation dot1Q 909
ap1200(config-subif)#bridge-group 9
```

2.1.13 The multiple (dynamic) VLAN assignment

The example configuration above did not configure dynamic VLAN assignment. Availability of this feature varies between models of the 1200 Series, so please exercise caution when procuring if you wish to make use of this feature. If multiple VLANs are configured on the Cisco AP, it is mandatory to associate each SSID to at least one VLAN, otherwise the Access Point will not activate the SSID's. It is possible however, to put different users who are connected to the same SSID (e.g. eduroam) on different VLANs based, for instance, on the user profile. To activate this feature it is necessary to enter

"aaa authorisation network default group radiusgroup"

in the Access Point's configuration. The AP then gives priority to the VLANs returned by RADIUS over the ones statically associated with the SSID. This enables the feature dynamic VLAN assignment.

Cisco's Access Points require that two virtual interfaces (a radio and an Ethernet port interface) are configured for each VLAN. If, for example, four VLANs are to be used for eduroam users (for students, admin staff, teachers and visiting eduroam users from other institutions for example) then it is necessary to define one Dot11Radio0.vlanID, and one FastEthernet0.vlanID, and ensure that both have the same encapsulation dot1Q vlanID and the same bridge-group for each VLAN.

Two commands that are also needed are the below, otherwise the access point will not change the user to the received VLAN:

encryption vlan vlanID mode ciphers aes-ccm broadcast-key vlan vlanID change 600 membership-termination capability-change

2.2 govroam IdP

2.2.1 Selecting EAP types

choices

The decision which EAP type(s) to deploy on your govroam IdP depends on several factors:

- Capabilities of your Identity management backend
- Types of devices you want to support

2.2.2 Choices depending on the Identity Management System

Regarding the identity management backend, the most fundamental differentiation between EAP types is the type of credential they support.

- Does your identity management backend support X.509 Client Certificates? Then you can use EAP-TLS.
- Does your identity management backend use username/password combinations?
- Does it store the passwords as either clear text or encrypted as NT-Hash? Then you can use EAP-TTLS, PEAP, EAP-FAST, EAP-PWD and more.
- Does it store the passwords in a different crypt format? Then you can use EAP-TTLS only.

As you see, the decision is largely dependent on your identity management system; so your choices may be limited. As a more concrete advice for some IdM backends:

• Microsoft Active Directory: stores passwords as NT-Hashes.

In all cases, the Top-Level Domain of the identities' realm should be a publicly available (DNS) TLD. For Dutch organisations this is typically ".nl". The national govroam RADIUS servers need this for proper dispatching of authentication requests. This means that non-compliant TLD's like .local or .intra cannot be used.

The use of ".local" as top level suffix usually stems from a Microsoft Windows Active Directory based environment. Changing user identities is out of scope of the set-up of a govroam RADIUS peering. However, from experience, a set of recommendations are provided for your convenience.

The use of ".local" has been deprecated since Windows Server 2003. It is also not allowed in X.509 certificates that public Certificate Authorities can provide. If your 19organisation19 still uses ".local" as a top level suffix, you have a couple of options:

- Comply to recommendations and best practices for Microsoft environments and provide your users with a UPN ending on a publicly available top-level domain name (e.g. ".nl"). Moving forward can have impact on many aspects of the IT landscape but ensures that user identity management is based on industry standards.
- Translate the domain name (and optionally username) in your RADIUS server. This feature is not available in Microsoft NPS
- Introduce a separate identity in the form of a URI ending on a publicly available top-level domain name (e.g. ".nl")

2.2.3 Anonymous outer identities

Almost all EAP types support the use of anonymous outer identities. The primary use of anonymous outer identities is for better preservation of privacy for your users; a properly configured supplicant will then not even reveal the real username of the user to the visited govroam SP; instead, the username is replaced with a dummy value.

This feature needs protocol support by the EAP type in question; the basic idea is that there have to be two stages of communicating the client identity:

- one identity, the outer identity, is used to route the user's login request from the govroam SP via the govroam RADIUS path to the govroam IdP
- the second, "inner" identity, is only revealed inside a cryptographically protected tunnel to the IdP

Since the outer identity is only needed for routing purposes towards the IdP, the local username part does not have to be accurate and can be obfuscated. The IETF-suggested way of obfuscating the username is to leave it empty; but it can just as well be replaced with "anonymous", "anon" or similar. However, the realm part (i.e. behind the @ sign) always needs to be accurate because it contains the routing information.

The inner identity always needs to be fully accurate, because it is used to authenticate the user. It does not necessarily have to contain an @ sign at all, because that username is local to the IdP and is only seen and evaluated there.

Example:

- Outer identity: <u>anonymous@gemeente.nl</u>
- Inner identity: stefan.winter

For govroam request routing, the part @gemeente.nl of the outer identity is used to route the request to the gemeente.nl realm and to establish a secure tunnel; while the real username inside this tunnel which is looked up in a user database is "20unnel.winter".

EAP-Type	Support for anonymous outer identities
EAP-TTLS	yes
PEAP	yes
EAP-FAST	yes
EAP-TLS	support in protocol, but not typically available in supplicants
EAP-PWD	no

Here is a break-down of anonymous outer identity support for some popular EAP types:

If the EAP type allows for the use of outer identities, it is a client device configuration option to either make use of them or not; there is little you as an IdP can do to force the use of anonymous outer identities (except for providing and encouraging the use of pre-configured installers which will then make all the necessary settings on the client device automatically).

2.2.4 Choices depending on the envisaged devices

The landscape of wireless-enabled devices is rather heterogeneous, and support for EAP types varies. Ideally, you should survey which types of devices you should come to expect among your user base,

check the capabilities of these devices, and make an informed decision regarding the EAP type of choice.

However, the EAP protocol is flexible enough to handle multiple EAP types: if your IdM backend can support the use of multiple EAP types, then you can configure all the supported EAP types. In that case, you have to select a "default" EAP type – it should be set to the EAP type with the broadest support in your client base.

Now, assuming you have the option of configuring a range of EAP types *and* your clients support that same range, which of these types should you prefer?

- We suggest the use of PEAP over EAP-TTLS for it does a mild amount of protection of the user password inside the secure tunnel.
- If you cannot support PEAP, consider to allow TTLS-PAP and the more unusual variant TTLS-GTC (initially Generic Token Card; also used for passwords which are not savable on the client device). Some older devices (certain Symbian OS builds) support TTLS, but not PAP inside. Enabling TTLS-GTC will allow these devices to connect.

2.2.5 EAP Server certificate considerations

Almost all EAP types in govroam (with the exception of EAP-PWD) require an X.509 server certificate with which the RADIUS server identifies itself to the end user before the user sends his credentials to the server.

2.2.6 Consideration 1: Procuring vs. creating your own server certificate

In a generic web server context, server certificates are usually required to be procured by a commercial Certification Authority (CA) operator; self-made certificates trigger an "Untrusted Certificate" warning. It makes sense for browsers to have a pre-configured trust store with many well-known Cas because the user may browse to any website; and the operator of that website may have chosen any of those well-known Cas for his website. In an abstract notion, one can say: it is required to have many Cas in the list because the user device does not have all required information for certificate validation contained in its own setup; it misses the information "which CA did the server I am browsing to use to certify the genuinely one of his website?".

These considerations are not at all true in an EAP authentication context, such as a govroam login. Here, the end user device is pre-provisioned with the entire set of information it needs to verify this specific TLS connection: the IdP has a certificate from exactly one CA, and needs to communicate both that CA and the name of his authentication server to the end user. A trust store list from the web browser is thus insignificant in this context; certificates from a commercial CA are as valid for EAP authentications as are self-made certificates or certificates from a small, special-purpose CA. For a commercial CA, the installation of the actual CA file may be superfluous in some client operating systems (particularly those who make their "web browser" trust store also accessible for EAP purposes), but marking that particular CA as trusted for this specific EAP authentication setup still needs to be done.

Note that also root CA certificates have an expiry date. Both for commercial and private Cas please be aware that an exchange of the root CA certificate will require re-configuration of all your endusers' devices to accept the new CA. As a consequence: for commercial Cas, check their root CA's expiry date so you can make an informed decision whether you want to buy the certificate from them or not. For your own private-use CA: choose a very long expiry date for the CA. Especially for commercial Cas, keep in mind that if you ever want to switch to a *different* CA as a trust anchor, all your end-user devices again need to be re-configured for that new root.

Configuration tools like govroam CAT enable to provision the chosen CA(s) and the expected server name(s) into client devices without user interaction. In that light, it does not make much difference whether to procure a server certificate from a commercial CA or to make your own; either way, configuration steps are necessary on the end-user device to enable and secure your chosen setup. With the conceptual differences being small, a number of secondary factors come into play when making the decision where to get a server certificate from:

- Do you have the necessary expertise to create a self-signed certificate; or to set up a private Certification Authority and issue a server certificate with it? Consider in particular the next "Consideration 2" which imposes some properties onto the certificates you need.
