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# RFC 9965

## The eap.arpa. Domain and Extensible Authentication Protocol (EAP) Provisioning

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### Abstract

This document defines the eap.arpa. domain for use only in Network Access Identifiers (NAIs) as a way for Extensible Authentication Protocol (EAP) peers to signal to EAP servers that they wish to obtain limited, and unauthenticated, network access. EAP peers signal which kind of access is required via certain predefined identifiers that use the NAI format of RFC 7542. A table of identifiers and meanings is defined, which includes entries for RFC 9140.

This document updates RFCs 5216 and 9190 to define an unauthenticated provisioning method. Those specifications suggest that such a method is possible, but they do not define how it would be done. This document also updates RFC 9140 to deprecate "eap-noob.arpa" and replace it with "@noob.eap.arpa".

### Status of This Memo

This is an Internet Standards Track document.

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## 1. Introduction

In most uses, EAP [RFC3748] requires that the EAP peers have pre-provisioned credentials. Without pre-provisioned credentials, the device cannot obtain network access in order to be provisioned with credentials. This limitation creates a bootstrapping problem.

This specification addresses that bootstrapping problem. It creates a framework for predefined "well-known" provisioning credentials and instantiates that framework for two mechanisms.

Clients can submit these predefined provisioning credentials to a server in order to obtain limited network access. At the same time, servers can know in advance that these credentials are to be used only for provisioning; thus, they can avoid granting unrestricted network access to peers that submit these credentials.

The device can either use the EAP channel itself for provisioning, as with the Tunnel Extensible Authentication Protocol (TEAP) [RFC9930], or the EAP server can give the device access to a limited captive portal such as with [RFC8952]. Once the device is provisioned, it can use those provisioned credentials to obtain full network access.

The predefined provisioning credentials use a generic identity format. Identifiers in this space are generically referred to as "EAP Provisioning Identifiers" (or "EPIs").

Since the identity is predefined and used only for unauthenticated network access, there is little benefit to specifying predefined passwords. Where supported by the underlying EAP method, this specification provides for password-less access. Where passwords are required, the password is defined to be the same as the identity.

## 1.1. Background and Rationale

In this section, we provide background on the existing functionality and describe why it was necessary to define provisioning methods for EAP.

### 1.1.1. Review of Existing Functionality

For EAP-TLS, both [RFC5216], Section 2.1.1 and [RFC9190] provide for "peer unauthenticated access". However, those documents define no way for a peer to signal that it is requesting such access. The presumption is that the peer connects with some value for the EAP Identity, but does so without using a client certificate. The EAP server is then supposed to determine that the peer is requesting unauthenticated access and take the appropriate steps to limit authorization.

There appears to be no EAP peer or server implementations that support such access since there is no defined way to perform any of the steps required, i.e., to signal that this access is desired and then limit access.

The Wi-Fi Alliance has defined an unauthenticated EAP-TLS method, using a vendor-specific EAP method as part of HotSpot 2.0r2 [HOTSPOT]. However, there appear to be few deployments of this specification.

Nimble Out-of-Band Authentication for EAP (EAP-NOOB) [RFC9140] takes this process a step further. It defines both a way to signal that provisioning is desired and a way to exchange provisioning information within EAP-NOOB. That is, there is no need for the device to obtain limited network access as all of the provisioning is done inside of the EAP-NOOB protocol.

TEAP [RFC9930] provides for provisioning via an unauthenticated TLS tunnel. It provides for a server unauthenticated provisioning mode, but the inner TLS exchange requires that both ends authenticate each other. There are ways to provision a certificate, but the peer must still authenticate itself to the server with preexisting credentials. As a result, any provisioning method that uses TEAP will have to address this limitation.

### 1.1.2. Taxonomy of Provisioning Types

There are two scenarios where provisioning can be done. The first is where provisioning is done within the EAP method, as with EAP-NOOB [RFC9140]. The second is where EAP is used to obtain limited network access (e.g., as with a captive portal). That limited network access is then used to run IP-based provisioning over more complex protocols.

### 1.1.3. Rationale for Provisioning over EAP

It is often useful to do all provisioning inside of EAP because the EAP / Authentication, Authorization, and Accounting (AAA) admin does not have control over the network. It is not always possible to define a captive portal where provisioning can be done. As a result, we need to be able to perform provisioning via EAP: not via some IP.

