



Federal Office
for Information Security

BSI TR-03108-2: Testspezifikation

Conformance Tests for Secure E-Mail Transport
in compliance to BSI TR-03108-1

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1 Introduction

The Technical Guideline [TR-03108-1] specifies the requirements for a secure transport of e-mails. The current document extends [TR-03108-1] by defining conformity criteria for e-mail service providers (EMSP) and specifying tests which verify that the provided interfaces fulfil the requirements defined in the Technical Guideline. The tests cover the interfaces to the end user as well as from and to other EMSPs.

1.1 Motivation and Objectives

Since the objective of [TR-03108-1] and the tests is the improvement of security, the tests focus on a secure DNS lookup using DANE/DNSSEC and on the subsequent TLS connection. The protocols in the TLS-protected tunnel, like IMAP, SMTP or POP are, as well as functional tests, not in the scope of this document. Even though aiming at security, the guideline takes interoperability issues into account as well.

Generally speaking, the specification and therewith the tests are strict with respect to the configurations towards the end users. The rationale behind this is that the user can be informed in case of any issue. He is enabled to decide about further proceeding. For example, if the TLS certificate of the web interface cannot be verified, the browser will display an alert and ask for further actions. The decision is put in the users hands.

This, however, does not hold for the communication between two distinct EMSPs. Once the e-mail has been transferred to the users EMSP, it will be automatically forwarded to the recipients server. If any issue arises, the user will usually not be able to take actions. In the most cases details of the transmission are hidden. This implies that the user completely relies on decisions made by the EMSP. Therefore, a uniform certification is required to encourage the trust in these decisions.

Taking in consideration the complexity of the solutions to be tested, a variety of aspects has to be covered during the evaluation procedure. Therefore, the following needs to be regarded:

- The requirements from the [TR-03108-1] are fulfilled.
 - Including the configuration of TLS according to [TR-03116-4]
- The DNSSEC requirements as defined in [RFC4033], [RFC4034] and [RFC4035].
- The utilization of DANE as described in [RFC6698].
- The STARTTLS protocol is utilized [RFC2595] resp. [RFC3207].
- The test defined in this document only focus on conformance to the respective requirements. They do not validate security, functionality or availability.
- This document does not define any particular tools to be used by the auditor. He or she is not restricted in the choice and can utilize any tool which seems appropriate (see Section 2.3.1).

1.2 Structure of this Document

The document is structured as follows. In the first section, motivation and scope of the test specification is given. In Section 2 the required test environment and the test profiles are described. Section 3 defines the implementation conformance statement (ICS). In the ICS, the information that an EMSP has to provide to apply for a certificate is specified. The parameters and certificates that are required for the tests are given in Section 4. Section 5 describes the XML format that is used for the test cases. Section 6 contains the list of test cases.

1.3 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 [[RFC2119]]. 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 Test Environment and Elements

The test series described in this document consider the e-mail service providers (EMSP) already offering their services via the Internet. Therefore, the testing laboratory will have to take the existing infrastructure into account. This chapter describes the aspects to be regarded.