- Does your govroam NRO operate a special-purpose CA for govroam purposes, so that you could get a professionally crafted certificate without much hassle?
- Do your end-user devices all verify the exact server identity (issuing CA certificate AND expected server name)?

The third question is particularly important these days because some popular operating systems, particularly Android ones, do not allow to verify the expected server name. For such operating systems, using a commercial CA for the server certificate opens up a loophole for fraud: anyone with a valid certificate from this CA, regardless of the name in the certificate, can pretend to be the govroam authentication server for your end-user; which ultimately means the end-user device will send the user's login credentials to that unauthorised third-party. If you use a self-signed certificate or private CA however, which issues only one/very few certificates, and over which you have full control, then no unauthorised third party will be able to get a certificate in the first place, and thus can't fraud your users.

Another factor to consider when making the decision private vs. commercial CA is that of size and length of the EAP conversation during every login: with a private CA, you will be able to construct a certificate chain without intermediary CA certificates; requiring less bytes to be transmitted inside the EAP conversation (see Consideration 3, below). This results in fewer EAP round-trips and thus a faster authentication.

So, as a general <u>recommendation</u>: if you have the required expertise, it is suggested to set up a private CA exclusively for your IdP's govroam service. This CA should have a very long lifetime to prevent certificate rollover problems. The CA should issue only server certificates for your govroam IdP server(s). If you do not have that expertise, you should make use of your NROs special-purpose CA if it exists. If none of these work for you, a certificate from a commercial CA is the third option.

2.2.7 Consideration 2: Recommended certificate properties

Various end-user device operating systems impose different requirements on the contents of the server certificate that is being presented. Luckily, these requirements are not mutually exclusive. When creating or procuring a server certificate, you should check with the CA that its certificates satisfy as many of these requirements as possible to ensure broad compatibility with your users' devices. The list below does not include "standard" sanity checks applied to certificates; e.g. well-

formedness of the data, validity timestamps etc. These checks are done "as per usual" in every TLS connection.

The most important property of the server certificate is the name of the server. Since this certificate is not for a webserver, there is no necessity to put an actual hostname into the server name. Also, when an Identity Provider uses multiple servers for resilience reasons, then all these servers can and should have a certificate with the same name; and it may well be the identical certificate. Having different names for different servers means that end-user devices must be configured to trust multiple servers, which is more cumbersome than just having to configure one name string.

Some end-user device operating systems might (incorrectly) require the name to be parseable as a hostname; so it is a good idea to use a server name which parses as a fully-qualified domain name – the corresponding record does not have to exist in DNS though. The server name should then be both in certificate's Subject field (Common Namecomponent) and be a subjectAltName:DNS as well.

The following additional certificate properties are non-standard and are of particular interest in the govroam context:

Property	Content	Remarks
server name	parses as fully- qualified domain name	Server certificates with spaces, e.g. "RADIUS Service of Foo University" are known to be problematic with some supplicants, one example being Apple iOS 6.x .
server name	Subject/CN == SubjectAltName:DNS	Some supplicants only consult the CN when checking the name of an incoming server certificate (Windows 8 with PEAP); some check either of the two; some new EAP types such as TEAP will only check SubjectAltName:DNS. Keeping the desired name in both fields in sync is a safe bet for futureproofness.
Server name	not a wildcard name (e.g "*.someidp.tld")	Some supplicants exhibit undefined/buggy behaviour when attempting to parse incoming certificates with a wildcard. Windows 8 and 8.1 are known to choke on wildcard certificates.
Signature algorithm	Minimum: SHA-1 Recommended: SHA- 256 or higher	Server certificates signed with the signature algorithm MD5 are considered invalid by many modern operating systems, e.g. <i>Apple iOS 6.x and above</i> . Also Windows 8.1 and all previous versions of Windows (8, 7, Vista) which are on current patch levels will not validate such certificates. Having a server certificate (or an intermediate CA certificate) with MD5 signature will create problems on these operating systems. Apparently, no operating system as of yet has an issue with the root CA being self-signed with MD5. This may change at any point in the future though, so when creating a new CA infrastructure, be sure not to use MD5 as signature algorithm anywhere. The continued use of SHA-1 as a signature algorithm is not recommended, because several operating systems and browser vendors already have a deprecation policy for SHA-1 support. While the deprecation in browser-

		based scenarios does not have an immediate impact on EAP server usage, it is possible that system libraries and operating system APIs will over time penalise the use of SHA-1. Therefore, for new certificates, SHA-256 is recommended to avoid problems with the certificate in the future.
Length of public key	Minimum: 1024 Bit Recommended: 2048 Bit or higher	Server certificates with a length of the public key below 1024 bit are considered invalid by some recent operating systems, e.g. <i>Windows 7 and above</i> . Having a server certificate (or an intermediate CA certificate) with a too small public key will create problems on these operating systems. The continued use of 1024 bit length keys is not recommended, because several operating systems and browser vendors already have a deprecation policy for this key length. While the deprecation in browser- based scenarios does not have an immediate impact on EAP server usage, it is possible that system libraries and operating system APIs will over time penalise the use of short key lengths. Therefore, for new certificates, 2048 bit or more is recommended to avoid problems with the certificate in the future.
Extension: Extended Key Usage	TLS Web Server Authentication	Even though the certificate is used for EAP purposes, some popular operating systems (i.e. <i>Windows XP and</i> <i>above</i>) require the certificate extension "TLS Web Server Authentication" (OID: 1.3.6.1.5.5.7.3.1) to be present. Having a server certificate without this extension will create problems on these operating systems.
Extension: CRL Distribution Point	HTTP/HTTPS URI pointing to a valid CRL	Few very recent operating systems require this extension to be present; otherwise, the certificate is considered invalid. Currently, <i>Windows Phone 8</i> is known to require this extension; <i>Windows 8</i> can be configured to require it. These operating systems appear to only require the extension to be present; they don't actually seem to download the CRL from that URL and check the certificate against it. One might be tempted to fill the certificate extension with a random garbage (or intranet-only) URL which does not actually yield a CRL; however this would make the certificate invalid for all operating systems which do evaluate the extension if present. So the URL should be a valid one.
Extension: BasicConstraint (critical)	CA:FALSE	Server certificates need to be marked as not being a CA. Omitting the BasicConstraint:CA totally is known to cause certificate validation to fail with Mac OS X 10.8 (Mountain Lion); setting it to TRUE is a security issue in itself. Always set the BasicConstraint "CA" to false, and mark the extension as critical.

2.2.8 Consideration 3: Which certificates to send in the EAP exchange

End-user devices need to verify the server certificate. They do this by having a known set of trustworthy anchors, the "Trusted Root Certificates". These root certificates need to be available and activated on the device prior to starting the govroam login. Therefore, <u>it does not serve any useful purpose to send the root CA certificate</u> itself inside the RADIUS/EAP conversation. It is not harmful to send it anyway though, except that it unnecessarily inflates the data exchange, which means more round-trips during govroam authentication, and in turn a slower login experience. One possible exception is: there are reports of certain Blackberry devices for which it is advantageous to send the root CA certificate nonetheless; if you expect you need/want to support Blackberry devices, sending the root CA may be of help.

During the EAP conversation, the govroam IdP RADIUS server always needs to send its server certificate.

One question needs an administrative decision: if there is one or more intermediate Cas between the root CA and the server certificate (such as is the case with, for example, the TERENA Certificate Service (TCS) and many commercial Cas), should the intermediate CA certificates be sent to the end user device during the EAP conversation, or should the devices pre-install the intermediate Cas along with the root certificate?

In any case, for a successful verification of the server certificate, the end-user's device must have the full set of CA certificates available. It does not matter whether the intermediate Cas have been preprovisioned or are sent during the login phase; but if any one intermediate CA is missing, the verification of the server certificate will fail.

Pre-provisioning the intermediate Cas has the advantage of a relatively small amount of data being sent during the EAP authentication, which means fewer round-trips between the end-user's device and the govroam IdP RADIUS server. The downsides of this approach are that any changes to intermediate Cas (re-issue, rollover) will also need to be pushed to end-user devices. Also, if end-user devices are not under administrative control of the IdP, there is a danger that some end users do not follow the advice to install all intermediate Cas even though they should, and end up in a situation where the server certificate cannot be validated.

Sending the intermediate Cas during the login phase means a longer time to authenticate due to more round-trips, but means that it is sufficient for client devices to install the root CA certificate; if intermediate Cas change, the new ones will always become available to the device during the next authentication data exchange.

For most deployments, it probably makes more sense to <u>include the intermediate CA</u> <u>certificates</u> during the RADIUS/EAP conversation.

3 Set up of several popular RADIUS servers

Although some of the examples are based on previous versions, they give a good impression on how to set up some commonly used RADIUS servers.

3.1 FreeRADIUS

Please refer to the eduroam wiki (<u>https://wiki.geant.org/pages/viewpage.action?pageId=121346259</u>) for an excellent overview on the configuration of FreeRADIUS.