## 2. Terminology

### EAP Provisioning Identifier

The EAP Provisioning Identifier (or EPI) is defined to be a strict subset of the NAI [RFC7542]. The EPI is an NAI that is a subdomain of "eap.arpa.". The "realm" portion of the NAI is defined in [RFC7542], Section 2.2, which is a more restrictive subset of the domain name conventions specified in [STD13].

Readers of this document should note that the realm portion of the NAI is different from a domain name. In addition to the character set being more limited, the realm portion of the NAI does not include a trailing period (".").

### eap.arpa

The realm portion of the NAI.

This document uses the term "eap.arpa realm" when using that name within the context of an NAI.

### eap.arpa.

The domain name "eap.arpa.".

This document uses the term "eap.arpa. domain" when using that name within the context of the DNS. The trailing period (".") is added for consistency with DNS specifications.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

### 3. Overview

A device that has no device-specific credentials can use a predefined provisioning identifier in NAI format [RFC7542]. The NAI is composed of two portions: the utf8-username and the utf8-realm domain. For simplicity, we refer to these as the "username" and "realm" fields.

The realm is chosen to be independent of, and unused by, any existing organization; thus, it is to be usable by all organizations. The realm needs to be one that is not automatically proxied by any existing AAA proxy framework as defined in [RFC7542], Section 3. The realm also needs to be one that does not return results for dynamic discovery as described in [RFC7585].

However, this specification does not forbid the routing of packets for NAIs in the eap.arpa realm. Instead, it leaves such routing up to individual organizations.

This specification is fully compatible with all known EAP implementations, so it is fail-safe. When presented with a peer wishing to use this specification, existing implementations will return EAP Failure and will not otherwise misbehave.

#### 3.1. The eap.arpa Realm

This document defines the eap.arpa realm as being used for provisioning within EAP. A similar domain has previously been used for EAP-NOOB [RFC9140] as "eap-noob.arpa". This document extends that concept and standardizes the practices surrounding it.

#### 3.2. The Realm Field

The NAIs defined by this specification use the "realm" field defined in [RFC7542] to signal the behavior being requested; in particular, the subdomain under the eap.arpa. domain allows for different requested methods to be distinguished. The subdomain in the realm field is assigned via the "EAP Provisioning Identifiers" registry [EAPREG], which is defined in Section 5.2. The subdomain **MUST** follow the syntax defined in [RFC7542], Section 2.2, which is a more restrictive subset of the domain name conventions specified in [STD13].

Where possible, the first subdomain of the eap.arpa. domain **SHOULD** use the EAP method name, as defined in the "Extensible Authentication Protocol (EAP) Registry" registry group, "Method Types" registry. However, the names in the "EAP Method Type" registry [EAPREG] do not follow the domain name formats specified in [STD13], so it is not always possible to make a one-to-one mapping between the Method Type name and a subdomain of the eap.arpa. domain.

Where it is not possible to make a direct mapping between the EAP Method Type name due to the EAP Method Type name not matching the [RFC7542], Section 2.2 format, the NAI that is defined in the "EAP Provisioning Identifiers" registry **MUST** use a realm name that is similar enough to allow the average reader to understand which EAP Method Type is being used.

Additional subdomains are permitted in the realm; these permit vendors and Standards Development Organizations (SDOs) the ability to self-assign a delegated range of identifiers that do not conflict with other identifiers.

Any realm defined in this registry (e.g., "tls.eap.arpa") also implicitly defines a sub-realm "v." (e.g., "v.tls.eap.arpa"). Vendors or SDOs can self-allocate within the "v." realm using realms that they own. For example, a company that owns the "example.com." domain could self-allocate and use the realm "example.com.v.tls.eap.arpa". See [Section 5.2.5](#) for more discussion of this topic.

This specification does not make any provisions for private-use realms. The "v." sub-realm is sufficient for all private uses.

Experimental provisioning methods **MUST** be defined within the appropriate vendor's name space. For documents within the IETF, the "ietf.org" vendor space **MUST** be used. Different uses **SHOULD** be distinguished by using the name of a working group or document, such as "emu.ietf.org.v.eap.arpa".

