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# eIDAS Cryptographic Requirements for the Interoperability Framework

TLS and SAML

Version 1.4



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eIDAS Technical Specifications

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1.3		eIDAS Cooperation Network	No changes
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# 1. Introduction

Within the eIDAS Interoperability Framework [1], communication between eIDAS nodes (i.e. eIDAS-Services and eIDAS-Connectors) is performed via the citizen's browser. Here, the content of the communication between eIDAS nodes is performed using cryptographically protected SAML messages. To secure the transport layer of this communication between these components and the citizen's browser, TLS is used.

This document specifies cryptographic requirements for the protection of the SAML communication as well as on the usage of TLS within this communication.

## 1.1. KEY WORDS

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119. The key word "CONDITIONAL" is to be interpreted as follows:

CONDITIONAL: The usage of an item is dependent on the usage of other items. It is therefore further qualified under which conditions the item is REQUIRED or RECOMMENDED.

## 2. Requirements for TLS

Transport Layer Security (TLS) [2], formerly also known as Secure Socket Layer (SSL), is a protocol to protect the communication over the Internet, e.g. connection via HTTP (HTTPS). During TLS, a secure connection between the *Client* and the *Server* is negotiated.

As part of the establishment (*handshake*) of a TLS session, both parties negotiate the encryption and authentication algorithms (*cipher suite*) and the keys to be used during the session.

Within the context of the cross-border setting of the interoperability framework, the client is usually the citizen's browser, while the server is an eIDAS node. Here, the server has to authenticate to the client based on X.509 certificates.

In the following, minimal cryptographic requirements for the TLS building blocks are specified, i.e. the version of the TLS protocol, the cipher suites and crypto primitives as domain parameters, key lengths and certificates to be used by eIDAS nodes.

The security requirements given in following aim to provide a security level of at least 100 bit.

### 2.1. TLS VERSION

eIDAS nodes **MUST** support TLS 1.2 [2] and **SHOULD** support TLS 1.3 [3]. Prior TLS versions **MUST NOT** be accepted.

### 2.2. CIPHER SUITES

eIDAS nodes **MUST** only use cipher suites that provide perfect forward secrecy. It is **RECOMMENDED** to use a cipher suite from the following tables for the TLS handshake.

	<i>Key agreement and authentication mechanisms</i>		<i>Encryption</i>	<i>Mode of operation</i>	<i>Hash</i>
TLS_	ECDHE_ECDSA_	WITH_	AES_128_	CBC_ GCM_	SHA256
			AES_256_	CBC_ GCM_	SHA384
			CHACHA20_	POLY1305_	SHA256
	ECDHE_RSA_	WITH_	AES_128_	CBC_ GCM_	SHA256
			AES_256_	CBC_ GCM_	SHA384
			CHACHA20_	POLY1305_	SHA256
	DHE_RSA_	WITH_	AES_128_	CBC_ GCM_	SHA256
			AES_256_	CBC_	SHA256

	<i>Key agreement and authentication mechanisms</i>		<i>Encryption</i>	<i>Mode of operation</i>	<i>Hash</i>
				GCM_	SHA384

*Table 1: Recommended Cipher Suites for TLS 1.2*

	<i>Authenticated encryption with associated data algorithm</i>	<i>Key length</i>	<i>Mode of operation</i>	<i>Hash</i>
TLS_	AES_	128_	CCM_ GCM_	SHA256
		256_	GCM_	SHA384
	CHACHA20_		POLY1305_	SHA256

*Table 2 : Recommended Cipher Suites for TLS 1.3*

If the usage of one of these cipher suites is not possible due to restrictions of the client's browser, an eIDAS node SHOULD also accept a cipher suite of table 1 with \*\_SHA1 instead of \*\_SHA-256 or \*\_SHA384. However, eIDAS nodes MUST prefer the cipher suites given in table 1 and 2.

Other cipher suites than the ones listed above SHALL NOT be accepted by eIDAS nodes.

It is RECOMMENDED to use ECDHE rather than DHE. It is RECOMMENDED to use AES rather than CHACHA20. eIDAS nodes using TLS 1.3 MAY support the PSK mode psk\_dhe\_ke in order to facilitate Session Resumption

### 2.3. ELLIPTIC CURVES

If Elliptic Curve Cryptography (ECC) is used for TLS, named curves MUST be used. It is RECOMMENDED to support the following named curves and to use one of them (if supported by the browser):

- BrainpoolP256r1, BrainpoolP384r1, BrainpoolP512r1 (cf. [4], [5]);
- NIST Curve P-256, NIST Curve P-384, NIST Curve P-521 (cf. [6]).

