



802.1x/EAP Authentication Guide RadiusNT/X v4 & v5



IEA Software, Inc.

Administrative and Support Office
PO BOX 1170
Veradale, Washington 99037
Phone: (509) 444-BILL

Sales@iea-software.com
Support@iea-software.com



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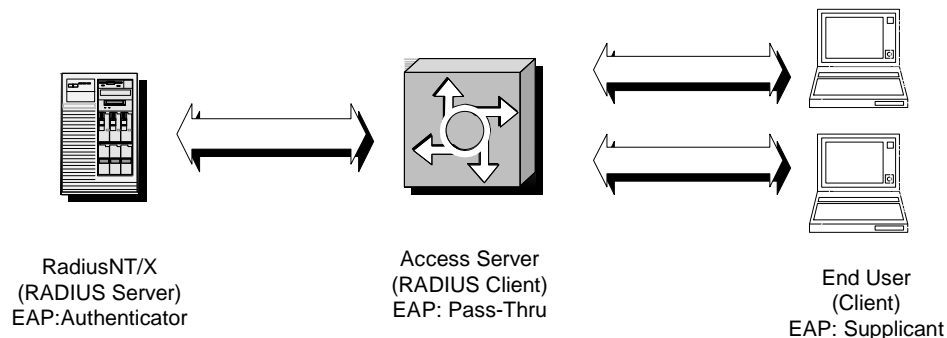
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EAP Authentication, what is it and how does it work?

In the RADIUS world several standard authentication protocols exist such as PAP, CHAP and MSCHAPv1/2. Normally to authenticate -- The Access server and end user client first negotiate the authentication protocol to be used. After choosing one (PAP, CHAP, MSCHAPv1/2, EAP,...) the appropriate data for the chosen authentication protocol is sent to the RADIUS server for authentication.

In this standard scenario all three systems (RADIUS, Access Server, End User client) must agree with and have specific knowledge of the authentication protocol being used.