3.2 FreeRADIUS with radsec

To encrypt all RADIUS traffic, radsec can be used. It requires an additional virtual server entry in the configuration, that defines the certificate to be used:

```
listen {
        ipaddr = *
        port = 2083
        type = auth+acct
        proto = tcp
        clients = radsec
    virtual server = default
        limit {
                max connections = 64
                lifetime = 0
                idle timeout = 300
        }
        tls {
                private_key_file = ${certdir}/radsec.pem
                certificate_file = ${certdir}/radsec.pem
                dh file = \{certdir}/dh
                random_file = /dev/urandom
                fragment size = 8192
                ca_path = ${cadir}
                cipher_list = "DEFAULT"
                require client cert = yes
        }
}
```

and dedicated clients in the configuration:

```
clients radsec {
   client default {
        ipaddr = 0.0.0.0/0
        proto = tls
        secret = radsec
        org = RADSEC
        limit {
            max_connections = 64
            lifetime = 0
            idle_timeout = 300
        }
   }
}
```

3.3 Radiator

One popular RADIUS server is Open Systems Consultant's "Radiator. This section details its configuration.

Because of the EAP authentication within RADIUS, a (small) PKI is required. If there is no PKI available, you could create the required key and certificate with, for instance, TinyCA. TinyCA (<u>http://tinyca.sm-zone.net/</u>) is a simple graphical interface on top of OpenSSL. It is possible to use OpenSSL directly (but instructions to do so are outside the scope of this document).

Depending on the EAP-type used, client certificates may also be needed.

Within the Radiator distribution there are also simple scripts available to create certificates for testing purposes.

The Radiator RADIUS server needs the configuration file /etc/radiator/radius.cfg.

This configuration file can be created with the editor of choice, for example

```
vi /etc/radiator/radius.cfg
or
pico /etc/radiator/radius.cfg
```

In the following examples there are two kinds of EAP that are configured at "institution":

- EAP-TLS based on client-certificates.
- EAP-TTLS and EAP-PEAP that do not require client certificates but use the traditional mechanism of

username/password authentication instead.

3.3.1 Clients

RADIUS is based on a client-server model. The NAS-devices (Access Points, switches etc.) forward credentials to a RADIUS server, i.e. act as a client, and therefore need to be defined on the RADIUS server. Other RADIUS servers can act as a client as well, so every kind of RADIUS-request can be forwarded to another server.

The clients are configured within Radiator using the <Client>-clause:

```
<Client 192.168.10.200>
Secret 6.6obaFkm&RNs666
Identifier ACCESSPOINT1
IdenticalClients 192.168.10.201
</Client>
```

In this example there is a client definition for 192.168.10.200, an Access-Point. The "secret" is a series of (at best 16) characters that are used to encrypt the credentials sent in the RADIUS-request.

It is of course recommended to create a secret that cannot be guessed easily, otherwise the RADIUSmessage can be decrypted. This is not an issue with EAP-authentication using 802.1X, since the credentials are also transmitted over a SSL-encrypted tunnel between the client and the final authentication server. However, with regular credentials (like those used with Web-based redirection authentication) this is sensitive information that might be captured, therefore a reasonably complex secret and an SSL tunnel is recommended.

The Identifier in the Client-definition can be used later on in the Radiator configuration to filter a specific request.

If more than one Client is to use this same secret and identifier definition, the IdenticalClients statement can be used. If there are many clients with different IP-addresses, there is also the possibility for a "catch-all" client. This is the default client that is used after all other client definitions didn't match. Define this client as:

```
<Client DEFAULT>
```

If this kind of configuration is used, it is worth filtering with firewall-rules on RADIUS packets. There are only a few places where a RADIUS-request should come from; the management VLAN with the NAS-devices (switches and access-points), and the RADIUS infrastructure where unknown requests can be sent to.

3.3.2 Realms and VLAN assignment

The processing of authentication and accounting requests is done by linear processing of the present <Realm>- or <Handler>-clauses in the Radiator configuration file. Handler-clauses are more potent than Realm clauses in terms of filtering anything besides realms, and are therefore the preferred method. A realm is the part behind a username to indicate the origin of a user. With RADIUS, the username is usually separated from the realm with a "@" so the complete username looks like a regular e-mail address.

A <Handler>-clause is terminated with a </Handler>.

Within a Handler many mechanisms can be configured that define what to do with the RADIUS request.

3.3.3 PROXY example

The simplest Handler for proxying the request to another server uses the "AuthBy RADIUS" definition within this Handler.

In this example a proxy-configuration is shown. First we have a Handler that matches on any request, as long as it does not come from the client with the identifier "Proxy-Identifier". This is to prevent a proxy loop. When a request comes from a proxy-server, it should never be forwarded back to that proxy-server.

Another important part is the hostname to which the request should be forwarded. Multiple hostnames can be defined here for redundancy reasons: if the first host does not respond within three seconds, the second one is tried instead. The UDP ports to which the RADIUS-request should be forwarded can be defined in this "AuthBy RADIUS" clause as well.

```
<Handler Client-Identifier=/^(?!Proxy-Identifier$)/>
<AuthBy RADIUS>
Host 192.87.36.3
Secret super_secret!
AuthPort 1812
```

```
AcctPort
                          1813
StripFromReply Tunnel-Type, Tunnel-Medium-Type, Tunnel-Private-Group-ID
AddToReply Tunnel-Type=1:VLAN, Tunnel-Medium-Type=1:Ether 802,
                                                  Tunnel-Private-Group-ID=1:909
```

```
</AuthBy>
</Handler>
```

For a "Host", both the IP-address and FQDN can be used. The choice is more or less a personal preference of the RADIUS administrator, but be aware that the hostnames are only looked up once at the Radiator (re)start. If the lookup fails, the Host cannot be used until the next restart. This can represent a problem at a power outage, where for instance the DNS server is not yet available even though Radiator is.

While by using hostnames one benefits from the administrative ease when an IP-address is changed, it is still necessary to restart the RADIUS server.

The last part in this <AuthBy RADIUS>-definition shows the addition of RADIUS-attributes to the RADIUS- response. These attributes can be used to define a VLAN that will be assigned to users that are authenticated using this Handler. With StripFromReply, the attributes that came from the proxyserver are stripped first to prevent malicious VLAN-assignments, afterwards the attributes are added with the proper values for the local network design. In this case, VLAN 909 is used for guests.

3.4 Secure authentication with EAP-TLS

EAP-TLS requires both server and client certificates. Rolling out such certificates is a sometimes daunting administrative process, and is out of the scope of this document. The remainder of this section assumes that client certificates have been issued to the users already.

In this example the AuthBy-definition is outside the Handler, and is referred to using the Identifier. (This is useful if the AuthBy-definition is reused in another Handler, for instance.)

```
<AuthBy FILE>
    Identifier ID4-TLS
     Filename %D/TLS-users
    EAPType TLS
    EAPTLS CAFile %D/cert/institution-ca-chain.pem
    EAPTLS CertificateFile %D/cert/radius-server-cert.pem
    EAPTLS CertificateType PEM
     EAPTLS_PrivateKeyFile %D/cert/radius-server-key.pem
     EAPTLS PrivateKeyPassword (the secret that secures the private-key)
    EAPTLS MaxFragmentSize 1024
    AutoMPPEKeys
     SSLeavTrace 1
     StripFromReply Tunnel-Type, Tunnel-Medium-Type, Tunnel-Private-Group-ID
    AddToReply Tunnel-Type=1:VLAN, Tunnel-Medium-Type=1:Ether 802,
                                         Tunnel- Private-Group-ID=1:909, User-Name=%u
```

</AuthBy>

In this AuthBy-clause there is an EAPTLS file defined that lists every employee. In this way, the users that can access the infrastructure using EAP-TLS are controlled.

The definitions that follow determine what to do with the EAP-request. First the "EAPType TLS" limits the use of this AuthBy-definition for TLS-only. Here regular password authentication is not desired, just certificates. Next, the certificate files are configured and the secret that secures the private-key file can be provided. If there is no secret for the private key, this can be omitted.

The next part defines in what size blocks the EAP-messages should be fragmented. Since some parts of the EAP-TLS challenge are too big to fit in a RADIUS request, the packets should be fragmented.

The MPPE-keys (Microsoft Point to Point Encryption, the protocol for encrypting the data across links) portion is important for wireless access. With 802.1X, encryption occurs at the edge of the network, between the Access- Point and the client. To provide this secure encryption, a unique key is created and encrypted using the MPPE- keys that are derived from the SSL-challenge. This can be done at the Access-Point and the Client end so that there is no need to transfer the WEP-key in plain text over the air. This, and the fact that the key can be rotated within a period defined by either the Access-Point or the RADIUS server, provides 802.1x users with a good level of security.

The last part of the AuthBy-definition shows how to assign a proper VLAN.