### 3.3. The Username Field

The username field is dependent on the EAP method being used for provisioning. For example, [\[RFC9140\]](#) uses the username "noob". Other EAP methods **MAY** omit the username as recommended in [\[RFC7542\]](#). The username "anonymous" is **NOT RECOMMENDED** for specifications using this format, even though it is permitted by [\[RFC7542\]](#). The name "anonymous" is widely used in NAIs today, and we wish to avoid confusion.

The username field is assigned via the "EAP Provisioning Identifiers" registry, which is defined in [Section 5.2](#). The username field **MAY** be empty or hold a fixed value. While [\[RFC7542\]](#) recommends omitting the username portion for user privacy, the names here are defined in public specifications. Therefore, user privacy is not needed for provisioning identifiers; the username field can be publicly visible.

### 3.4. Operation

Having described the format and contents of NAIs in the eap.arpa realm to define the EPI, we now describe how those EPIs are used by EAP peers and EAP servers to signal provisioning information.

#### 3.4.1. EAP Peers

An EAP peer signals that it wishes a certain kind of provisioning by using an EPI along with an associated EAP method. The meaning of the EPI, and behavior of the peer, are defined by a separate specification. That specification will typically define both the EPI and the EAP method or methods that are used for provisioning.

The EPI used by the peer **MUST** be taken from an entry in the "EAP Provisioning Identifiers" registry, and the EAP method used with that NAI **MUST** match the corresponding EAP method from that same entry.

Where an EAP peer allows local selection of a provisioning method, the EPI is defined by the provisioning method and not by the end user. As a result, when a provisioning method is being selected, the EAP peer **MUST NOT** have a configuration interface that lets the EAP user identifier field be configured directly. Instead, the user (or some other process) chooses a provisioning method and the EAP peer then selects the EPI that matches that provisioning method.

While EAP peers allow users to enter user identifiers directly for existing EAP methods, they **MUST NOT** check whether those identifiers match any EPI. Any user who enters an identifier that matches an EPI either will get rejected because the server does not support provisioning or the user will be placed into a captive portal. There are no security or privacy issues with a user manually entering an EPI as the user identifier.

When all goes well, running EAP with the EPI results in new authentication credentials being provisioned. The peer then drops its network connection and re-authenticates using the newly provisioned credentials. The user **MAY** be involved in this process, but, in general, provisioning results in the EAP peer automatically gaining network access using the provisioned credentials.

There are a number of ways in which provisioning can fail. One way is when the server does not implement the provisioning method. Therefore, EAP peers **MUST** track which provisioning methods have been tried and not repeat the same method to the same EAP server when receiving an EAP Nak.

Peers **MUST** rate limit their provisioning attempts. If provisioning fails, it is likely because provisioning is not available. Retrying provisioning repeatedly and in quick succession is not likely to change the server behavior. Instead, it is likely to result in the peer being blocked. The peer **SHOULD** retry provisioning no more than once every few minutes and **SHOULD** include jitter and exponential backoff on its provisioning attempts.

Since there is no way to signal whether the failed provisioning is due to a transient failure on the EAP server or due to the EAP server not supporting that provisioning method, EAP peers **SHOULD** err on the side of long delays between retrying the same provisioning method to an EAP server. EAP peers **MAY** retry a given provisioning method after a sufficiently long interval that the EAP server might have implemented the provisioning method, e.g., at least a day and perhaps no more than a month.

Another way for the provisioning method to fail is when the new credentials do not result in network access. It is **RECOMMENDED** that when peers are provisioned with credentials, they immediately try to gain network access using those credentials. That process allows errors to be quickly discovered and addressed.

An EAP peer may have been provisioned with temporary credentials or credentials that expire after some period of time (e.g., an X.509 certificate with notAfter date set). Therefore, it **SHOULD** attempt to provision new credentials before the current set expires. Unfortunately, any re-provisioning process with EAP will involve the device dropping off from the "full" network in order to connect to the provisioning network. Therefore, it is **RECOMMENDED** that re-provisioning methods be provided that can be used when the device has full network access. See [Section 3.6](#) for additional discussion on this topic.

### 3.4.2. EAP Servers

An EAP session begins with the server receiving an initial EAP-Request/Identity message. An EAP server implementing this specification **MUST** examine the identity to see if it uses a realm located under the eap.arpa realm. If so, the identity is an EPI. Processing of all other identities is unchanged by this specification.