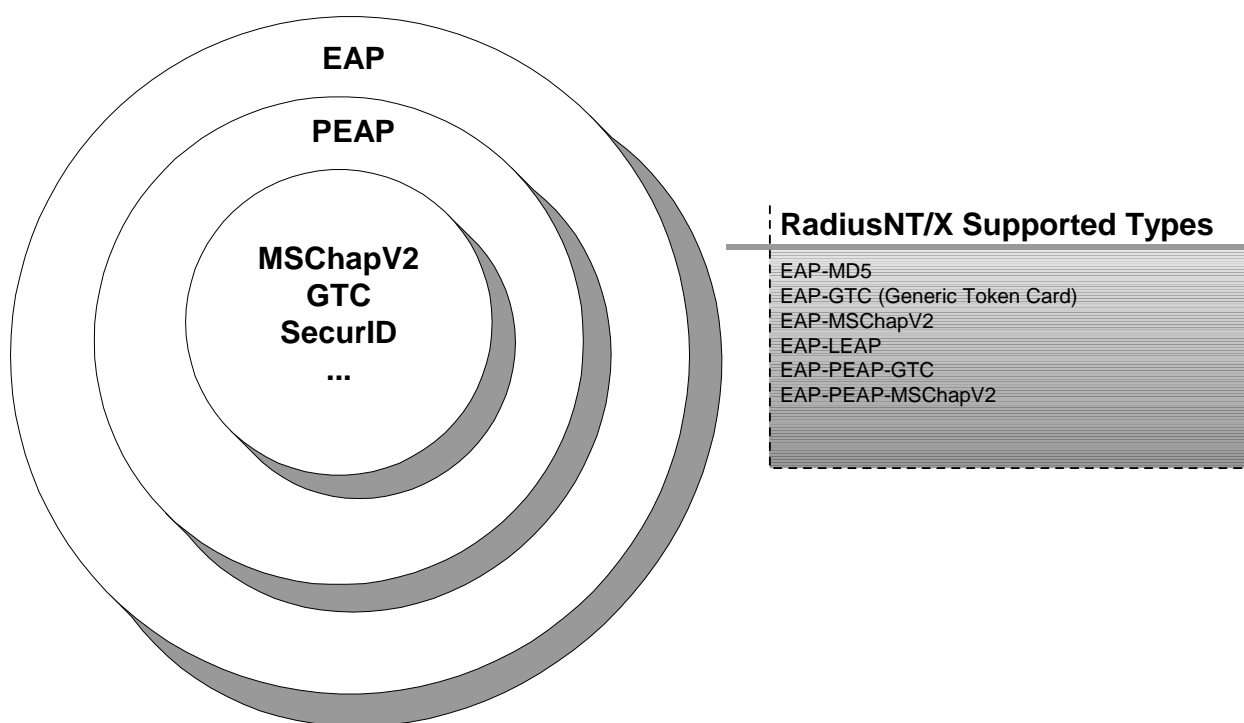


As the complexity of relationships between systems and increasing need for more elaborate and secure authentication methods grows the problems associated with this model become evident. The Extensible Authentication Protocol (EAP) protocol attempts to solve the following problems with minimal change to existing network infrastructure.

1. Authentication protocol negotiation between access server and end user does not include the RADIUS authentication server and its policies in the initial authentication step. If the RADIUS server does not allow, agree or support the authentication protocol being used the authentication attempt fails leaving the problem up to the network administrators and or end users to solve. A classic example of this problem can be found with RADIUS servers configured to authenticate against a one-way encrypted backend database. This was common with many UNIX and Windows user databases. Since the RADIUS CHAP protocol requires access to plain text unencrypted passwords, a client and server that unknowingly agree on CHAP are in for quite a surprise when the RADIUS server finds it impossible to authenticate their request.
2. Today the variety of RADIUS capable access servers number in the hundreds, many have very limited processing and memory capacity available for client authentication. To expect access servers to have the necessary resources available to play their traditional role in the authentication process is unrealistic and in many ways it is even less unrealistic to expect all access server vendors to continually take the time to add specific support for each of the dozens of authentication methods available today in addition to the many more planned for the future.
3. Trust is the foundation of every network security system. Historically RADIUS was used in a dialup environment using a public telephone network, which was generally trust-worthy enough for most applications. Given today's wireless networks, global roaming environments and large areas on shared cable networks there is no clear single entity providing services over the available medium. Therefore in many cases the End User cannot trust the Access Server or intermediate proxies with the task of handling passwords, authentication protocol negotiation or to provide the necessary challenge or keying material for the authentication process. In many environments it is also necessary the access server reflect the RADIUS servers trust in itself to the End-User client.

In order to solve these and other problems with minimal change to existing systems the EAP and later Protected-EAP protocols were designed. EAP simply provides a conduit between the Authenticator and Supplicant (RADIUS and End-User client) where they discuss the best way to authenticate and then actually go about the task of authenticating. Essentially removing the Access Server from the authentication process. Since EAP itself is merely a conduit, it can be thought of as a computers operating system. An operating system in itself is useless without applications to execute. EAP types provide these 'applications' by providing the authentication protocol used to perform the actual authentication step. In this way future authentication protocols can be easily added by adding new EAP types to the Authenticator and Supplicant.

Protected-EAP (PEAP) is an EAP type providing the EAP protocol over an encrypted, certificate-authenticated conduit. In addition to the encryption it also offers keying material that can be used by the RADIUS server and End-User client to establish a secure link for all future network traffic (WEP, WPA/AES, etc). Since PEAP itself implements the EAP protocol, just over a more secure, encrypted channel, it too requires an EAP type of its own to execute. The diagram below illustrates this relationship.



PEAP uses virtually the same technology used today to protect secure web sites on the Internet. The PEAP protocol uses TLS v1 (essentially SSL version 3.1) and utilizes the same trusted third party public key infrastructure as secure web sites.

Which EAP Type (authentication protocol) is right for me?

The short answer for 802.1x/EAP you generally choose EAP types supported by client software your End Users already has or can reasonably be made available. EAP-PEAP-MSChapV2 provides the highest security of all methods listed here and is included with all currently available versions of Microsoft Windows. It is also available in third party Supplicants (clients) from meetinghouse and others and currently is our best recommendation. If you must use a backend authentication database containing UNIX, LDAP or NT passwords a good choice is EAP-PEAP-GTC with Supplicants (clients) available from Cisco, meetinghouse and others.

Since RadiusNT/X fully supports EAP type negotiation you may use several different EAP types with various clients (supplicants) concurrently.