```
<Handler Realm=30unnelled30n.cc, EAP-Message=/.+/>
AuthBy ID4-TLS
</Handler>
```

The Handler above shows the referral to the AuthBy-definition and some filtering mechanisms to filter out the proper requests. If more things need to be filtered on, they can be added to this handler, as follows:

NAS-Port-Type=/^(Wireless-IEEE-802-11|Ethernet)\$/

In this way, only requests with the proper NAS-Port-Types are allowed. For Accounting purposes, a new handler should be defined in this case, that filters on:

"Request-Type=Accounting-Request"

since the request does not match the Handler that filters on the EAP-Message.

3.5 EAP-TTLS or EAP-PEAP

When issuing end user certificates is not an option, the EAP-mechanisms PEAP and TTLS can be used.

These two mechanisms look the same in that they both set up a TLS tunnel on which the credentials can be transported. They vary in the supported password encryption schemes.

Virtually all implementations of PEAP encrypt the user's password as an NT hash exclusively. TTLS implementations typically offer plain text transport of the password, called TTLS-PAP (the outer TLS tunnels makes sure the password cannot be eavesdropped) and sometimes other encryption schemes like MS- CHAPv2.

Administratively, the choice whether to use PEAP or TTLS can be challenging.

Technically, three backend cases need to be considered for deployment:

Backend stores passwords in	PEAP-MSCHAPv2?	TTLS?
Plain text or reversibly encrypted	Yes	Yes (TTLS-PAP, TTLS-MSCHAPv2)
NT-Hash	Yes	Yes (TTLS-PAP, TTLS-MSCHAPv2)
other irreversible encryption	No	Yes (TTLS-PAP)

Where both options are possible, we suggest the following order of preference: TTLS-MSCHAPv2, PEAP- MSCHAPv2, TTLS-PAP (in descending order of preference).

Instead of a flat file, a more flexible backend for user accounts is a database like MySQL, or LDAP.

In these Handlers, the filtering options "TunneledByPEAP" and "TunnelledByTTLS" define that the tunnelled authentication (with the username and password in it) is handled here.

The "outer authentication", where the SSL"tunnel is set up, looks like the TLS handler.

</Handler>

3.6 Microsoft NPS

The following example govroam example setup is an adaptation form: "Running eduroam on NPS with Windows 2008 R2 Enterprise" DRAFT version 2013-07-15 Author: Paul Dekkers License: CC-BY

3.7 Running govroam on NPS with Windows 2008 R2 Enterprise

The network policy server is the RADIUS server as part of Windows server editions. These instructions assume a basic setup of an Active Directory.

As a quick-start / overview, the following topics are covered in more detail in this document:

- Network Policy Server (NPS) needs to be installed as a server role;
- A server-certificate suitable for NPS (eg. One signed by a public CA) is required;
- You need to configure RADIUS clients (and shared secrets) in NPS to allow requests from your Access Points plus the proxy-servers (details provided and negotiated (shared secret) by your National Roaming Operator (NRO));
- The proxy-servers of your NRO will be configured in a RADIUS server group, with one server preferred (lower priority) and a secondary for failover (higher priority);
- You will have one or more Network Policies: these will handle the actual EAP authentication of your users. A policy can be duplicated to add VLAN-assignment attributes for local use, while remote users should not receive these attributes. Configure "Microsoft PEAP" for your policies (Add, then Edit to select the server-certificate) and deselect all "less secure" mechanisms.
- The Connection Request Policies determine how a request is dealt with: proxied to your NRO servers, or handled locally. For local-accounts, create a condition that matches your users with their realm, while preventing usage for unknown (sub)realms or no-realms.
 - A good regular expression for local users is for example "@lab\.gvoram\.nl\$" as an explicit realm match for the User Name;
 - A good catch-all expression to handle unknown sub-realms would be
 "\.lab\.govroam\.nl\$" that should come as lowest prio policy-rule before the proxies.
 - The User Name condition for the Connection Request Policy to the proxy-servers can be something like "@.+\.[a-z]{2,6}\$" to match only valid realms;

The Network Policy Server has the following limitations:

- You cannot strip attributes (for instance VLAN attributes assigned by other identity providers (IdPs)) but you can explicitly set values applicable to your environment if you work with VLANs or want to prevent invalid attributes;
- You cannot add attributes in outbound requests: adding an "Operator-Name" attribute to indicate where a user gets online is thus not possible and could be set by the National Roaming Operator instead;
- NPS doesn't answer to Status-Server requests: it's a best-practise for govroam proxy-servers to check your servers' availability with those requests, and ideally you would do that the other way around too;
- Because of the previous limitations, inform your National Roaming Operator that you're working with NPS;
- While the outer username (via the Connection Request Policy) can be rewritten, the inner username (often users configure both to be the same) handled by the Network Policy cannot. This means that your users will have to use the registered UPN (User-Principal-Name) which by convention maps to the e-mail address / user-ID@domain-name.

3.7.1 Installation of NPS

In the "initial configuration" or "Server Manager" look for "Roles" and click "Add Roles".

Add Roles Wizard Select Server Ro	les	×
Before You Begin Server Roles Network Policy and Access Services Role Services Confirmation Progress Results	Select one or more roles to install on this server. Roles: Active Directory Certificate Services (Installed) Active Directory Pomain Services (Installed) Active Directory Pomain Services (Installed) Active Directory Rights Management Services DHCP Server DHCS Server (Installed) Fax Server Hyper-V Vetwork Policy and Access Services Privious Deployment Services Windows Deployment Services Windows Server Update Services Windows Server roles	Description: Network Policy and Access Services provides Network Policy Server (NPS), Routing and Remote Access, Health Registration Authority (HRA), and Host Credential Authorization Protocol (HCAP), which help safeguard the health and security of your network. Health and security of your network. Ext > Install Cancel

Select the "Network Policy and Access Services" option and click "Next >". After reading the introduction to NPS, continue to the role services to install:

	×
ices	
Select the role services to install for Network Policy and Ac Role services:	cess Services: Description:
Network Policy Server Routing and Remote Access Services Remote Access Service Remote Access Service Routing Health Registration Authority	Network Policy Server (NPS) allows you to create and enforce organization-wide network access policies for client health, connection request authentication, and connection request authorization.
	ices Select the role services to install for Network Policy and Acc Role services: Image: Metwork Policy Server Image: Routing and Remote Access Service Image: Remote Access Service

Select only the "Network Policy Server" component, and click "Next >" again.

You will see a summary of the installer-actions, and need to click "Install" to continue. Wait for the installation to finish, and click "Close".

You can now find the "Network Policy Server" under the "Administrative Tools" in the start menu, in the Server Manager, or as a snap-in to mmc.

3.7.2 Server certificate for NPS

You need to have a server certificate in order to use PEAP-authentication with govroam. PEAP sets up a secure tunnel (just like HTTPS does for websites) in order to protect the credentials, and is an

important part of the mutual authentication: both the user needs to prove who he is, and the authentication server needs to prove to the user that he or she is providing credentials to the right authority.

Without certificate (self signed or not) it's not possible to do local authentication. NPS can still be used as a proxy to receive requests from Access Points, log, filter, and forward to the govroam infrastructure.

If you have no certificate installed (or in doubt about your certificate), read Appendix A about Certificates.

3.7.3 Configuration of NPS

The NPS console (snap-in) allows you do use a Wizard for 802.1X / secure wireless. While you can use this for govroam, it doesn't provide all the required settings (like realm/user-name pattern-matching), so you need to make some more changes in the created policies anyway. In these instructions, we'll create the policies directly from the "Connection Request Policies" and the "Network Policies".



Before any policy can be applied to authentication requests, we need to create "RADIUS clients" in order to allow both your Access Points (and/or Switches) and the govroam infrastructure to actually send requests to your server (that's also a client).

To prevent typo's between multiple peers and allow easier changes, it's preferable to create a shared secret template for peers using the same shared secret. You can for instance create one for your

access points and one for the proxy-servers. The proxy-server secret you need to negotiate with your national govroam roaming-operator. The access-point secret, you configure

on your own access-points so you can make something up there yourself.

You can create these templates in the "Template Management" and "Shared Secrets" section, by right-clicking and selecting "New"...



After creating the template, create clients for your access-points and proxy-servers, by right- clicking "RADIUS clients" (under RADIUS Clients and Servers) and "New":

Now, we create a server group for the proxy-servers, that will be used to send authentication requests to for non-local users. In the "RADIUS Clients and Servers" right-click "Remote RADIUS Server Groups" and "New"...

Network Policy Server		Add RADIUS Server
File Action View Help		Address Authentication/Accounting Load Balancing Select an existing Remote RADIUS Servers template:
ADJUS Clents and Servers RADJUS Clents and Servers RADJUS Clents Renote RADJUS Server Groups Policies Connection Request Policies	Remote RADIUS Server Groups Remote RADIUS server groups allow you to specify where to forward connection reconstruction reconstruction reconstruction reconstruction and a server is configured as a RADIUS proxy.	None
Network Policies Health Policies Network Access Protection Network Access Protection Access Protection Access Protection Access Protection Access Protection	Rew Remote RADIUS Server Group Group name: proxy-servers RADIUS Servers:	Server: proxy-1] Verify
	RADIUS Server Priority Weight Add Editu. Editu. Editu.	