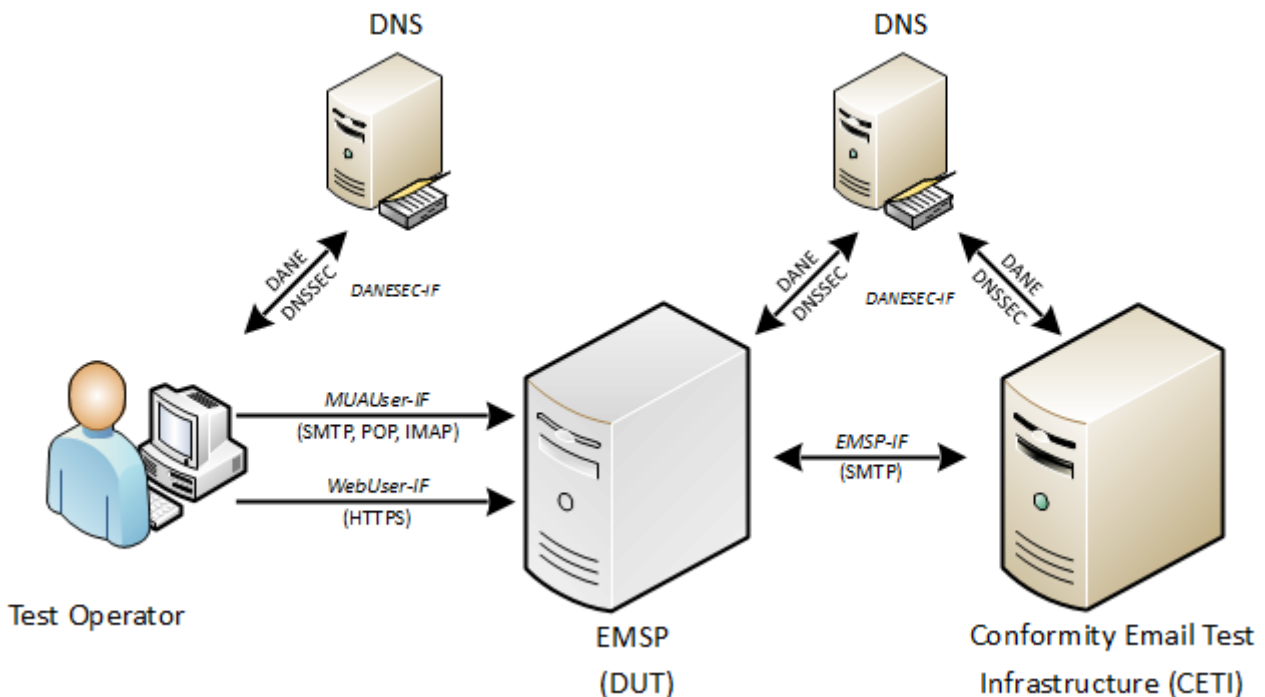


Figure 1: Outline of a Generic Test Setup

2.1 Overview Interfaces

The test setup assumes that an EMSP handles several network interfaces (see Figure 1). Those network interfaces are used to communicate with end users, DNS servers and other EMSPs. In the following, a short description and definition of those interfaces is given.

- Interface for EMSPs – *EMSP-IF*: This interface is used for e-mail exchange between EMSPs and will be denoted as *EMSP-IF* in this test specification.
- Interface for DANE/DNSSEC resolvers – *DANESEC-IF*: This interface is used for the execution of the DNS, DANE and DNSSEC protocols and will be denoted as *DANESEC-IF* in this test specification.
- Interface for end users – *WebUser-IF* and *MUAUser-IF*: This interface is used by end users to access the services of an EMSP and thus to exchange e-mails. Because this interface can be accessed over HTTPS (using a webfrontend) and StartTLS/TLS (using a Mail User Agent, short MUA such as Thunderbird), this interface includes two respective interfaces that will be denoted as *WebUser-IF* and *MUAUser-IF* in this test specification.

Each interface can consist of several ports dedicated to specific protocols. The specific underlying protocol data is not part of this document and is therefore not covered by test cases. Nevertheless, all interfaces are expected to establish a TLS connection before exchanging data of the protocol. STARTTLS may be utilised. An exception is the connection towards the name resolvers, as DNSSEC does not enforce data encryption.

The tests specified for an interface have to be performed for each port that is offered by the EMSP relevant in the context of [TR-03108-1]. A generic setup is outlined in Figure 1. Note that the two interfaces sketched for the user TLS and HTTPS communication are covered by the same cryptography tests.

Based on Figure 1 it has to be verified that:

- A correct TLSA record for DANE/DNSSEC is available for all interfaces.
- The user interface is protected using TLS in accordance with [TR-03116-4], in particular, the defined and only the defined ciphers are supported.
- STARTTLS is used whenever a non-TLS port is contacted.
- An incoming connection for other e-mail-servers via TLS is possible; the ciphers required in [TR-03116-4] are supported.
- An outgoing connection to other e-mail-servers is using TLS whenever possible, the ciphers required in [TR-03116-4] are supported.
- Furthermore, the respective negative tests are defined.

2.2 DUT

In this test specification, the e-mail server to be tested is called Device Under Test (DUT).

The DUT is depicted in gray in the Figure 1 to emphasize that it is merely a placeholder rather than an integral part of the test environment. The tests defined in this document do not require any preparation of a dedicated test e-mail infrastructure. This implies that the DUT represents all components and interfaces already used operationally. Taking this into account, the tests are intentionally designed not to perform any “destructive” steps or to require any DUT configuration leading to possible down time of its services. In addition to the test interfaces mentioned in Section 2.1, the behaviour of the DUT has to be tested for both *incoming* and *outgoing connections*. The connection is always looked at from the perspective of the DUT.

Incoming connections imply queries received and processed by the DUT, but also queries sent by the user or another EMSP in order to contact the DUT (e.g. DNS queries).

- Outgoing connections imply queries sent by the DUT (e.g. DNS query, E-mail delivery, etc.).

2.3 Conformity E-Mail Test Infrastructure

The complete infrastructure required for the test series is enclosed in the Conformity E-mail Test Infrastructure, abbreviated CETI. It includes all components required to interact with the DUT. The CETI also includes a Test-DNS-Zone (see Section 2.4) used to analyse the behaviour of the DUT when testing *outgoing connections*. It exemplarily comprises target e-mail servers hosting the respective accounts. It may also comprise further tools and services required for conformity tests.

2.3.1 Test Tools

The current test specification does not restrict the operator in his or her choice of tools. This means that the operator theoretically can use any tool he or she finds the most suitable. However, it has to be assured that the results achieved by a particular tool of choice are legitimate and verifiable (replicable) by any other possible tester.