If the server receives an EPI that is malformed, it **MUST** reply with an EAP Failure as per [RFC3748], Section 4.2. For example, an NAI may end with the eap.arpa realm but may also contain data that is not permitted by the format described in [RFC7542]. Otherwise, the EPI is examined to determine which provisioning method is being requested by the peer.

If the server does not recognize the EPI requested by the peer, it **MUST** reply with an EAP Nak of type zero (0). This reply indicates that the requested provisioning method is not available. The server also **MUST** reply with a Nak of type zero (0) as per [RFC3748], Section 5.3.1 if the peer proposes an EAP method that is not supported by the server or is not recognized as being valid for that provisioning method. The peer can then take any remedial action that it determines to be appropriate.

Once the server accepts the provisioning method, it then replies with an EAP method that **MUST** match the one associated with the EPI. The EAP process then proceeds as per the EAP state machine outlined in [RFC3748].

Implementations **MUST** treat peers using an EPI as untrusted and untrustworthy. Once such a peer is authenticated, it **MUST** be placed into a limited network such as a captive portal. The limited network **MUST NOT** permit unrestricted network access. Implementations should be aware of methods that bypass simple blocking such as tunneling data over DNS.

A secure provisioning network is one where only the expected traffic is allowed and all other traffic is blocked. The alternative of blocking only selected "bad" traffic results in substantial security failures. As most provisioning methods permit unauthenticated devices to gain network access, these methods have a substantial potential for abuse by malicious actors. As a result, the limited network needs to be designed assuming that it will be abused by malicious actors.

A limited network **SHOULD** also limit the duration of network access by devices being provisioned. The provisioning process should be fairly quick: in the order of seconds to tens of seconds in duration. Provisioning times longer than this likely indicate an issue; it may be useful to block the problematic device from the network.

A limited network **SHOULD** also limit the amount of data being transferred by devices being provisioned and **SHOULD** limit the network services that are available to those devices. The provisioning process generally does not need to download large amounts of data; similarly, it does not need access to a large number of services.

Servers **SHOULD** rate limit provisioning attempts. A misbehaving peer can be blocked temporarily or even permanently. Implementations **SHOULD** limit the total number of peers being provisioned at the same time. There is no requirement for RADIUS servers to allow all

peers to connect without limit. Instead, peers are provisioned at the discretion of the network being accessed, which may permit or deny those devices based on reasons that are not explained to those devices.

Implementations **SHOULD** use functionality such as the RADIUS Filter-Id attribute ([RFC2865], Section 5.11) to limit network access for the peer being provisioned, as discussed in Section 3.4.2. For ease of administration, the Filter-Id name could simply be the EPI or a similar name. Such consistency aids with operational considerations when managing complex networks.

Implementations **MUST** prevent peers in the limited network from communicating with each other. There is no reason for a system that is being provisioned to communicate with anything other than the provisioning server(s).

### 3.5. Other Considerations

Implementations **MUST NOT** permit EAP method negotiation with provisioning credentials. That is, when an EPI is used, any EAP Nak sent by a server must contain only EAP method zero (0). When an EAP peer uses an EPI and receives an EAP Nak, any EAP methods given in that Nak **MUST** be ignored.

While a server may support multiple provisioning methods, there is no way in EAP to negotiate which provisioning method can be used. It is also expected that the provisioning methods will be specific to a particular type of peer device. That is, a given peer is likely to support only one provisioning method.

As a result, there is no need to require a method for negotiating provisioning methods.

### 3.6. Considerations for Provisioning Specifications

The operational considerations discussed in this document have a number of impacts on specifications that define provisioning methods.

#### 3.6.1. Negotiation

Specifications that define provisioning for an EAP method **SHOULD** provide a method-specific process by which implementations can negotiate a mutually acceptable provisioning method.

However, for the reasons noted in this document, we cannot make this suggestion mandatory. If it is not possible for a provisioning method to define any negotiation, then that limitation should not be a barrier to publishing the specification.

#### 3.6.2. Renewal of Credentials

Where a provisioning method is expected to create credentials that do not expire, the specification **SHOULD** state this explicitly.

Where credentials expire, it is **RECOMMENDED** that specifications provide guidance on how the credentials are to be updated. For example, an EAP method could permit re-provisioning to be done as part of a normal EAP authentication using the currently provisioned credentials.