	OK Cancel	
Action: In progress		OK Cancel

Enter a name for your server group, such as "proxy-servers", and click "Add..." to add one or more of the servers. Enter the proper name (proxy-1 in the example is not a proper name ;-) but you will get these details from your National Roaming Operator (NRO)), and proceed to the Authentication/Accounting tab for the shared secret settings:

	Add RADIUS Server
	Address Authentication/Accounting Load Balancing
Remote RADIUS Server Groups	Select an existing Shared Secrets template:
Remote RADIUS server groups allow you to specify where to forward connection re server is configured as a RADIUS proxy.	Shared secret:
Group Name New Remote RADIUS Server Group	Confirm shared secret:
Group name: proxy-servers	Request must contain the message authenticator attribute
RADIUS Server Priority Weight Add proxy-1 1 50	Accounting port: 1813
Edit Remove	Select an existing Shared Secrets template:
	Shared secret:
OK Cancel	Forward network access server start and stop notifications to this server
	OK Cancel

For a secondary server, consider the last tab "Load Balancing". It's recommended not to loadbalance single EAP-sessions across multiple servers, which is what NPS will do when the Load-Balancing Priority is all set to the same level. In many situations it just works, but there's no guarantee, so better set it to a lower priority so it's only used for failover. If in doubt, ask your National Roaming Operator for advice.

		Add RADIUS Server
1 00	Remote RADIUS Server Groups Remote RADIUS server groups allow you to specify where to forward connection re server is configured as a RADIUS proxy.	Address Authentication/Accounting Load Balancing The priority of ranking indicates the status of a server. A primary server has a priority of 1. . Weight is used to calculate how often request are sent to a specific server in a group of servers that have the same priority. .
	Group Name	Priority: 2 Weight: 50
	Rew Remote RADIUS Server Group Group name: proxy-servers RADIUS Servers: RADIUS Server Proxy-1 1 50 Edit Remove	Advanced settings Number of seconds without response before request is considered dropped: Maximum number of dropped requests before server is identified as unavailable: Number of seconds between requests when server is identified 30 as unavailable:
1	OK Cancel	OKCancel

The "Connection Request Policy" is there to decide what to do with an authentication request: forward it to a proxy-server, or authenticate locally. The decision is based on RADIUS attributes, such as the User-Name, but this can also be a RADIUS client IP-address or friendly-name for instance.

The order or Connection Request Policies is important. You can move policy-rules up and down, and also temporarily disable a rule.

A typical order is as follows:

NPS (Local)	Connection Request Policies				
RADIUS Clients and Servers Policies Connection Request Policies Network Policies	Connection request policies allow you you must configure PEAP authentication	to designate ion in conne	e whether connectio ction request policy.	n requests are processed locally or forwarded to remote RADIUS servers. For NAP VPN or 802.1X,	
Health Policies	Policy Name	Status	Processing Order	Source	
Network Access Protection	Jocal eduroam users	Enabled	1	Unspecified	
Templates Management	🗐 reject unknown local realms	Enabled	2	Unspecified	
en places management	duroam	Enabled	3	Unspecified	
	Use Windows authentication for all users	Disabled	4	Unspecified	

- 1. authenticate local users @your-realm.tld (you can add more for eg. @student.your-realm.tld)
- 2. authenticate mis-matches in your-realm, such as non-existant.your-realm.tld
- 3. forward to remote proxy-servers

First, create a connection to the proxy-servers by right-clicking the "Connection Request Policies" and "New".

Network Policy S	Server	_ 🗆 ×
File Action Vie	Specify Connection Request Policy Specify Connection Request Policy Name and Connection Type You can specify a name for your connection request policy and the type of connections to which the policy is applied.	warded to quest policy.
Policies	Policy name: eduroam	
Network Acc Accounting Shared 5 RADIUS Remote Pries Remote Remote	Network connection method Select the type of network access server that sends the connection request to NPS. You can select either the network access server type or Vendor specific, but nether is required. If your network access server is an 802.1X authenticating switch or wireless access point, select Unspecified. Type of network access server: Unspecified Vendor specific: 10 ====	
	Previous Next Finish Cancel	
Action: In progress	,	

Give the policy a name (such as "govroam"), and click "Next". Now conditions for matching this policy have to be specified. This rule will be based on User-Name matching.

D Hetwork Policy Server	
File Action Vier Hew Connection Request Policy Image: Specify Conditions Specify Conditions Image: Specify Conditions Specify the condition is required. Image: Specify the condition and then click Add. Health P Image: Specify the user name of the access request message. You can use pattern The HCAP Loc Image: Specify the user name of the access request message. You can use pattern Image: Specify the specify the user name of the access request message. You can use pattern Image: Specify The user name of the access request message. You can use pattern Image: Specify the Specify the user name of the access request message. You can use pattern Imac	
Add Cancel Add Edt Remove Previous Next Finish Cancel	

We use a regular expression here to match user-names that look valid. User-names in govroam are like the e-mail addresses, and end on something.tld (something.nl in case of Dutch government organisations) – that means we shouldn't forward realms that have no dot "." In them, or when there's no realm (after the @-sign, the domain is realm in RADIUS-slang) at all.

The regular expression @.+\.[a-z]{2,6}\$ is a case-insensitive match for realms ending on something dot tld between 2 and 6 letters. Keep in mind that this might change in the future when internationalized top-level domains are allowed, then this regular expression might need to be updated. A more lenient regexp would be @.+\..+\$ to allow a realm with something dot something as a minimum. Both regexps handle any number of sub-realms.

File Action Viet	ew C	onnection Request	Policy	
NPS (Local) RADIUS Clies RADIUS RADIUS RADIUS		Specify th A minimum	y Conditions e conditions that determine whether this connection request policy is evaluated for a connection request. n of one condition is required.	warded to
Policies	Con	ditions:		
Connect		Condition	Value	
Health P Network Acc Accounting Templates M	2	User Name	@.+\[a-z](2.6)\$	

After the condition is set, click "Next". (Note that the default Wizard also adds a condition for NAS Port Type, and sets this to "Wireless – IEEE 802.11". This is fine if your Access Points add this and if you need to do that kind of filtering of RADIUS requests. You could add "Wired", as some AP's seem to be non-compliant and add this.)

Next, specify what to do with the requests that match the condition. In this case, we want to forward the request to the proxy-servers, so the RADIUS server group needs to be selected:

Network Policy Server		_ 🗆 ×
File Action New Connection Request Policy Image: Strain Strai	nection Request Forwarding uest can be authenticated by the local server or it can be forwarded to RADIUS servers in a rver group. mection request, these settings are applied.	warded to quest policy.
 Network Acc Accounting Shared S RADIUS Remote Health P Remedia 	Specify whether connection requests are processed locally, are forwarded to remote RADIUS servers for authentication, or are accepted without authentication. C Authenticate requests on this server Image: Topologic requests to the following remote RADIUS server group for authentication: proxy-servers Image: Topologic requests without validating credentials	
Action: In progress	Previous Next Finish Cancel	

The final configuration options for a Connection Request Policy allows you to add RADIUS attributes to the RADIUS reply. You don't need to do anything with this, but you can define or override VLAN attributes if your Access Point is configured to use VLANs. This way you can define a different VLAN for guests compared to local users. (More about VLANs for local-users later.)

Network Policy	Server	
File Action Vies	New Connection Request Policy	×
NPS (Local)	Configure Settings NPS applies settings to the connection request if all of the connection request policy conditions for matched.	or the policy are warded to quest policy.
Policies Connect Network Health P	Configure the settings for this network policy. If conditions match the connection request and the policy grants access, settings are applied. Settings:	
Network Acc Accounting Templates M Shared S RADIUS Remote IP Filters	Specify a Realm Name Attribute Attribute RADIUS Attributes Attribute Attribute	bute, and nts. See
i Health P 指 Remedia	Name Value Tunnel-Pvt-Group-ID 118 Tunnel-Type Virtual LANs (VLAN) Tunnel-Medium-Type 802 (includes all 802 media plus Ethemet canonical Add Edit	il for
Action: In progress	Previous Next Firmh	Cancel

The above example adds VLAN 118 for guests authenticated via your Access-Points. Look at your Access-Point documentation to find the actual attributes you need to use, some use non-standardized attributes for this. When in doubt, start without any of these attributes.

As final step, review the settings made by the wizard, and click Finish.

Network Policy Se	erver		_ 🗆 🗙
File Action Vies	lew Connection Request Poli	cy X]
	Completi	ng Connection Request Policy Wizard	warded to
Policies Connect Network	You have successfully created eduroam	the following connection request policy:	
Network Acc	Policy conditions:		
E I Templates M	User Name @+\[a-z][2]	sis	
RADIUS Remote IP Filters Health P	NAS Port Type Ethemet OR '	Wreless - IEEE 802.11	
	Condition	Value	
	Authentication Provider Authentication Provider Name Tunnel-Pvt-Group-ID Tunnel-Type Tunnel-Medium-Type	Forwarding Request proxy-servers 118 Virtual LANs (VLAN) 802 (includes all 802 media plus Ethernet canonical format)	
	To close this wizard, click Finish	n. Previous Next Finish Cancel	
Action: In progress	,		

After creating a new policy-rule, always reconsider the order of policies. A policy might catch all

the requests and make NPS not consider any of the newer requests.