2.3.2 Test E-Mail

Several test cases require the tester to send an e-mail via the DUT to the testing infrastructure. In order to be able to uniquely identify each e-mail sent in a particular test case, it is RECOMMENDED to include the test case ID in the subject field of the test e-mail. Additionally, it may be necessary to include a sequence number in cases where multiple test cases with the same ID are run (templates).

The naming convention could be:

- EMAIL_TSP_<module>_<test case ID>_<sequence number>

2.3.3 DNS Caching Problem

Some tests require the DUT to retrieve the DNS information of a particular zone and to process it. Several of them must be performed repeatedly. This especially holds for the template test cases, but also for not-templates needed to be re-run for some reason.

This could potentially lead to the DUT utilizing its DNS cache entries instead of retrieving the information of the zone again. Even if the DUT does not operate any DNS caching mechanisms itself, it is still possible that it uses the DNS server which does. Therefore, the test laboratory **MUST** implement mechanisms preventing the DNS re-usal. It is essential that for any test concentrating on the DANE/DNSSEC capability of the DUT (cf. Section 6.2) the DNS resolution takes place *each time*.

Unfortunately, it is not sufficient only to rely on TTL for that. Each DUT or an intermediate DNS server may disregard or overwrite these values. Therefore, it is **RECOMMENDED** to use a random ID in the name of the DNS zones used for tests. In this case each run is performed with its own unique zone name/URL utilized only once. The next run of this test case is performed to the URL with another random ID. The characteristics are, however, the same as required for the scenario of the test case. Consequently, the DUT is forced to freshly resolve the new URL each time.

2.4 DNS

One of the topics discussed in the [TR-03108-1] is the ability of the EMSP to utilize the DNSSEC records by resolving the remote domain name. The DUT **MUST** be able to process the TLSA record and validate the presented TLS server certificate. Therefore, it is essential that the testing laboratory prepares the respective DNS records.

On the other side, the DUT **MUST** maintain the respective DNSSEC records itself. This is necessary to enable the users respective the users' e-mail clients to connect to it. The availability and correctness of such records **MUST** also be verified in the respective test cases.

2.5 Test Operator

The operator is responsible for initiating and supervising the test series. He or she plays the role of an e-mail user. Any test units which cannot be run automatically **MUST** be performed manually. This, for example, holds for the test cases regarding the webfrontend. The operator **MUST** further observe the behaviour and messages presented by the DUT and decide about conformity.

2.6 Test Profiles

Test profiles are used to assess the functionalities and capabilities of the DUT. Test profiles determine the applicability of concrete test cases. There are two kinds of profiles: basic and recommended. The basic profiles represent mandatory requirements which **MUST** be met by the DUT in order to successfully accomplish the certification.

Recommended profiles represent the requirements which should be met, but the applicant may for some reason decide otherwise. This decision does not necessary lead to non-conformity.

A distinction is made between *incoming* and *outgoing* connections. This distinction is made from the perspective of the DUT. Incoming connections are connections or connection attempts made by other communication partners (e.g EMSPs, end users) towards the DUT. Outgoing connections are connections or

connection attempts made by the DUT towards communication partners. The identifiers *SERVER* and *CLIENT* are respectively used for incoming (i.e. server accepts) and outgoing (i.e. client sends) connections.

The following test profiles could be identified.

2.6.1 Basic Profiles

- **CRYPTO_SERVER:** Any DUT should provide interfaces serving incoming network connections. This profile assesses the capabilities and proper implementation of the interfaces required to ensure secure communication for incoming connections. In this case, the interface may be accessed by another EMSP or an end user using a mail user agent. This profile therefore covers the EMSP-, WebUser- and MUA-IF defined in Section 2.1. All incoming connections **MUST** be protected by TLS and fulfil the requirements of [TR-03116-4].
- **CRYPTO_CLIENT:** Analogously to the CRYPTO_SERVER profile, the DUT **MUST** support the parameters of [TR-03116-4] for outgoing connections. Therefore, this profile assesses the capabilities and proper implementation of the required interfaces for outgoing connections. This profile also covers the same interfaces as CRYPTO_SERVER.
- **DANE_SERVER:** This profile assesses the DANE capabilities of the DUT for incoming connections. This profile covers the DANESEC-IF defined in Section 2.1, whereby the focus lies on DANE.
- **DANE_CLIENT:** This profile assesses the DANE capabilities of the DUT for outgoing connections. This profile covers the DANESEC-IF defined in Section 2.1, whereby the focus lies on DANE.
- **DNSSEC_SERVER:** This profile assesses the (DNS) resolving capabilities of the DUT for incoming connections. Prior to connection establishment to the DUT, another EMSP **MUST** acquire its DNS information protected by DNSSEC. Therefore, a correct implementation of the respective functionalities is required. This profile covers the DANESEC-IF defined in Section 2.1, whereby the focus lies on DNSSEC.
- **DNSSEC_CLIENT:** This profile assesses the (DNS) resolving capabilities of the DUT for outgoing connections. Prior to connection establishment to another EMSP, the DUT **MUST** acquire its DNS information protected by DNSSEC. Therefore, a correct implementation of the respective functionalities is required. This profile covers the DANESEC-IF defined in Section 2.1, whereby the focus lies on DNSSEC.
- **USER_INFO:** [TR-03108-1] requires EMSP to inform its users about security incidents. Furthermore, it **MUST** inform them about security relevant topics. The tests assigned to this profile evaluate the availability and suitability of such information.
- **STARTTLS:** Essentially, all communication **MUST** take place via TLS protected channels. If the connection establishment starts on a non-TLS port, STARTTLS **MUST** be employed to signalize the TLS support.