The following table provides a listing of all supported authentication protocols and their relative strengths and weaknesses. Detailed evaluations of each protocol are available online and are outside the scope of this document.

Protocol	Offline attack	Severe crypto flaws known	UNIX/NT/LDAP compatibility	Mutual auth	Encryption keys
PAP	See #1	See #1	Yes	No	No
CHAP	Yes	No	See #4	No	No
MSChapV1	Yes	Yes	See #3	No	Yes
MSChapV2	Yes	No	See #3	Yes	Yes
*HTTP Digest	Yes	No	See #4	Yes	No
EAP-MD5	Yes	No	See #4	No	No
EAP-GTC	See #2	See #2	Yes	No	No
EAP-LEAP	Yes	Yes	See #3	Yes	Yes
EAP-PEAP-MSChapV2	No	No	See #3	Yes	Yes
EAP-PEAP-GTC	No	No	Yes	Yes	Yes
EAP-PEAP-MD5	No	No	See #4	Yes	Yes

* HTTP Digest is supported only in RadiusNT/X version 5.0.35 or later.

#1. PAP passwords are encrypted between RADIUS server and access server. Password security is dependant upon link between access server and client over which the password travels. RADIUS encryption can be improved by choosing RADIUS shared secrets with 16 or more random characters containing letters numbers and symbols. It can be further improved by using additional layer2/3 security such as a physically secure switched network and IPSec.

#2. GTC passwords are not encrypted between RADIUS server and access server and thus provide much less security than standard RADIUS PAP. Security is also dependant upon the link between access server and client over which the password travels. It can be improved by using additional layer2/3 security such as a physically secure switched network and IPSec.

#3. While possible RadiusNT/X v4 and v5 does not currently support authentication against Active directory or NT SAM using this protocol. UNIX password authentication is not possible using this protocol. LDAP authentication is possible provided clear text passwords are made available to RadiusNT/X by the directory server.

#4. Of the three only LDAP authentication is possible provided clear text passwords are made available to RadiusNT/X by the directory server.

Versions and editions of RadiusNT/X supporting EAP Authentication

We recommend at least RadiusNT/X 5.0.42 and 4.0.67 to authenticate and proxy EAP authentication requests. While previous versions of RadiusNT 5 will work successfully in most environments, compatibility improvements have been made as well as the ability to proxy EAP requests starting with these versions. If you are using a prior version of RadiusNT/X v4 or v5 contact our support department (support@iea-software.com) to obtain an update.

Current customers using Emerald 4.5 and RadiusNT/X version 4 must either purchase the EAP feature for RadiusNT/X version 4 or purchase a RadiusNT/X version 5 upgrade licenses. If you have purchased Emerald 4.5 in December of 2003 or later and are currently using RadiusNT/X v4, contact our sales group to receive a complimentary RadiusNT/X version 5 upgrade license.

If you have a RadiusNT/X v5 license, it must be a RadiusNT/X v5 professional or enterprise license. RadiusNT/X v5 standard does **NOT** support EAP.

In summary EAP requires any edition of RadiusNT/X 4.0.67+ with EAP feature license or RadiusNT/X 5.0.42 Professional or Enterprise.

If you have RadiusNT 2.5, 3.0, or 4.0 and would like to take advantage of EAP features please contact our sales group about purchasing an upgrade license (sales@iea-software.com)

If you are currently evaluating Emerald 4.5 professional or enterprise, ask our sales group to provide you with a RadiusNT/X v5 license key. You are entitled to RadiusNT/X v5 at no additional cost. RadiusNT/X v4 is distributed with Emerald 4.5 by default since RadiusNT/X version 5 was not available at the time of the initial release of Emerald 4.5. For your convenience the current version of Emerald 4.5 is bundled with both versions 4 and 5 of RadiusNT/X.

Configuring RadiusNT/X for EAP Authentication

Generally very little if any configuration is necessary to support most End User supplicants (clients). EAP support is automatically enabled as long as you're licensed for EAP features. To configure EAP Authentication, open the RadiusNT/X admin and select the EAP menu option.