While testing, take into account that it might take a second or two before NPS actually uses the newly configured settings.

You could test govroam authentication with a remote (test)-account provided you have one. The next step is to create a policy for local users.

Again, click the "Connection Request Policies" tree-item and select "New".

	lew Connection Request Policy	3
RADIUS Clients RADIUS Clients Remote RAI	Specify Connection Request Policy Name and Connection Type You can specify a name for your connection request policy and the type of connections to which the policy is applied.	amote RADIUS
Network Pol	Policy name:	
Health Polici	local eduroam users	
Kerneliation Accounting Accounting	Network connection method Select the type of network access server that sends the connection request to NPS. You can select either the network access server type or Vendor specific, but neither is required. If your network access server is an 802.1X authenticating switch or wireless access point, select Unspecified.	
Remote RAL	Type of network access server:	_
Remediation	Vendor specific:	

Give the policy a name such as "local govroam users", and click "Next".

🥐 🌳 🞽 🗊 🛙	New Connection Request Policy
NPS (Local) RADIUS Clients RADIUS Clients Remote RAI Policies Connection	Specify Conditions Specify the conditions that determine whether this connection request policy is evaluated for a connection request.
Network Po Health Polic	select condition
E So Network Access	Select a condition, and then click Add.
System Hea	HCAP A
Accounting Templates Mani Shared Sec RADIUS Cle Remote RAI	Location Groups The HCAP Location Groups condition specifies the Host Credential Authorization Protocol (HCAP) location groups required to match this policy. The HCAP protocol is used for communication between NPS and some third party network access servers (NASs). See your NAS documentation before using this condition. User Name
IP Filters Health Polic	User Name The user name that is used by the access client in the RADIUS message. This attribute is a character string that Upically contains a realm name and a user account name.
	Connection Properties
	Access Client IPv4 Address The Access Client IPv4 Address condition specifies the IPv4 address of the Access Client that is requesting access from the RADIUS client.
	Access Client IPv6 Address
	Add Cancel
-	Add Edit Remove

Again, we need to specify conditions for the policy to match. In this case we'll want to match local users, by their user-names. This can be done by a regular expression:

Please don't allow users to authenticate without realm! It will be very confusing for users if it works locally without @realm, and you need to have a @realm in a remote location. That breaks the whole working of govroam for this user and it will lead to misconfigured clients and support calls.

Click "OK" and "Next" when done.

♦ 2 0 F	lew Connection Request Policy		×
RADIUS Clients RADIUS Clients RADIUS Clients RADIUS Clients Remote RAI Policies	Specify Con The connection rec remote RADIUS se	nection Request Forwarding uest can be authenticated by the local server or it can be forwarded to RADIUS servers in a rver group.	emote RADIUS
Network Pol	If the policy conditions match the co Settings:	nnection request, these settings are applied.	
Remediation	Forwarding Connection Request	Specify whether connection requests are processed locally, are forwarded to remote BADULS servers for a theritication, or are accented without authentication.	
E Mana	Authentication		
RADIUS Cle Remote RAI IP Filters Health Polici	No counting	Authenticate requests on this server Forward requests to the following remote RADIUS server group for authentication: proxy-servers New Accept users without validating credentials	

Now, select to "Authenticate requests on this server".

The next screen asks to override authentication methods configured for this user in the Network Policies.

-	Specify Authentication Methods
	Configure one or more authentication methods required for the connection request to match this policy. For EA authentication, you must configure an EAP type. If you deploy NAP with 802.1X or VPN, you must configure Protected EAP.
Override	network policy authentication settings
hese authe onnections	entication settings are used rather than the constraints and authentication settings in network policy. For VPN and 802.1X with NAP, you must configure PEAP authentication here.
AP types a	are negotiated between NPS and the client in the order in which they are listed.
AP Tune	12
	MoveUp
	MoveDown
Add	Edit Remove
less secu	re authentication methods
- Microso	off Encrypted Authentication version 2 (MS-CHAP-v2)
📕 🛛 User	can change password after it has expired
Microso	If Encrypted Authentication (MS-CHAP)
User	can change password after it has expired
- Linepcu	ed durine nucedon (Univir) upted authentination (PAP, SPAP)
Allow cli	pres during measure () () () () () () () () () (
Allow cli	ients to connect without negotiating an authentication method.

Make sure no override is done.

The next screen allows you to configure RADIUS attributes, but don't enter anything here.

figure the settings for this netw onditions match the connection	ork policy. I request and the policy grants access, settings are applied.	
titings: pecify a Realm Name Attribute ADIUS Attributes Standard Z Vendor Specific	To send additional attributes to RADIUS clients, select a RADIUS standard attribute, and then click Edit. If you do not configure an attribute, it is not sent to RADIUS clients. See your RADIUS client documentation for required attributes.	Ļ
	Name Value	
	Add Edit. Remove	

If you want to assign VLAN attributes for your users, you'll need to do that in the Network Policy.

Review your settings, and click "Finish".

Next, create a Network Policy for your local users.

These policies are only used for Connection Request Policies that have "Authenticate requests on this server" set.

Give your policy a name such as "local govroam users" and leave the other settings default.

roups	Specify the group membership required to match this policy.	
Windows Group The Windows Gr		f the selected
groups.	Groups	
Machine Group	LAB\Domain Users	ected groups.
User Groups The User Groups		ups.
CAP		
Location Group The HCAP Loca required to match network access	Add Groups Remove	pcation groups a third party

We need to specify the conditions for matching this request. Here you can define the users in your AD that are allowed to authenticate.

New Network	k Policy	×
	Specify Access Permission	
	Configure whether you want to grant network access or deny network access if the com policy.	nection request matches this
· Access	granted	
Grant act	ccess if client connection attempts match the conditions of this policy.	
C Access	denied	
Deny acc	ccess if client connection attempts match the conditions of this policy.	
Access i	is determined by User Dial-in properties (which override NPS policy)	
Grant or o	deny access according to user dial-in properties if client connection attempts match the conditions	of this policy.

In the next screen, select to grant access to these users. Now for the authentication methods that are allowed:

	Add EAP X
	Authentication methods:
	Microsoft: Smart Card or other certificate
	Microsoft: Protected EAP (PEAP)
Add Edit	MICrosoft: Secured password (EAP-MISCHAP v2)
cure authentication r	4 F
soft Encrypted Authentic ser can change password	OK Cancel

Deselect the "Less secure authentication methods", and click "Add..." to add an EAP type named "Microsoft: Protected EAP (PEAP)".

	New Network Policy	
NPS (Local) RADIUS Clients RADIUS Clients RADIUS Clie Remote RAI Policies Connection	Configure Authentication Methods Configure one or more authentication methods required for the connection request to match this policy. For EAP authentication, you must configure an EAP type. If you deploy NAP with 802.1X or VPN, you must configure Protected EAP in connection request policy, which overrides network policy authentication settings.	inot
Chetwork Polic Health Polic Setwork Access Ketwork Access Remediator Accounting Accounting Acounting Acount Access Acount Access	EAP types are negotiated between NPS and the client in the orfactic valuable theorem based EAP types: Microsoft: Protected EAP (PEAP) Microsoft: Protected EAP (PEAP) Select the certificate the server should use to prove its identity to the client. A certificate that is configured for Protected EAP in Connection Request Policy will override this certificate. Add Edit Remove Isb.edurcom.nl Issuer: TERENA SSL CA Expiration date: 7/11/2014 11:59:59 PM Version can change password after it has expired Disconnect Microsoft Encrypted Authentication (MS-CHAP-vz) Move Up Other can change password after it has expired Secured password (EAP-MSCHAP vz)	ī
	Encrypted authentication (L-Ner) Unencrypted authentication (PAP, SPAP) Alow clents to connect without negotiating an authenticatio Perform machine health check only Perform machine health check only Previous Next Finish Cancel	T

Edit the PEAP settings, and make sure the proper certificate for the server authentication and TLS tunnel setup is selected. (See the Appendix about certificates if any of these steps give a warning or if you don't have a certificate installed just yet.)

w Network Policy		
Configure Se NPS applies setting are matched.	ettings s to the connection requ	sest if all of the network policy conditions and constraints for the policy
Configure the settings for this network i conditions and constraints match th Settings:	policy. e connection request and	d the policy grants access, settings are applied.
RADIUS Attributes Standard C Vendor Specific Network Access Protection NAP Enforcement	To send additional al then click Edit. If you your RADIUS client of Attributes:	ttributes to RADIUS clients, select a RADIUS standard attribute, and u do not configure an attribute, it is not sent to RADIUS clients. See documentation for required attributes.
🕎 Extended State	Name	Value
Routing and Remote Access	Framed-Protocol Service-Type	PPP Framed
 Multilink and Bandwidth Allocation Protocol (BAP) IP Filters Encryption 		
IP Settings	Add	Edit Remove
		Previous Next Finish Cancel

In the next step of the wizard you will have the chance to configure any RADIUS attributes.