2.6.2 Recommended Profiles

- **CERTIFIED_CA:** All the certificates that the EMSP uses for communication with other EMSPs have been issued by a certificate authority (CA) that was certified according to [TR-03145], or is able to offer Certificate Transparency along with its certificates and provides Extended Validation Certificates [EVCERT].

3 Implementation Conformance Statement

The purpose of the Implementation Conformance Statement (ICS) is the declaration of supported functionality of the EMSP to be approved by the testing laboratory. The declarations of the applicant are used for the determination of test cases to be performed.

The Implementation Conformance Statement **MUST** be filled completely by the applicant. The information of the filled ICS **MUST** be documented in the test report.

3.1 User Information Source

According to [TR-03108-1] the EMSP has to inform the user about the IT security issues and educate on this topic. The applicant **MUST** provide in Table 1 the sources a user can use to access this information.

Topic	Source Address
IT security issues	
IT security education	

Table 1: User information

3.2 Online Interfaces

An applicant **SHALL** provide a declaration containing the list of **ALL** the interfaces served online. These will be used to carry out the test cases defined in this document. Table 2 describes the required fields.

Element	Address
Webinterface for the user	
Network interface(s) for the users e-mail client	
Network interface(s) available for incoming messages from other EMSP	
Port for connections that use STARTTLS [[STARTTLS_PORT]]	

Table 2: Online interfaces

3.3 Operational Information

In order to define a clear test frame, an applicant **SHALL** provide information related to the operation of the underlying infrastructure. This information is mainly given in the form of parameters which will serve as input for specific test cases.

Parameters	Description	Value (in seconds)
TIMEOUT	Expected time limit for e-mail delivery. This specifies the maximum time expected between sending an e-mail using the DUT services, and receiving this e-mail.	

Table 3: Operational information

3.4 Profiles

An applicant SHALL provide a declaration containing information of the supported profiles. Table 4 describes required basic test profiles (cf. Section 2.6.1).

Profile ID	Description	Yes / No
CRYPTO_SERVER	Cryptographic tests for incoming connections.	
CRYPTO_CLIENT	Cryptographic tests for outgoing connections.	
USER_INFO	The EMSP informs the user about security incidents. Furthermore, the it informs users about relevant security topics.	
DANE_SERVER	Support of DANE for incoming connections. This particularly means the connections towards the DUT.	
DANE_CLIENT	Support of DANE for outgoing connections. This particularly means the connections towards other EMSPs.	
DNSSEC_CLIENT	Support of DNSSEC for outgoing connections. This particularly means the connections towards other EMSPs.	
DNSSEC_SERVER	Support of DNSSEC for incoming connections. This particularly means the connections towards the DUT.	
STARTTLS	Utilisation of STARTTLS for non-TLS ports.	
TLS_1.2	TLS tests specific to TLS 1.2.	
CRYPTO_ECC	Support of ECC ciphersuites for TLS connections.	

Table 4: Basic profiles

Profile ID	Description	Yes / No
CERTIFIED_CA	All the certificates that the EMSP uses for communication with other EMSPs have been issued by a certificate authority (CA) that was certified according to [TR-03145].	

Table 5: Recommended profiles

3.5 Supported Cryptography

The EMSP under test maintains several network interfaces available online. All connections (except for DNSSEC) MUST be protected by TLS. Each of it can support different algorithms and parameters. For example, the TLS channel for accessing the webfrontend does deviate from the one towards a target e-mail server. Therefore, all channels MUST be declared separately.

An applicant SHALL provide a declaration containing information on the supported cryptography. The declaration MUST be filled with all cryptographic parameters that are supported by the test object, i.e. other cryptographic parameters than listed in the ICS SHALL NOT be supported. If laboratory is able to determine further parameters or algorithms not declared here, a respective note MUST be delivered in the test report.

3.5.1 TLS: Browser -> Test Object

This channel is used by the user to connect to the webfrontend of his EMSP. It is protected by the TLS.

Table 6 MUST contain the supported cipher suites for each supported TLS version.

TLS version	Cipher Suite

Table 6: Supported TLS versions and Cipher Suites

Further, the applicant MUST provide the list of the supported TLS parameters in the tables 7 to 9 below.