It is **RECOMMENDED** that the provisioning methods provide for a method that can be used without affecting network access. A specification could define provisioning endpoints such as Enrollment over Secure Transport (EST) [RFC7030] or Internet X.509 Public Key Infrastructure Certificate Management Protocol (CMP) [RFC9810]. The provisioning endpoints could be available both on the provisioning network and on the provisioned (i.e., normal) network. Such an architecture means that devices can be re-provisioned without losing network access.

### 3.7. Notes on AAA Routability

[RFC7542], Section 3 describes how the NAI allows authentication requests to be routable within a AAA proxy system. While the EPI uses the NAI format, the eap.arpa realm has been chosen because it is not routable within a AAA proxy system.

When we say that the eap.arpa realm is not routable in a AAA proxy system, we mean two different things:

1. The eap.arpa. domain does not exist within the DNS, so it will never be resolvable for dynamic discovery as described in [RFC7585].
2. The eap.arpa realm will never be used by any administrator; the administrator is unable to satisfy the requirements of [RFC7542], Section 2.5 by registering the realm within the DNS.

In addition, administrators will not have statically configured AAA proxy routes for this domain. Where routes are added for this domain, they will generally be used to implement this specification.

In order to avoid spurious DNS lookups, RADIUS servers supporting [RFC7585] **SHOULD** perform filtering in the domains that are sent to DNS. Specifically, names in the eap.arpa. domain **MUST NOT** be looked up in DNS.

## 4. Interaction with EAP Methods

As the provisioning identifier is used within EAP, it necessarily has interactions with, and effects on, the various EAP methods. This section discusses those effects in more detail.

Some EAP methods require shared credentials such as passwords in order to succeed. For example, both EAP-MSCHAPv2 (Protected Extensible Authentication Protocol aka PEAP) and EAP-pwd [RFC5931] perform cryptographic exchanges where both parties know a shared password. Where password-based methods are used, the password **SHOULD** be the same as the provisioning identifier, as there are few reasons to define a method-specific password.

This requirement also applies to TLS-based EAP methods such as EAP Tunneled Transport Layer Security (EAP-TTLS) and PEAP. Where the TLS-based EAP method provides for an inner identity and inner authentication method, the credentials used there **SHOULD** be the provisioning identifier for both the inner identity and any inner password.

It is **RECOMMENDED** that provisioning be done via a TLS-based EAP method. TLS provides for authentication of the EAP server along with integrity and confidentiality protection for any provisioning data exchanged in the tunnel. Similarly, if provisioning is done in a captive portal outside of EAP, EAP-TLS permits the EAP peer to run a full EAP authentication session while having nothing more than a few Certification Authorities (CAs) locally configured.

#### 4.1. High Level Requirements

All provisioning methods that are specified within the eap.arpa. domain **MUST** define a way to authenticate the server. This authentication can happen either at the EAP layer (as with TLS-based EAP methods) or after network access has been granted (if credentials are provisioned over HTTPS).

Where TLS-based EAP methods are used, implementations **MUST** still validate EAP server certificates in all situations other than provisioning. Where the provisioning method under the eap.arpa. domain defines that provisioning happens via another protocol such as with HTTPS, the EAP peer **MAY** skip validating the EAP server certificate.

Whether or not the server certificate is ignored, the peer **MUST** treat the local network as untrusted. [RFC8952], Section 6 has more discussion on this topic.

The ability to not validate the EAP server certificates relaxes the requirements of [RFC5216], Section 5.3 that the server certificate always be validated. For provisioning, it is acceptable in some cases to not validate the EAP server certificate but only when there are other means to authenticate the data that is being provisioned.

However, since the device is likely otherwise configured with web CAs [CAB], the captive portal would also be unauthenticated provisioning methods could use those CAs within an EAP method in order to allow the peer to authenticate the EAP server. Further discussion of this topic is better suited for the specification(s) that define a particular provisioning method. This issue is not discussed further here, other than to say that it is technically possible.

#### 4.2. EAP-TLS

This document defines an NAI "portal@tls.eap.arpa", which allows EAP peers to use unauthenticated EAP-TLS. The purpose of the identifier is to allow EAP peers to signal to EAP servers that they wish to obtain "captive portal" network access.