But: don't add attributes just like that! If you want to override for instance the VLAN by setting attributes for your own users, you need to do this in a separate policy that only works for your local clients (Access-Points) only. If you set VLAN attributes for your users in authentication requests that originate from the govroam infrastructure your users might be denied access, which might be a difficult thing to debug.

Don't use NAP enforcement or any of the other settings: they don't have value for govroam deployments.

Finally, review your settings, and click "Finish".

Back Local)	Network Policies				
RADIUS Clients and Servers	Network policies connect.	allow you to	designate who is au	thorized to conr	nect to the network and the circumstances under which they can or cannot
Connection Request Polici	Policy Name	Status	Processing Order	Access Type	Source
Health Policies	😹 local eduroam users	Enabled	1	Grant Access	Unspecified

Your local accounts should now be able to authenticate wirelessly! Go ahead and try it, before making any more changes.

In order to assign VLAN attributes to your local users, we need to duplicate the Network Policy.

The order of rules is important: make sure the rule for matching local users is first. You can add extra conditions to this rule to make sure it only matches local requests, and add VLAN attributes in the properties ("Settings" tab) for this policy.

u can use pattern matching	Client Friendly Name roomkaas Client Friendly Name Specify the friendly name of the RADIUS client. You can use pattern matching syntax. accesspoint-1 OK Cancel	roomkaas Client Friendly Name Specify the friendly name of the RADIUS client. You can use pattern matching syntax. accesspoint-1
u can use pattern matching	Client Friendly Name Specify the friendly name of the RADIUS client. You can use pattern matching syntax. accesspoint-1 OK Cancel	Client Friendly Name X Specify the friendly name of the RADIUS client. You can use pattern matching syntax. accesspoint-1
u can use pattern matching	Client Friendly Name Specify the friendly name of the RADIUS client. You can use pattern matching syntax. accesspoint-1 OK Cancel	Client Friendly Name X Specify the friendly name of the RADIUS client. You can use pattern matching syntax. accesspoint-1
u can use pattem matching	Specify the friendly name of the RADIUS client. You can use pattern matching syntax. accesspoint-1 OK Cancel	Specify the friendly name of the RADIUS client. You can use pattern matching syntax.
u can use pattern matching	Specify the friendly name of the RADIUS client. You can use pattern matching syntax. accesspoint-1 OK Cancel	Specify the friendly name of the RADIUS client. You can use pattern matching syntax.
	accesspoint-1	accesspoint-1
	accesspoint-1	accesspoint-1
	OK Cancel	accesspoint-1
	OK Cancel	
A CONTRACT OF A	OK Cancel	100 CT
OK Cancel		OK Cancel

First, add a Condition to only match local requests. A simple example is to use the friendly name for your clients: if you named your clients accesspoint-1 and accesspoint-2, you can use an expression here like accesspoint-*

In the settings tab, add additional attributes for your users.

NPS (Loca) RADIUS Clents RADIUS Clents RADIUS Clents RADIUS Clents Remote RAI Ornection Network Pol Network Pol Remote RAI System Health Polci Accounting Shared Secr RADIUS Clents Shared Secr RADIUS Clents DP Filters Health Polci Remote RAI DP Filters Health Polci Remote RAI	ever Network Policy Image: Configure Settings NPS applies settings to the conner are matched. Configure the settings for this network policy. F conditions and constraints match the connection receiver and constraints match the connection receiver and rec	
	P Settings	Add Close Previous Next Finish Cancel

The standardized attributes for VLANs are Tunnel-Medium-Type, Tunnel-Type and Tunnel-Pvt-Group-ID where the Tunnel-Pvt-Group-ID contains the number of the VLAN you want to assign.

The other attributes need to contain default values,

Tunnel-Medium-Type = 802, and Tunnel-Type = Virtual LANs (VLAN).

One last Connection Request Policy needs to be created (unless your National Roaming Operator only forwards the realms you're using to your servers).

N	ew Connection Request Policy	
Ar Ar PS (Specify Connection Request Policy Name and Connection Type You can specify a name for your connection request policy and the type of connections to which the policy is applied.	
R	Policy name:	
	reject unknown local realms	in
	Network connection method Select the type of network access server that sends the connection request to NPS. You can select either the network access server type or Vendor specific, but neither is required. If your network access server is an 802.1X authenticating switch or wireless access point, select Unspecified.	
if	Ve type of network access server:	
4	C Vendor specific:	
	10 ==	
		P
a		
=	Previous Next Finish Cancel	-

We need to create a policy to reject "unknown local realms": realms that are sub-realms of your realm, but are not actually used. When they are forwarded to you by the proxies, you shouldn't forward them back to the proxy servers, because that will create loops.

24	A minimu	m of one condition is required	l.	request policy is e		onnection request
Select condition	on tion, and the	n click Add.				
User Name User Name Connection P Connection P Connection P Connection P Connection P Connection P	Name Name Joser name t log contains roperties ess Client I Access Client I sess Client I	Specify the user name of the a matching syntax. User Name matching syntax.	access request messag	e. You can use patte	m r strin	n groups party g that g access
					Add	Cancel

The condition to match for this rule (that should come after all other rules for local users but before the proxy userse) should match a user-name ending on your top-level realm. This is done by a regular expression such as \.lab\.govroam\.nl\$

lew Connection Request I	olicy
Specify The connect remote RAI	Connection Request Forwarding tion request can be authenticated by the local server or it can be forwarded to RADIUS servers in a DIUS server group.
If the policy conditions match	the connection request, these settings are applied.
Forwarding Connection Request	Specify whether connection requests are processed locally, are forwarded to remote RADIUS servers for authentication, or are accepted without authentication.
Not counting	Authenticate requests on this server C Forward requests to the following remote RADIUS server group for authentication: proxy-servers New Accept users without validating credentials

Though we're going to reject the request, set it to authenticate on this server. It needs to be processed locally, and not forwarded.

_		THE OWNER WATER OF	Override network policy authentication settings	In	
	1	P	These authentication settings are used rather than the constraints and authentication settings in network policy. For VPN and 802.1X		

Don't override any of the settings and finalize the policy; you can create a Network Policy to match the requests as well and assign a Reply-Message to log why the request was rejected, but it's no problem to leave that out.

Connection Deguast Polici				
Connection Request Polici	Policy Name	Status	Processing Order	Source
Network Policies	local eduroam users	Enabled	1	Unspecified
Network Access Protection	Ireject unknown local realms	Enabled	2	Unspecified
Sustem Health Validators	eduroam	Enabled	3	Unspecified
Remediation Server Group	Use Windows authentication for all users	Disabled	4	Unspecified

Make sure the order of Connection Request Policies and the Network Policies is correct and test your configuration.

3.8 Testing

For a RADIUS server set up as an IdP, testing is fairly simple. The national govroam RADIUS servers perform regular dummy authentication requests for monitoring purposes that should be visible (as rejected requests) in the logging. If not, check your routing, NAT-ing and firewall(s) (and optionally the VPN tunnel).

In order to test your SP setup, a couple of tools can be used together with the test-account that your organisation received from the govroam operations department:

- eapol_test
- radtest

4 Appendix A: Certificates

You need to have a server certificate in order to use PEAP-authentication with govroam. PEAP sets up a secure SSL tunnel (just like HTTPS does for websites) in order to protect the credentials, and is an important part of the mutual authentication: both the user needs to prove who he or she is, and the authentication server needs to prove to the user that he or she is providing credentials to the right authority.

Without certificate (self signed or not) it's not possible to do local authentication. NPS can still be used as a proxy to receive requests from Access Points, log, filter, and forward to the govroam infrastructure.

Open the Microsoft Management Console, mmc (via "Start" – "Run" – "mmc"). Go to "File", "Add/Remove Snap-in...", select "Certificates", click "Add >" and answer the prompt by choosing "Computer account":

After this, select you want to access the resources on the Local Computer (assuming that's where you install your NPS on), and click "Ok" in the "Add or Remove Snap-ins" window to work with the MMC console.

If you have a signed certificate already in pkcs12 format, you can import it (and/or intermediate certificates) to the "Personal" store by right-clicking the "Personal" folder and choosing "Import..." under "All Tasks".

Clicking "Next" after the Certificate Import Wizard introduction asks you for the certificate files to import.

🗢 🔿 🙍 📅 📋 🙆 😹 🚺		Certificate Import Wizard	3
Certificates (Local Computer)	Object Type	File to Import Specify the file you want to import.	ctions crsonal A More Actions
Trusted Root Certification / Trusted Root Certification / Trusted Publishers Trusted Publishers Trusted Certificates Trusted People Trusted People		File name: Browse Browse Note: More than one certificate can be stored in a single file in the following formats: Personal Information Exchange-PKCS #12 (.PFX,.P12)	
Remote Desktop Certificate Enrollment Requ Gartificate Card Trusted Roots Trusted Devices		Cryptographic Message Syntax Standard-PKCS #7 Certificates (.P7B) Microsoft Serialized Certificate Store (.SST)	
		Learn more about <u>certificate file formats</u>	
		< Back Next > Cancel	

In the next screens you're asked for the password that protected the file, and folder to store the certificate in (this is the "Personal" folder that you just selected). Then the import is complete you will find your certificate in the Personal folder, and you can select it from NPS later.