TLS versions	Algorithm	Minimal supported key length

Table 7: Supported Key lengths

TLS versions	Supported elliptic curves

Table 8: Supported Elliptic Curves

TLS versions	Supported signature algorithms

Table 9: Supported Signature Algorithms

The test laboratory MUST verify that the declaration of the applicant is conform to the requirements of [TR-03116-4]. The result of the verification MUST be documented in the test report.

3.5.2 TLS: User MUA -> Test Object

The user is most likely to use a dedicated e-mail client to manage his e-mails. This client connects to the test object do deliver or retrieve new e-mails. The connection has to be protected by the TLS.

Table 10 MUST contain the supported cipher suites for each supported TLS version.

TLS version	Cipher Suite

Table 10: Supported TLS versions and Cipher Suites

Further, the applicant MUST provide the list of the supported TLS parameters in the tables 11 to 13 below.

TLS versions	Algorithm	Minimal supported key length

Table 11: Supported Key lengths

TLS versions	Supported elliptic curves

Table 12: Supported Elliptic Curves

TLS versions	Supported signature algorithms

Table 13: Supported Signature Algorithms

The test laboratory MUST verify that the declaration of the applicant is conform to the requirements of [TR-03116-4]. The result of the verification MUST be documented in the test report.

3.5.3 TLS: CETI -> Test Object

The user who have e-mail accounts by the test object server MUST be enabled to receive e-mails from senders registered on other servers. Therefore, the DUT MUST be able to accept incoming connections protected by the TLS.

Table 14 MUST contain the supported cipher suites for each supported TLS version.

TLS version	Cipher Suite

Table 14: Supported TLS versions and Cipher Suites

Further, the applicant MUST provide the list of the supported TLS parameters in the tables 15 to 17 below.

TLS versions	Algorithm	Minimal supported key length

Table 15: Supported Key lengths

TLS versions	Supported elliptic curves

Table 16: Supported Elliptic Curves

TLS versions	Supported signature algorithms

Table 17: Supported Signature Algorithms

The test laboratory MUST verify that the declaration of the applicant is conform to the requirements of [TR-03116-4]. The result of the verification MUST be documented in the test report.

3.5.4 TLS: Test Object -> CETI

Once the user has uploaded his e-mails to the test object, the DUT automatically forwards these to the target servers. A connection between these both servers MUST be protected by the TLS.

Table 18 MUST contain the supported cipher suites for each supported TLS version.

TLS version	Cipher Suite

Table 18: Supported TLS versions and Cipher Suites

Further, the applicant MUST provide the list of the supported TLS parameters in the tables 19 to 21 below.

TLS versions	Algorithm	Minimal supported key length

Table 19: Supported Key lengths

TLS versions	Supported elliptic curves

Table 20: Supported Elliptic Curves

TLS versions	Supported signature algorithms

Table 21: Supported Signature Algorithms

The test laboratory MUST verify that the declaration of the applicant is conform to the requirements of [TR-03116-4]. The result of the verification MUST be documented in the test report.

3.5.5 DNSSEC

The DNSSEC Resource Records are protected by a digital signature. In order for the DUT to be able to verify the DNSSEC records, it MUST support the respective cryptographic algorithms. The applicant MUST provide in Table 22 the complete range of algorithm combinations the test object is able to support.

DNSSEC Algorithms

Table 22: DNSSEC Algorithms

The test laboratory MUST verify that the declaration of the applicant is conform to the requirements of [TR-03116-4] and can actually be processed. The result of the verification MUST be documented in the test report.

Further, the applicant MUST provide the list of the supported key lengths in the Table 23. The declaration MUST also be filled for each TLS channel separately.

Signature Algorithm	Minimal Supported Key Length

Table 23: Supported Key Lengths for DNSSEC Signatures

3.6 DNSSEC Authentication Trust Anchors

In order for the EMSP to be able to perform a DNSSEC information validation, the respective public keys of the authoritative zone have to be stored by the resolver. The applicant MUST submit all authentication public keys configured for validating the DNSSEC authentication chain. The test operator MUST verify that the submitted information is sound and conforms to the requirements from [TR-03108-1].

DNSSEC Zone Name	Authentication Public Key

Table 24: Authentication Public Keys

3.7 Supported TLSA RRs

According to the [RFC6698], the TLSA Resource Record can be configured in several ways. It can have different certificate usages, selectors or matching types. In case the does support the DANE_* profiles, it MUST support at least one combination of these values to be able to successfully validate the presented TLS server certificate. In order for the testing laboratory to verify the correct implementation of DANE, the applicant MUST provide all supported TLSA values in Table 25.

Certificate Usage	Selector	Matching Type

Table 25: TLSA RR values

3.8 Location

The applicant **MUST** submit all locations where the e-mail servers are physically operated. This information **MUST** at least contain the country of the e-mail server. The test operator has to verify that the locations respect the requirements from [TR-03108-1].

Physical Locations of E-mail Servers

Table 26: Locations

3.9 [TR-03145] Certificate Information

If the EMSP uses the certificate authority that was certified according to [TR-03145] and has marked the recommended profile `CERTIFIED_CA`, he **MUST** provide the information on this CA. The testing laboratory **MUST** verify that all certificates used for communication with other EMSPs are issued only by this CA. Other certificates **MUST NOT** be used.