EAP	
Preferred EAP method	MD5 (CHAP)
Preferred PEAP method	GTC (Generic Token Card)
PEAP Certificate (public and private keys)	d:\emerald\mycert.pem
PEAP CA Certificate	
PEAP version negotiation	PEAP v0 or v1 (IETF eap-tls-eap-05)

Option	Description
Preferred EAP method	This should reflect the EAP method most of your clients will be using. This improves latency of requests slightly by making protocol negotiation easier for the client and server.
Preferred PEAP method	This should reflect the PEAP method most of your clients will be using. This improves latency of requests slightly by making protocol negotiation easier for the client and server.
PEAP Certificate	SSL certificate file containing a public and private key in PEM (Base64) format. If you are obtaining a certificate from a well-known certificate authority you can generally follow their instructions for creating this file for the apache web server.
PEAP CA Certificate	Your CA's certificate chain file in PEM (Base64) format.
PEAP version negotiation	PEAP protocol version negotiation, the default and recommended setting is 'PEAP v0 or v1' to allow the widest range of clients to authenticate. When using a version of RadiusNT/X prior to 5.0.42 we recommend a setting of 'PEAP v0 only' as version 1 negotiation will fail due to compatibility problems addressed in 5.0.42 and later.

Note: We have tested RadiusNT/X with some supplicants that do not support EAP Type negotiation, as a result the Preferred EAP and Preferred PEAP methods must be configured to match these clients EAP or PEAP Types, if not authentication requests against such a supplicant will fail. Experimentally we found the configuration providing the greatest compatibility between all supplicants tested is when the Preferred EAP method is set to 'MD5' and the Preferred PEAP method is set to 'GTC'. This setting allowed clients from Microsoft, Cisco and another vendor to successfully authenticate various EAP protocols successfully. In the long term any failure to perform EAP type negotiation should be brought to the attention of the vendors for correction in a future version of their supplicant.

A PEAP certificate file is required before the EAP-PEAP type is available to supplicants (client) for authentication. See the next section on PEAP certificates for a detailed discussion on PEAP and creating the required certificates. If you've installed Emerald with RadiusNT you can use Emeralds default sample certificate file 'ieas.pem' located in your Emerald folder as a PEAP certificate. Doing this will provide data encryption but will not provide certificate validation. You must disable certificate validation on the end users supplicant (client) when using the sample certificate. We recommend the included sample certificate be used for testing purposes only.

PEAP certificates, signing requirements and examples

There are only minor differences between standard SSL certificates used by secure web sites and those used with PEAP on 802.1x wireless networks.

With PEAP the SID of the network, rather than your organizations domain must match the common name (cn) of the certificate. Additionally an EKU (Enhanced Key Usage) for Server Authentication (OID 1.3.6.1.5.5.7.3.1) must be specified when creating your public certificate or signing request.

In these examples we will use the OpenSSL utility to create a Certificate Signing Request (CSR) used with a third party certificate authority such as Verisign or Thawte. We will also generate a 'self-signed' certificate that does not require a certificate authority but does require users to first accept your certificate as valid on a one time basis depending on the supplicant and its configuration.

The openssl utility used to create the certificates in this example is available from the IEA Software web site: <http://www.iea-software.com/ftp/emeraldv4/winnt/sslcert.zip>

Example creating a certificate signing request for a certificate authority

```
openssl req -new -nodes -keyout private.pem -out public.csr -extensions PEAP -config openssl.cnf
```

Using configuration from openssl.cnf

Loading 'screen' into random state - done

Generating a 1024 bit RSA private key

.....++++++

.....++++++

writing new private key to 'private.pem'

*You are about to be asked to enter information that will be incorporated
into your certificate request.*

What you are about to enter is what is called a Distinguished Name or a DN.

There are quite a few fields but you can leave some blank

For some fields there will be a default value,

If you enter '.', the field will be left blank.

Country Name (2 letter code) [AU]:US

State or Province Name (full name) [Some-State]:Washington

Locality Name (eg, city) []:Spokane

Organization Name (eg, company) [Internet Widgits Pty Ltd]:IEA Software, Inc.

Organizational Unit Name (eg, section) []:

Common Name (eg, YOUR name) []:ieas

Email Address []:support@iea-software.com

The output file public.csr is processed by your certificate authority (CA), which will return a signed certificate file to you. Combine private.pem with the certificate returned from the CA into a single file. This file becomes the 'PEAP Certificate' file. You will likely also need the CA's certificate chain file if one is required. This file becomes the 'PEAP CA Certificate'. The full pathnames for both files must be configured in the EAP section of the RadiusNT/X administrator.