Elliptic curves with a key length less than 250 bit MUST NOT be accepted.

### 2.4. CERTIFICATES

As of 2018, newly issued TLS certificates for eIDAS nodes SHOULD be qualified website certificates<sup>1</sup>.

### 2.5. DOMAIN PARAMETERS, KEYS AND RANDOM NUMBERS

eIDAS nodes SHALL use the following key lengths for ephemeral keys during the TLS handshake:

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<sup>1</sup> Cf. Article 45 of the eIDAS Regulation.

<i>Protocol</i>	<i>Minimal Key length</i>
ECDHE	256
DHE	3072

*Table 3: Key lengths for TLS*

To provide acceptable security of a TLS session, it is REQUIRED that random numbers (for nonces or ephemeral keys) to be used within the TLS handshake are generated with cryptographically secure random number generators that provide sufficient entropy (according to the security level of 120 bits).

## **2.6. ADDITIONAL REQUIREMENTS AND RECOMMENDATIONS**

If the client indicates support for signature algorithms with a SHA-2 hash function for the signature algorithm to be used, eIDAS nodes SHALL use this hash function for signatures within the handshake (and not SHA-1).

Furthermore, the following recommendations for the deployment of TLS are given:

- The heartbeat extension SHOULD NOT be used (cf. [7]).

Furthermore, the following requirements and recommendations for the deployment of TLS 1.2 are given:

- TLS compression SHOULD NOT be used.
- If a CBC-based cipher suite is used, it is RECOMMENDED to first encrypt and then authenticate the data to be transmitted. Hence, eIDAS nodes SHALL support and use the Enc-then-MAC extension according to [8].
- Session Renegotiation SHOULD NOT be used.
- eIDAS nodes SHOULD NOT use a truncated HMAC (cf. truncated\_hmac extension, [9]).

Furthermore, the following requirements and recommendations for the deployment of TLS 1.3 are given:

- eIDAS nodes MUST NOT send or accept 0-RTT data

# 3. Requirements for SAML

The Security Assertion Markup Language (SAML) is a XML framework for the exchange of authentication information that is used within the eIDAS Interoperability Framework for the communication between eIDAS nodes.

SAML is used, to protect

- confidentiality of the person identification data,
- authenticity/integrity of the person identification data, and
- secure identification of communication end-points.

SAML uses XML Encryption and XML Signatures based on authentication via X.509 certificates according to [10].

Furthermore, eIDAS-Connectors and eIDAS-Proxy-Services need to provide metadata about their node. This is done via signed SAML Metadata, that has to be validated up to a published trust anchor.

In the following, we specify security requirements for the deployment of SAML that provide a security level of at least 120 bit. Besides the provision of a suitable security level, the proposal also aims to achieve interoperability between different eIDAS nodes.

## 3.1. GENERAL REQUIREMENTS

The following rules MUST apply to the SAML communication between eIDAS nodes:

- SAML request and SAML response messages MUST be signed by the sending party.
- The signature of a SAML assertion is OPTIONAL.
- The (signed) SAML assertion within the SAML response message MUST be encrypted.

Ephemeral keys or random numbers (for nonces or generation of ephemeral keys) SHALL be used only once. It is REQUIRED that random numbers to be used within SAML are generated with cryptographically secure random number generators that provide sufficient entropy (according to the security level of 120 bits).

### 3.1.1. Hash functions

In XML Encryption/Signature, hash function are used for different purposes (e.g. key derivation, signatures). The following hash functions MUST be supported.

<i>Algorithm</i>	<i>Minimal output length</i>
SHA-2	256

*Table 4: Hash function for SAML*

Other hash functions than listed above SHALL NOT be used or accepted.



## 3.2. XML ENCRYPTION WITH SAML

To protect the confidentiality of data, a hybrid crypto system is used. The content MUST be encrypted via symmetric cryptography (Content Encryption) and the corresponding symmetric key (Session Key) MUST be randomly generated for each transmission. A static public key of the receiver MUST be used to encrypt the session key (Key Encryption).

### 3.2.1. Content Encryption

For content encryption, algorithms of the following list MUST be supported:

- <http://www.w3.org/2009/xmlenc11#aes128-gcm>
- <http://www.w3.org/2009/xmlenc11#aes256-gcm>

Additionally, the following algorithms MAY be supported:

- <http://www.w3.org/2009/xmlenc11#aes192-gcm>

Other algorithms than listed above SHALL NOT be used or accepted for content encryption.