Required Information	Value
Name of the [TR-03145] CA	
BSI certificate number	
Subject	
Validity notBefore	
Validity notAfter	
Subject Key Identifier	

Table 27: [TR-03145] Certificate Information

4 Definition of Configuration Data

According to the test setup outlined in Figure 1, several interfaces for different protocols have to be tested. This implies that different test parameters and data **MUST** be prepared prior to starting the test series. Such necessary parameters and data are described in this chapter.

4.1 Test Setup

The tests require specific parameters to be prepared by the test operator and may deviate from test laboratory to test laboratory. Therefore, they are only referred in test cases as variables. All required parameters are defined in Table 28.

Variable	Description
CETI_URL	A URL which must be used by the DUT to connect to the CETI test server. The DUT has to resolve this address beforehand.
CETI_URL_NO_DANE	A URL which must be used by the DUT to connect to the CETI test server. The DUT has to resolve this address beforehand. DANE is not used for this URL.
CETI_URL_NO_TLS	A URL which must be used by the DUT to connect to the CETI test server. The DUT has to resolve this address beforehand. This URL is used for connections using STARTTLS.
DEFAULT_URL	A valid URL which is used to connect to [DNSSEC_DEFAULT] zone.
TIMEOUT	Expected time limit for e-mail delivery. This value is given in seconds and specifies the maximum time expected between sending an e-mail using the DUT services, and receiving this e-mail on another mail server. This value has to be given by the applicant in the ICS and will be used as parameters in the affected test cases.
TLS_VERSION	A variable that specifies the used TLS version in TLS template test cases that iterate the version.
CIPHERSUITE	A variable that specifies the used ciphersuite in TLS template test cases that iterate the ciphersuites.
ECDHE_GROUP	A variable that specifies the used ECC domain parameters in TLS template test cases that iterate the domain parameters.
SIG_ALGORITHM	A variable that specifies the used signature algorithm in TLS template test cases that iterate the supported signature algorithms.
STARTTLS_PORT	A variable that defines the port connections that use STARTTLS as specified in Section 3.2.

Table 28: Testing environment parameters

4.2 DNS Zones Specification

For the purpose of the test cases multiple DNS zones must be prepared and available to the DUT. Each zone has specific parameters relevant to the particular test case it is used in. Further, a zone described here may be understood as a set of zones with a required property. For example, if the zone [DNSSEC_DEFAULT] is referenced in a test case, it can be necessary to prepare several zones with the properties described for [DNSSEC_DEFAULT] below. This is due to the DNS caching problem described in Section 2.3.3.

Zone Reference	Description
BAD_FIELDS_TLSA	A set of DNS RRs of the CETI protected by DNSSEC to resolve the [CETI_URL]. In this zone, there are several TLSA Resource Records with undefined field values (e.g. Certificate Usage, Selector, Matching Type, etc.).
MULTIPLE_TLSA	A set of DNS RRs of the CETI protected by DNSSEC to resolve the [CETI_URL]. In this zone, there are multiple TLSA RRs.
TLSA_RECORD	A set of TLSA records according to [RFC6698] used by the CETI to specify its TLS server certificate. Please note that it must be prepared according to the declaration in the ICS (cf. Section 3.7).
ZONE_1220	A set of DNS records of the CETI soundly protected by the DNSSEC where the DNS message length consists of exactly 1220 octets.
ZONE_CUF_NDEF	A set of DNS records of the CETI protected by DNSSEC where the value of the Certificate Usage Field is not defined in [RFC6698].
ZONE_DANE	A set of DNS records of the CETI soundly protected by the DNSSEC where a valid TLSA RR is present. Different field values of the TLSA RR are applied according to the respective test case scenario.
ZONE_DNSKEY_NDEF	A set of DNS records of the CETI protected by DNSSEC where the value of the Protocol field in the DNSKEY RR is not equal to 3.
ZONE_DNSSEC	A set of DNS records of the CETI soundly protected by the DNSSEC where different DNSSEC parameters are applied according to the respective test case.
ZONE_EXPIRED_KSK	A set of DNS records of the CETI protected by DNSSEC where the DNSKEY used as SEP is outdated.
ZONE_KSK_BAD_SIG	A set of DNS records of the CETI protected by DNSSEC where the signature of the DNSKEY used as SEP is manipulated.
ZONE_KSK_ALGO_NSUP	A set of DNS records of the CETI protected by DNSSEC where the DNSKEY used as SEP is valid but the signature algorithm is not supported by the DUD according to the ICS (see Section 3.5.5).
ZONE_MTF_NDEF	A set of DNS records of the CETI protected by DNSSEC where the value of the Matching Type Field is not defined in [RFC6698].
ZONE_MTF_NMATCH	A set of DNS records of the CETI protected by DNSSEC where the value of the Matching Type Field does not match the content of Certificate Association Data Field.
ZONE_NO_TLSA	A set of DNS records of the CETI protected by DNSSEC where no TLSA