Example creating a 'self-signed' certificate

```
openssl genrsa -out private.pem
```

Loading 'screen' into random state - done
warning, not much extra random data, consider using the -rand option
Generating RSA private key, 512 bit long modulus

.....++++++
..++++++
e is 65537 (0x10001)

openssl req -new -x509 -key private.pem -out public.pem -extensions PEAP -config openssl.cnf -days 5000

Using configuration from openssl.cnf
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.

Country Name (2 letter code) [AU]:US
State or Province Name (full name) [Some-State]:Washington
Locality Name (eg, city) []:Spokane
Organization Name (eg, company) [Internet Widgits Pty Ltd]:IEA Software, Inc.
Organizational Unit Name (eg, section) []:
Common Name (eg, YOUR name) []:ieas
Email Address []:support@iea-software.com

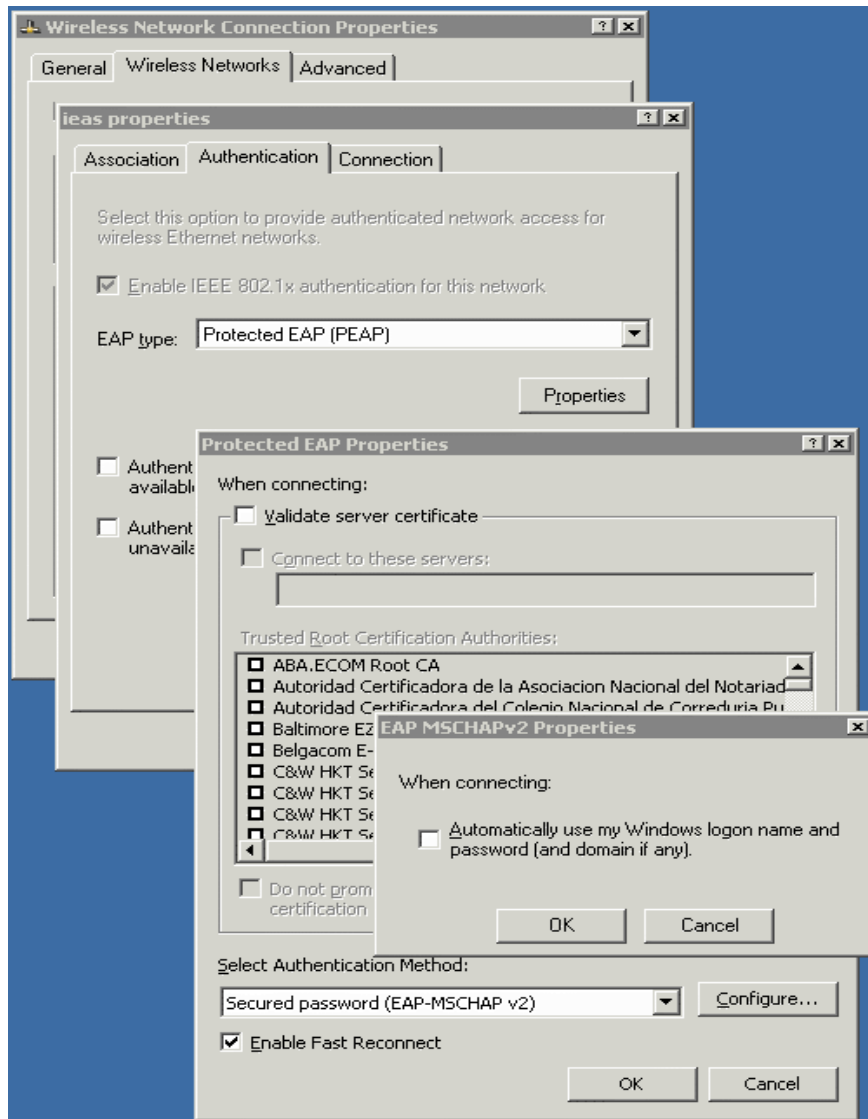
Combine the two files private.pem and public.pem into one. The full pathname of this file becomes the 'PEAP Certificate' file configured in the EAP section of the RadiusNT/X administrator. 'PEAP CA Certificate' is not used and should be left blank.