This identifier signals to the EAP server that the peer wishes to obtain "peer unauthenticated access" as per [RFC5216], Section 2.1.1 and [RFC9190]. Note that peer unauthenticated access **MUST** provide for authentication of the EAP server, such as with a server certificate. Using TLS-PSK with a well-known Pre-Shared Key (PSK) value is generally not appropriate, as it would not provide server authentication.

An EAP server that agrees to authenticate this request **MUST** ensure that the device is placed into a captive portal with limited network access as discussed above in Section 3.4.2.

This method is an improvement over existing captive portals, which are typically completely unsecured and unauthenticated. Using peer unauthenticated TLS for network access ensures that the EAP server is proven to be authentic. The use of 802.1X [IEEE802.1X] ensures that the link between the EAP peer and EAP authenticator (e.g., access point) is also secured.

Further details of the captive portal architecture can be found in [RFC8952]. The captive portal can advertise support for the eap.arpa. domain via an 802.11u [IEEE802.11u] realm.

### 4.3. EAP-NOOB

It is **RECOMMENDED** that server implementations of EAP-NOOB accept both identities "noob@eap-noob.arpa" and "@noob.eap.arpa" as synonyms.

It is **RECOMMENDED** that EAP-NOOB peers use "@noob.eap.arpa" first and, if that does not succeed, then they use "noob@eap-noob.arpa".

## 5. IANA Considerations

This document describes a number of IANA actions:

- IANA has made two registry updates in order to define the eap.arpa. domain (Section 5.1).
- IANA has created a new registry (see Section 5.2).

### 5.1. .arpa Updates

There are two updates to the ".ARPA Zone Management" registry [ARPAREG] (detailed in Sections 5.1.1 and 5.1.2).

IANA has also been instructed to refuse further allocation requests that are directly within the ".ARPA Zone Management" registry for any functionality related to the EAP. Instead, allocations related to EAP are to be made within the new "EAP Provisioning Identifiers" registry in the "Extensible Authentication Protocol (EAP) Registry" registry group (see [EAPREG]).

#### 5.1.1. Deprecating eap-noob.arpa

IANA has updated the "eap-noob.arpa" entry in the ".ARPA Zone Management" registry [ARPAREG] as follows:

The USAGE/REFERENCE field has been updated to prefix the text with (DEPRECATED) and to add a reference to this document (RFC 9965).

#### 5.1.2. Defining the eap.arpa. Domain

IANA has updated the ".ARPA Zone Management" registry [ARPAREG] to include the following entry:

DOMAIN: eap.arpa

USAGE/REFERENCE: For provisioning within the Extensible Authentication Protocol framework. RFC 9965

IANA has updated the "Special-Use Domain Names" registry (see [\[SPECIAL-USE\]](#)) as follows:

Name: eap.arpa.

Reference: RFC 9965

#### 5.1.2.1. Domain Name Reservation Considerations

This section answers the questions that are required by [Section 5](#) of [\[RFC6761\]](#). At a high level, these new domain names are used in certain situations in EAP. The domain names are never seen by users, and they do not appear in any networking protocol other than EAP.

1. Users: Human users are not expected to recognize these names as special or use them differently from other domain names. The use of these names in EAP is invisible to end users.
2. Application Software: EAP servers and clients are expected to make their software recognize these names as special and treat them differently. This document discusses that behavior. EAP peers should recognize these names as special and should refuse to allow users to enter them in any interface. EAP servers and RADIUS servers should recognize the eap.arpa. domain as special and refuse to do dynamic discovery ([\[RFC7585\]](#)) for it.
3. Name Resolution APIs and Libraries: Writers of these APIs and libraries are not expected to recognize these names or treat them differently.
4. Caching DNS Servers: Writers of caching DNS servers are not expected to recognize these names or treat them differently.
5. Authoritative DNS Servers: Writers of authoritative DNS servers are not expected to recognize these names or treat them differently.
6. DNS Server Operators: These domain names have minimal impact on DNS server operators. They should never be used in DNS or in any networking protocol outside of EAP.

Some DNS servers may receive lookups for this domain, if EAP or RADIUS servers are configured to do dynamic discovery for realms as defined in [\[RFC7585\]](#), and where those servers are not updated to ignore the .arpa domain. When queried for the eap.arpa. domain, DNS servers **SHOULD** return an NXDOMAIN error.