Zone Reference	Description
	RR is present.
ZONE_SF_NDEF	A set of DNS records of the CETI protected by DNSSEC where the value of the Selector Field is not defined in [RFC6698].
ZONE_SF_NMATCH	A set of DNS records of the CETI protected by DNSSEC where the value of the Selector Field does not match the content of Certificate Association Data Field.
ZONE_TLSA_BAD_SIG	A set of DNS records of the CETI protected by DNSSEC where the signature of the TLSA RR is manipulated.
ZONE_TLSA_EXP	A set of DNS records of the CETI protected by DNSSEC where the signature of the TLSA RR is expired.
ZONE_TLSA_NSUP	A set of DNS records of the CETI protected by DNSSEC where the values of the TLSA RR are not supported by the DUT (i.e. not listed in the ICS in Section 3.7).
ZONE_TLSAS_NOK	A set of DNS records of the CETI protected by DNSSEC where multiple TLSA RRs are present. However, none of these RRs corresponds to the TLS server certificate used by the CETI.
ZONE_TLSAS_OK	A set of DNS records of the CETI protected by DNSSEC where multiple TLSA RRs are present. Only one of these RRs corresponds to the TLS server certificate used by the CETI.

Table 29: DNS zones of the testing environment

4.3 Certificate Specification

In order to test the behaviour of outgoing TLS connections of the DUT, a valid certificate is required for most tests. In addition, some tests require a manipulated (invalid) certificate to test the correct behaviour of the client. The required certificates and their content is described in Table 30.

Certificate Reference	Description
CERT_DEFAULT	A correct and valid certificate chain that matches the test domain that is used in the tests. Depending on the use case, it may require a DSA, RSA or a ECDSA key and different hash functions.
CERT_INVALID_SIG	A certificate chain with an end certificate that matches the test domain but contains an invalid signature.
CERT_SELF_SIG	A certificate chain with an end certificate that matches the test domain but is selfsigned.
CERT_EXPIRED	A certificate chain with an end certificate that matches the test domain but is expired certificate that matches the test domain that is used in the tests.
CERT_INVALID_DOMAIN_NAME	A correct and valid certificate chain that does not match the name of the domain that is used in the tests in the Subject Alternative Name Extension of the end certificate.
CERT_INVALID_STRUCTURE	A certificate chain with an end certificate with a flawed encoding. In particular, a byte is added to a valid certificate to break the ASN.1 structure.

Table 30: Certificates required for the TLS tests

5 Definitions for Test Cases

This chapter explains the test case notation and commonly used elements.

5.1 Test Case Notation

All test cases are described within a set of XML files. An overview over the corresponding XML scheme is given in the following.

As depicted in Figure 2, each test is an object of the type `TestCase`. All test cases are organized hierarchically which is realized in XML using the abstract base type called `TestHierarchy`.

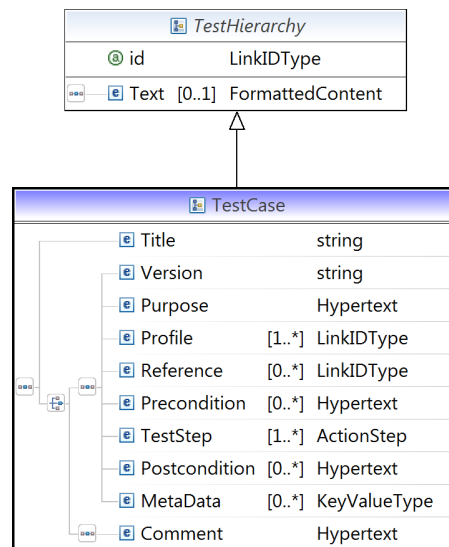


Figure 2: XML Schema Test Case

Each `TestCase` object has a unique `id` attribute and contains the following elements:

- `Title`
title of the test case.
- `Version`
current version of the test case.
- `Purpose`
a short description of the intention of the test.
- `Profile`
links to all relevant profiles.
- `Reference`
optional reference to any kind of specification this test case is based on.
- `Precondition`
all requirements which need to be fulfilled before running the test.
- `TestStep`
this XML element is a complex type and consists of the different sub-elements addressed below.
- `Postcondition`
the description of conditions which may be met after the test completion

- `MetaData`
optional elements in form of key-value pairs containing meta information.

If a test has been moved or deleted, the body of `TestCase` only contains a `Title` and a respective description in the `Comment` element.

The `TestStep` object of type `ActionStep` is used at least once and contains the elements from Figure 3.