After configuring the PEAP certificate file locations, save your changes. Stop RadiusNT if running as a windows service and start RadiusNT/X in debug 'radius -x15 -X4'. At startup you should see all supported EAP types being registered.

Registered: EAP-Identity
Registered: EAP-GTC
Registered: EAP-MD5
Registered: EAP-LEAP
Registered: EAP-MSCHAPV2
Registered: EAP-PEAP
Registered: EAP-PEAP-Identity
Registered: EAP-PEAP-GTC
Registered: EAP-PEAP-MSCHAPV2

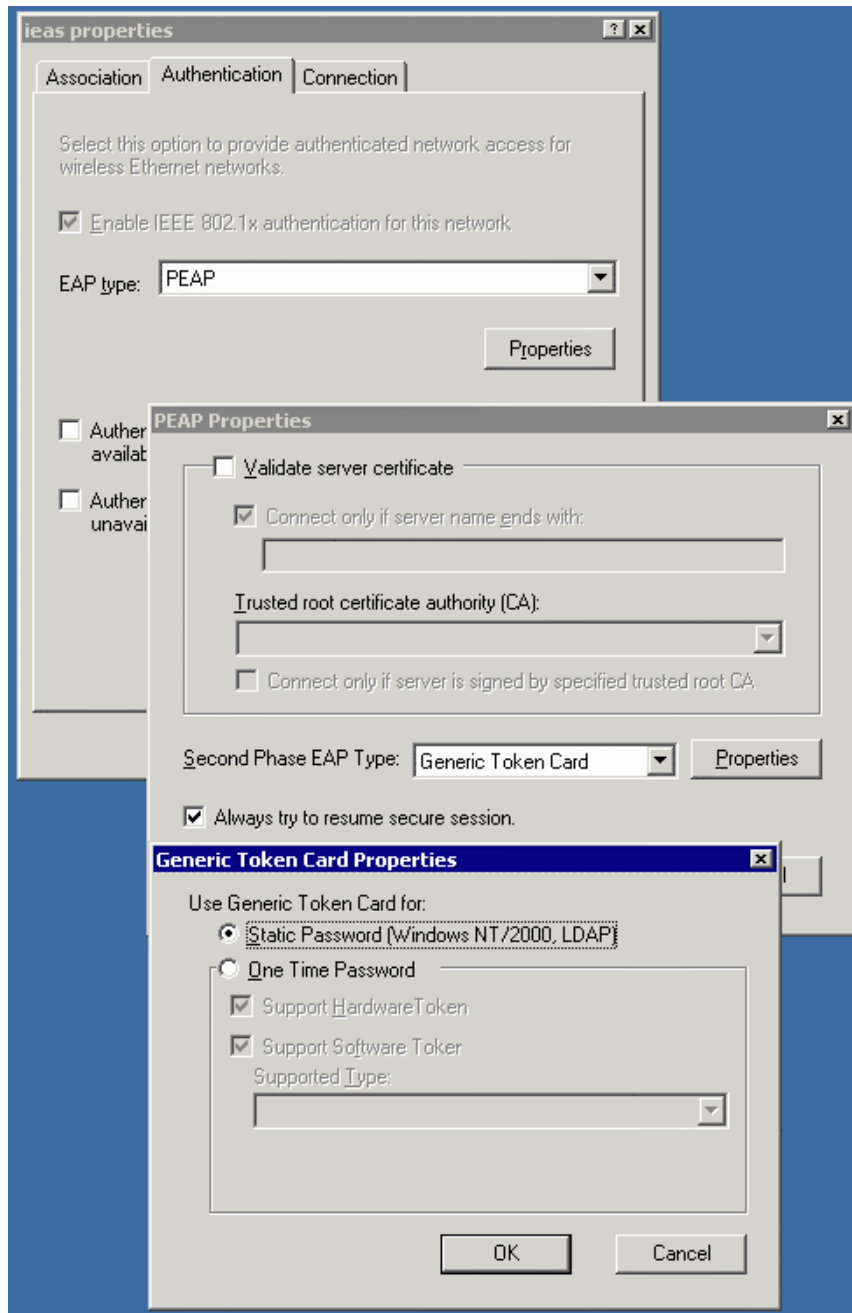
If EAP-PEAP fails to register with a reason of N/A or missing file, check the file locations of the certificate files you created with the full pathname+filename entered for PEAP Certificate and PEAP CA Certificate in the RadiusNT/X admin.