4.1 Generate a certificate request

If you have no existing certificate to import, you need to generate a CSR to be signed.

File Action	View Favorites Wind	dow Help	
🔿 🖄 🗄	🖬 🗋 🙆 😖 🚺	2	
Console Root	Obj	ect Type	
Certificate	es (Local Computer)	Certificates	
Perm	Find Certificates		
🕀 📫 Tr	All Tasks	Find Certificates	
🕀 🧰 Er	an development to be		
🕀 🧮 In	View	Request New Certificate	
🕀 🛄 Tr	New Window from Here	Import	
🕀 🔛 Ur	New Taskpad View	Advanced Operations	Create Custom Request
	and an and a second second		Manage Enrollment Policies
🛨 🛄 Tr	Refresh	-	
🛨 🦲 Re	Export List		
Ξ Cε —		-	
🛨 🗾 Sn	Help		
Truste	ed Devices	_	

Create the request by right-clicking the "Personal" tree in the Certificates snap-in, selecting "All Tasks – Advanced Operations" and "Create Custom Request". Click "Next" after the introduction and (assuming you have no internal CA running) choose "Custom Request, proceed without enrollment policy" as shown below.

If you have an internal CA, the procedure is different. If your (Windows) clients also get this CA enrolled by the Active Directory, an internal CA might be an option for your server certificate. If your clients (especially true with "bring your own" devices) don't have the internal certificate, having a certificate from a public certificate authority (CA) makes the configuration of govroam on the devices easier. Windows for one, refuses to authenticate if it can't verify the certificate used by any of its stored CA's, whether public or not. A self-signed certificate, means more work for the end-users (and maybe more support calls).

ertificate Enrollment	
ertificate Enrollment	
Select Certificate Enrollment Policy	
Certificate enrollment policy enables enrollment for certificates based enrollment policy may already be configured for you.	on predefined certificate templates. Certificate
Configured by your administrator	
Active Directory Enrollment Policy	۲
Configured by you	Add New
Custom Request	
Proceed without enrollment policy	
Learn more about certificate enrolment policy	
	Next Cano
	- TEXE - GUIL

After clicking "Next", leave the options for the Custom request default to PKCS10;

hose an option from	the list below and configure the certificate options as required.
Template:	(No template) CNG key
	Suppress default extensions
Request format:	@ PKCS #10
	COMC

In the next screen though, you need to change some properties for the requested certificate:

ck Next to use the options already s d then dick Next.	elected for this template, or click Details to customize	the certificate request,
Custom request	i) STATUS: Available	Details 🛞
The following options describe th Key usage: Application policies:	e uses and validity period that apply to this type of ce	ertificate:
Validity poriod (days)		

In the "General" tab you can configure a friendly name for the certificate; in this example the "common name" (CN) of the certificate is used: lab.govroam.nl – this is also the domain under which the Active Directory operates, and it will be the RADIUS realm too.

In the "Subject" tab, enter the "Common Name" for your certificate. You probably need to prove ownership of the hostname/domain used to the certificate authority (CA), plus your users will see this name in the certificate: so this name is important.

It doesn't need to be the name of the host itself: actually, if you have multiple NPS servers, it's important that all servers have the same certificate because devices will (at least) prompt when there is a certificate change (which is what then happens during failover).

If your users recognize the name of the certificate when they're prompted, that's probably safer and easier for instructions. (Besides, they might need to check other properties of the certificate, eg. the fingerprint, which is what the Windows 8 client will show for verification.)

If you make the certificate "govroam.your-org.tld" for instance, that's fine. In this case, we're using "lab.govroam.nl" for the CN.

	he
rtificate Properties	
Seneral Subject Extensions Priv	ate Key
The subject of a certificate is the use enter information about the types of in a certificate. Subject of certificate The user or computer that is receiving Subject name:	r or computer to which the certificate is issued. You can subject name and alternative name values that can be used g the certificate
Type:	
Common name	Add >
Value:	
lab.eduroam.nl	< Remove
Alternative name:	
Type:	
Directory name	
Value:	
	Add >
	- Theorem
	< Remove
learn more shout subject name	
Learn more about <u>subject name</u>	
	OK Cancel Apply

Click "Add" for the subject, and go to the Private Key menu. It's recommended (and by some CA's required) to make the key size 2048 bits. Click "OK" after these changes, and proceed to the "Next" step in the Wizard.

(Make sure the profile used at the public CA includes the TLS server extensions. If you use an internal CA in your Active Directory, you might want to include these extensions in the "Extensions" tab. For a public CA, you probably don't have to worry about this.)

Store your certificate signing request (CSR) in a file: to request the certificate you need to copy-paste the BASE64 contents to the request page.

Where do you want to save the offi	ne request?
If you want to save a copy of your certifi	cate request or want to process the request later, save the request to yo
hard usk of removable media, criter ure i	cauon and name of your ceruncate request, and then dick raisin.
File Name:	
File Name: [c:\mycsr.bd]	Browse

The certificate request (and private key for now), you will find under the Certificate Enrollment Requests. You can also delete it from there if you made a mistake.

Console Root I	ssued To 🔺	Issued By	Expiration Date
Certificates (Local Computer)	alab.eduroam.nl	lab.eduroam.nl	7/11/2014
🖃 🔛 Personal	2		
Certificates			
🛨 🧰 Trusted Root Certification /			
표 📑 Enterprise Trust			
표 🧮 Intermediate Certification A			
🕀 🚞 Trusted Publishers			
표 🧮 Untrusted Certificates			
표 🚞 Third-Party Root Certificati			
표 🚞 Trusted People			
표 🚞 Remote Desktop			
🖃 🧮 Certificate Enrollment Regu			
Certificates			
🕀 📔 Smart Card Trusted Roots			
Trusted Devices			

Now, request your certificate using the file/BASE64 copy-pasted content at your CA page. If you're a Terena Certificate Service you probably know the URL for this; you can also request a certificate at any of the well-known commercial CA vendors, such as Comodo, GlobalSign, Verisign... or even test it with a trial-certificate that's valid for limited time.

It's preferable to make your certificate expire after a longer period, such as 3 years: your users might receive a prompt about the new certificate that you need to tell them about before changing it. (Normally if they get such a prompt, this could be a man-in-the-middle attack, so inform them about that too! Mutual authentication is an important part of your security!)

After your certificate is issued by the CA, import it via the MMC snap-in:

Console1 - [Console Roo	ot\Certificates (Loca	al Computer)\Personal\([ertificates]				
File Action View Fa	avorites Window H	elp					_ 립 ×
Console Root	Issued To	*	Issued By	Expiration Date	Intended	Actions	
 Certificates (Local Com Personal 	nputer) AddTrus	t External CA Root uroam.nl	AddTrust External CA Root TERENA SSL CA	5/30/2020 7/11/2016	<ali> Server Au</ali>	Certificates	-
Certification Trusted R All Ta	asks 🔸	Request New Certificate	USERFirst-Hardware ust External CA Root	5/30/2020 5/30/2020	<al> <al> <al> </al> <al> </al></al></al>	More Actions	•
Enterprise View Intermedi New Trusted P	Window from Here	Advanced Operations	•				
🗉 🧮 Untrusted New	Taskpad View	-					
Third-Part Trusted P Expo	esh irt List						
E Certificate Help							
⊞ Smart Card Truster Trusted Devices	d Roots						

You can download the .pem files provided by the provisioning interface of the public CA.

Also install the intermediate certificates that you receive from your CA, in particular if they're not already installed in your store. The NPS server needs to send them (along with the certificate) to the clients in order to do proper verification. (This isn't different from protecting a website with SSL certificates.

5 Appendix B: Terms and abbreviations

AAA(A)	Authentication, Authorisation, Accounting (& Auditing)
AD	Microsoft Active Directory
AP	Access Point
CA	Certificate Authority
DHCP	Dynamic Host Configuration Protocol
EAP	Extensible Authentication Protocol
End User	individual or person using the govroam service
IEEE	Institution of Eletrical and Eletronics Engineers
IdP	Identity Provider, the home organisation of the End User
IP	Internet Protocol
LAN	Local Area Network
LDAP	Lightweight Directory Access Protocol
NAC	Network Access Control, combining 802.1X and RADIUS
Participant	Organisation (not an indivual) participating in the govroam community
RADIUS	Remote Authentication Dial-In User Server/Service/System
SSID	Service Set IDentifier
SP	Service Provider, the organisation providing wifi access
TLD	Top Level Domain
TLS	Transport Layer Security
User	Organisation (not an indivual) participating in the govroam community
VLAN	Virtual LAN
WLAN	Wireless LAN
WPA	Wireless Protected Access