### 3.2.2. Key Encryption

To encrypt the session key for content encryption, either key transport or key agreement mechanisms MUST be used. eIDAS-Services MUST support both key encryption mechanisms. In case of key transport, the session key is asymmetrically encrypted using the public key of the receivers X.509 certificate. If key agreement is applied, the sender derives a symmetric key pair by means of a ECDH key agreement using an ephemeral key pair and the static public key contained in the receivers X.509 certificate. The derived symmetric key is then used to wrap the session key.

#### 3.2.2.1 Methods for Key Transport

The following methods and key lengths MUST be supported for key transport. One of the methods MUST be used.

<i>Protocol/Algorithm</i>	<i>Minimal key length</i>
<a href="http://www.w3.org/2009/xmlenc11#rsa-oaep">http://www.w3.org/2009/xmlenc11#rsa-oaep</a>	3072

*Table 5: Algorithms for key transport*

Other algorithms or key lengths than listed above SHALL NOT be accepted for key transport.

#### 3.2.2.2 Methods for Key Agreement

The following methods and key lengths MUST be supported for encryption of session keys via key agreement. One of the methods MUST be used.

<i>Protocol/Algorithm</i>	<i>Minimal key length</i>
Key agreement	
<a href="http://www.w3.org/2009/xmlenc11#ECDH-ES">http://www.w3.org/2009/xmlenc11#ECDH-ES</a>	256
Key wrapping algorithm	
<a href="http://www.w3.org/2001/04/xmlenc#kw-aes128">http://www.w3.org/2001/04/xmlenc#kw-aes128</a>	128
<a href="http://www.w3.org/2001/04/xmlenc#kw-aes256">http://www.w3.org/2001/04/xmlenc#kw-aes256</a>	256

*Table 6: Key Agreement Algorithms for SAML*

For derivation of the symmetric key for key encryption a hash function as specified above MUST be used. The sender MUST generate a new ephemeral public key for each new message to be sent.

However, the receiver MUST support additional ephemeral data (KA-Nonce element) to be included into the derivation of the key encryption key.

### 3.3. SIGNATURES FOR SAML AND SAML METADATA

This section specifies the requirements for signatures of SAML assertions, SAML messages and SAML Metadata.

#### 3.3.1. Signature Algorithms

The following algorithms MUST be supported for the generation/verification of signatures. One of the algorithms MUST be used.

<i>Algorithm</i>	<i>Minimal key length</i>
RSASSA-PSS [11]	
<a href="http://www.w3.org/2007/05/xmldsig-more#sha256-rsa-MGF1">http://www.w3.org/2007/05/xmldsig-more#sha256-rsa-MGF1</a> <a href="http://www.w3.org/2007/05/xmldsig-more#sha384-rsa-MGF1">http://www.w3.org/2007/05/xmldsig-more#sha384-rsa-MGF1</a> <a href="http://www.w3.org/2007/05/xmldsig-more#sha512-rsa-MGF1">http://www.w3.org/2007/05/xmldsig-more#sha512-rsa-MGF1</a>	3072
ECDSA [9]	
<a href="http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha256">http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha256</a> <a href="http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha384">http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha384</a> <a href="http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha512">http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha512</a>	256

*Table 7: Signature Algorithms for SAML*

Within the signature algorithm, a hash function as specified above MUST be used. Other algorithms or key lengths than listed above SHALL NOT be accepted.

### 3.4. ELLIPTIC CURVES

If Elliptic Curve Cryptography (ECC) is used within SAML, only named curves MUST be used. It is RECOMMENDED

to support the following named curves:

- BrainpoolP256r1, BrainpoolP384r1, BrainpoolP512r1 ([12]);
- NIST Curve P-256, NIST Curve P-384, NIST Curve P-521 ([13])

Elliptic curves with a key length less than 256 bit SHALL NOT be accepted.

### 3.5. X.509 CERTIFICATES

#### 3.5.1. Certificates for SAML Metadata

The algorithms and keys for the signature of certificates within the certificate chain to verify the SAML Metadata MUST fulfill the following requirements.

<i>Algorithm</i>	<i>Minimal key length</i>	<i>Minimal hash length</i>
RSASSA-PSS [14]	3072 Bit	256 Bit
ECDSA [15]	256 Bit	256 Bit

*Table 8: Signature of Certificates*

#### 3.5.2. Certificates for SAML Communication

The authoritative references for X.509 certificates used for protection of SAML messages are the key representation elements in SAML metadata (cf. [16]). X.509 Certificates used for SAML communication SHOULD contain information on the key usage within the key usage extension. For different purposes (encryption vs signature), different certificates containing different keys SHALL be used.

# References

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- [16] eIDAS Technical Subgroup: eIDAS Message Format

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