Windows supplicant configuration example



Select PEAP as the eap type and EAP-MSCHAP v2 as the PEAP authentication method. If you created a PEAP certificate for use with your wireless network make sure the 'validate server certificate' checkbox is checked. If you are using the default ias.pem certificate 'validate server certificate' must not be checked.

Cisco supplicant configuration example



Select PEAP as the eap type and Generic Token Card as the Second Phase EAP Type. If you created a PEAP certificate for use with your wireless network make sure the 'validate server certificate' checkbox is checked. If you are using the default ieas.pem certificate 'validate server certificate' must not be checked.

Questions & Answers

Q. Does RadiusNT/X support certificate only authentication such as EAP-TLS or EAP-PEAP phase 1 only?

A. No, while RadiusNT/X supports validating server and client certificates it also requires password authentication be performed before a client will successfully authenticate.

Q. Does RadiusNT/X support EAP-TTLS?

A. No, we have found clients supporting EAP-TTLS also support EAP-PEAP. PEAP and TTLS perform the same function and currently have the same security properties. Of the two PEAP is actively being developed by the IETF and enjoys much greater support in the industry. Later versions of PEAP will provide additional security features not found in PEAP v0, v1 or EAP-TTLS.

Q. I'm getting an error NO PASSWORD when authenticating using EAP, what could be wrong?

A. The most likely cause is that you are using a version of RadiusNT/X that does not support EAP or are not licensed for the feature. See the [Versions and editions of RadiusNT/X supporting EAP Authentication](#) section above.

Q. I'm getting an error SSL routines:SSL3_GET_CLIENT_HELLO when authenticating using PEAP. How can I fix this problem?

A. The most common cause of this error is not having a PEAP certificate installed. PEAP certificates are required to use EAP-PEAP. See the section above on [PEAP certificates, signing requirements and examples](#) for more information on creating a PEAP certificate.

Q. While authenticating clients RadiusNT/X reports the error 'PEAP err - SSL_write wants read, however the protocol has no provision for it'. What can I do to fix this problem?

A. The most likely cause is the client's failure to successfully validate the server's certificate. If your clients have certificate validation enabled and you have chosen a 'self-signed' server certificate make sure clients have the RadiusNT/X servers public key installed as a trusted certificate. On the windows platform this can be done by distributing the server's public key in a file with an extension of .cer. The user simply needs to right-click over the file and select 'Install certificate'. Disabling the clients certificate validation will also prevent the error however it bypasses the benefits associated with certificates. If you're using a third party Certificate Authority (CA) such as Verisign or Thawte make sure your CA's certificate chain file if required has also been installed in the [RadiusNT/X administrator](#).

Q. I can't seem to authenticate using EAP, where should I look to find and solve this problem?

A. There are several possible sources of clues about EAP authentication failures. First and foremost run RadiusNT/X in debug mode using the following command-line parameters 'radius -x15 -X4'. Save a copy of all data shown during the authentication attempt. Another good source of information is debug or trace data from the supplicant (client). If not obvious from this data our support staff (support@iea-software.com) can assist you to further trouble shooting the problem. Possible authentication problems may be related to one of the following:

- Wrong default EAP type selected and supplicant (client) does not support EAP type negotiation.
- RadiusNT/X has multiple IP addresses on the same subnet and is not configured to bind to one of the two addresses.
- RadiusNT/X shared secret does not match access server shared secret

- Using PEAP without having first defined a PEAP certificate file in RadiusNT/X admin
- Client configured to validate server certificate when the server certificate is the default cert included with Emerald (ieas.pem) or another SSL certificate which does not have a Client Authentication EKU.
- RadiusNT is running as a service as well as debug mode.
- EAP type being used is not compatible with the backend authentication database.

Q. Which future EAP types will RadiusNT/X likely support?

A. We are looking into the possibility of including EAP-FAST and or EAP-SRP into future versions of RadiusNT/X as they mature. Both protocols provide many of the same benefits as PEAP but do so without PEAPs certificate requirements.