If they try to configure their authoritative DNS as authoritative for this reserved name, compliant name servers do not need to do anything special. They can accept the domain or reject it. Either behavior will have no impact on implementations of this specification.

7. DNS Registries/Registrars: DNS Registries/Registrars should deny requests to register this reserved domain name.

## 5.2. EAP Provisioning Identifiers Registry

IANA has added the following new registry to the "Extensible Authentication Protocol (EAP) Registry" registry group (see [\[EAPREG\]](#)).

Assignments in this registry are made via "Expert Review" as described in [RFC8126], Section 4.5. Guidelines for experts are provided in Section 5.2.2.

The registry format is as follows:

Title: EAP Provisioning Identifiers

Registration Procedure(s): Expert Review

Reference: RFC 9965

NAI: The Network Access Identifier in the format described in [RFC7542].

Method Type: The EAP method name, taken from the "Description" field of the "Method Types" registry (see [EAPREG]).

Reference: Reference where this identifier was defined.

### 5.2.1. Initial Values of the EAP Provisioning Identifiers Registry

NAI	Method Type	Reference
@noob.eap.arpa	EAP-NOOB	[RFC9140] and RFC 9965
portal@tls.eap.arpa	EAP-TLS	[RFC9190] and RFC 9965

Table 1: Initial Values of the EAP Provisioning Identifiers Registry

### 5.2.2. Guidelines for Designated Experts

The following text gives guidelines for designated experts who review allocation requests for the "EAP Provisioning Identifiers" registry.

#### 5.2.2.1. NAIs

The intent is for the NAI to describe both the EAP Method Type and the purpose of the provisioning method. A descriptive format allows administrators who are unfamiliar with a particular NAI to make reasonable deductions about the provisioning method being requested. For example, with an EAP Method Type "name" and a purpose "action", the NAI **SHOULD** be of the form "action@name.eap.arpa".

The NAI **MUST** satisfy the requirements of the format in [RFC7542], Section 2.2. The utf8-username portion **MAY** be empty. The utf8-username portion **MUST NOT** be "anonymous". The NAI **MUST** be a subdomain within the eap.arpa realm. NAIs with any "v." subdomain **MUST NOT** be registered in order to preserve the functionality of that subdomain.

NAIs in the registry **MUST NOT** contain more than one subdomain. NAIs with a leading "v." subdomain **MUST NOT** be registered. That subdomain is reserved for vendor and SDO extensions.

The subdomain of the NAI field should correspond to the EAP Method Type name. Care should be taken so that the domain name conventions specified in [STD13] are followed.

The NAIs in this registry are case-insensitive. While [RFC7542] notes that similar identifiers of different cases can be considered to be different, this registry requires that all entries **MUST** be lowercase for simplicity.

Identifiers **MUST** be unique when compared in a case-insensitive fashion. While [RFC7542] notes that similar identifiers of different cases can be considered to be different, this registry is made simpler by requiring case-insensitivity.

Entries in the registry should be short. NAIs defined here will generally be sent in a RADIUS packet in the User-Name attribute ([RFC2865], Section 5.1). That specification recommends that implementations should support User-Names of at least 63 octets. NAI length considerations are further discussed in [RFC7542], Section 2.3, and any allocations in this registry need to take those limitations into consideration.

Implementations are likely to support a total NAI length of 63 octets. Lengths between 63 and 253 octets may work. Lengths of 254 octets or more will not work with RADIUS [RFC2865].

### 5.2.3. Method Type

Values in the "Method Type" field of this registry **MUST** be taken from the "Method Types" registry (see [EAPREG]); otherwise, a value **MUST** be an Expanded Type, which usually indicates a vendor-specific EAP method.

The EAP Method Type **MUST** provide a Master Session Key (MSK) and an Extended MSK (EMSK) as defined in [RFC3748]. Failure to provide these keys means that the Method Type will not be usable within an authentication framework that requires those methods, such as with [IEEE802.1X].

### 5.2.4. Designated Experts

The designated expert will post a request to the EAP Method Update (EMU) WG mailing list (or a successor designated by the Area Director) for comment and review, including an I-D or reference to an external specification. Before a period of 30 days has passed, the designated expert will either approve or deny the registration request and publish a notice of the decision to the EMU WG mailing list (or its successor) as well as inform IANA. A denial notice must be justified by an explanation; in the cases where it is possible, concrete suggestions on how the request can be modified so as to become acceptable should be provided.

### 5.2.5. Organization Self Assignment

The "EAP Provisioning Identifiers" registry allows organizations to request allocations from it, but explicit allocations are not always required. Any NAI defined in this registry also implicitly defines a subdomain "v.". Organizations can self-allocate in this space under the "v." subdomain, e.g., "local@example.com.v.tls.eap.arpa".

The purpose of self-assigned realms is for testing and for future expansion. There are currently no use cases being envisioned for these realms, but we do not wish to forbid future expansion.

An organization that has registered a Fully Qualified Domain Name (FQDN) within the DNS can use that name within the "v." subdomain.

As DNS registrations can change over time, an organization may stop using a domain at some point. This change is reflected in the DNS but is unlikely to be reflected in shipped products that use a self-assigned realm. There is no solution to this problem other than suggesting that organizations using self-assigned realms do not allow their DNS registrations to expire.

Therefore, it is **RECOMMENDED** that organizations avoid the use of self-assigned realms. Organizations **MAY** use self-assigned realms only when no other alternative exists and when the organization expects to maintain operation for at least the lifetime of the devices that use these realms.

## 6. Privacy Considerations

The EAP Identity field is generally publicly visible to parties who can observe the EAP traffic. As the names given here are in a public specification, there is no privacy implication to exposing those names within EAP. In fact, the entire goal of this specification is to make those names public so that unknown (and private) parties can publicly (and anonymously) declare what kind of network access they desire.

However, there are many additional privacy concerns around this specification. Most EAP traffic is sent over RADIUS [[RFC2865](#)]. The RADIUS Access-Request packets typically contain large amounts of information such as Media Access Control (MAC) addresses, device location, etc.

This specification does not change RADIUS or EAP and, as such, does not change which information is publicly available or is kept private. Those issues are dealt with in other specifications, such as [[INSECURE-RADIUS](#)].

However, this specification can increase privacy by allowing devices to anonymously obtain network access and then securely obtain credentials.

The NAIs used here are contained in a public registry; therefore, they do not have to follow the username privacy recommendations of [[RFC7542](#)], [Section 2.4](#). However, there may be other personally identifying information contained in EAP or AAA packets. This situation is no different from normal EAP authentication; thus, it has no additional positive or negative implications for privacy.

## 7. Security Considerations

This specification defines a framework that permits unknown, anonymous, and unauthenticated devices to request and to obtain network access. As such, it is critical that network operators provide limited access to those devices.

Future specifications that define an NAI within this registry, should give detailed descriptions of what kind of network access is to be provided.

## 7.1. On-Path Attackers and Impersonation

In most EAP use cases, the server identity is validated (usually through a certificate) or the EAP method allows the TLS tunnel to be cryptographically bound to the inner application data. For the methods outlined here, the use of public credentials and/or skipping server validation allows "on-path" attacks to succeed where they would normally fail.

EAP peers and servers **MUST** assume that all data sent over an EAP session is visible to attackers and can be modified by them.

The methods defined here **MUST** only be used to bootstrap initial network access. Once a device has been provisioned, it gains network access via the provisioned credentials and any network access policies can be applied.

## 7.2. Provisioning is Unauthenticated

This specification allows unauthenticated EAP peers to obtain network access, however limited. As with any unauthenticated process, this access can be abused. Implementations should take care to limit the use of the provisioning network.

[Section 3.4.2](#) describes a number of methods that can be used to secure the provisioning network. In summary:

- allow only traffic that is needed for the current provisioning method. All other traffic should be blocked. Most notable, DNS has been used to exfiltrate network traffic, so DNS recursive resolvers **SHOULD NOT** be made available on the provisioning network.
- limit the services available on the provisioning network to only those services that are needed for provisioning.
- limit the number of devices that can access the provisioning network at the same time.
- for any one device, rate limit its access to the provisioning network.
- for a device that has accessed the provisioning network, limit the total amount of time that it is allowed to remain on the network.
- for a device that has accessed the provisioning network, limit the total amount of data that it is allowed to transfer through the network.

## 8. References

### 8.1. Normative References

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- [EAPREG] IANA, "Extensible Authentication Protocol (EAP) Registry", <<https://www.iana.org/assignments/eap-numbers>>.
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