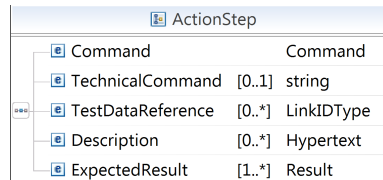


Figure 3: XML Schema `ActionStep`

In particular, it consists of:

- `Command`
represents the actual action that is performed within a single step.
- `TechnicalCommand`
can optionally be used to specify a technical representation of the command to be able to process the step automatically by some testing suite.
- `TestDataReference`
If the step refers to some predefined test data, such as certificates, the data element is referred using this element.
- `Description`
adds further information about the command that is performed in the step.
- `ExpectedResult`
denotes the behaviour of the test object in order to pass the test.

6 Test Cases

This chapter provides an overview of all tests conducted during the certification process. In order to improve the readability, the tests are aggregated into modules. These group each test by the interface and the technology it is using. Modules do not add any additional semantic meaning to the tests.

Test cases can belong to one of two categories. Positive tests evaluate the correct behaviour of the test object during conform and expected interactions. Negative tests evaluate the correct behaviour of the test object in case it is presented with incorrect or fraudulent inputs. Each test case which is not explicitly marked as positive test is considered to be a negative test case.

6.1 Module A – User Interface

[TR-03108-1] requires from the EMSP to inform the user in several ways. The compliance to these requirements is evaluated in this module.

ID	Description	Profiles
EMAIL_T SP_A_01	Positive test evaluating the ability of the EMSP to educate the user on IT security issues (using the source stated in the ICS).	USER_INFO

Table 31: List of test cases in Module A

6.2 Module B – DANE/DNSSEC - Outgoing Connections

The DUT is assumed to prepare and maintain a correct DANE/DNSSEC record for incoming connections and furthermore to use DANE/DNSSEC for outgoing connections whenever supported by the other endpoint.

ID	Description	Profiles
EMAIL_TS P_B_01_T	Positive test evaluating the ability of the test object to successfully resolve and authenticate the address of a remote EMSP using DNSSEC.	DNSSEC_CLIENT
EMAIL_TS P_B_02	Positive test evaluating the ability of the test object to successfully resolve the address of a remote EMSP server if the DNSSEC message length is 1220 octets.	DNSSEC_CLIENT
EMAIL_TS P_B_03	This test case checks the behaviour of the test object in case the signature of the DNSKEY used as SEP is manipulated.	DNSSEC_CLIENT
EMAIL_TS P_B_04	This test case checks the behaviour of the test object in case the signature of the DNSKEY used as SEP is outdated.	DNSSEC_CLIENT
EMAIL_TS P_B_05	This test case checks the behaviour of the test object in case the signature of the DNSKEY used as SEP is valid but the algorithm is not supported.	DNSSEC_CLIENT
EMAIL_TS P_B_06	This test case checks the behaviour of the test object in case the protocol field in the DNSKEY RR contains a number other than 3.	DNSSEC_CLIENT
EMAIL_TS P_B_07_T	Positive test evaluating the ability of the test object to establish a TLS connection to a remote EMSP by utilising TLSA Resource Records for validating the presented TLS server certificate. The test verifies that the DUT supports all TLSA parameters listed in the ICS.	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS P_B_08	This test case checks the behaviour of the test object in case the TLSA Resource Record is missing in the targets zone.	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS	This test case checks the behaviour of the test object in case the signature	DNSSEC_CLIENT,

ID	Description	Profiles
P_B_09	of the TLSA Resource Record is manipulated.	DANE_CLIENT
EMAIL_TS P_B_10	This test case checks the behaviour of the test object in case the signature of the TLSA Resource Record is outdated.	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS P_B_11	This test case checks the behaviour of the test object in case the TLSA Resource Record indicates values not supported by it.	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS P_B_12	Positive test evaluating the ability of the TLSA to successfully identify the matching TLSA Resource Record, if the zone contains several of such records.	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS P_B_13	This test case checks the behaviour of the test object in case the DNS zone contains several TLSA Resource Records, but none of them matches with the end entity TLS server certificate used by the remote server, or is not contained in the PKIX certification path, depending on the Certificate Usage Field.	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS P_B_14	This test case checks the behaviour of the test object in case the TLSA Resource Record indicates value of Certificate Usage Field not defined in [RFC6698].	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS P_B_15	This test case checks the behaviour of the test object in case the TLSA Resource Record indicates value of Selector Field not defined in [RFC6698].	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS P_B_16	This test case checks the behaviour of the test object in case the TLSA Resource Record indicates value of Selector Field which does not correspond to the content of Certificate Association Data Field.	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS P_B_17	This test case checks the behaviour of the test object in case the TLSA Resource Record indicates value of Matching Type Field not defined in [RFC6698].	DNSSEC_CLIENT, DANE_CLIENT
EMAIL_TS P_B_18	This test case checks the behaviour of the test object in case the TLSA Resource Record indicates value of Matching Type Field which does not correspond to the content of Certificate Association Data Field.	DNSSEC_CLIENT, DANE_CLIENT

Table 32: List of test cases in Module B

The test case EMAIL_TSP_B_01_T MUST be repeated for each algorithm combination supported by the DUT for DNSSEC signature validation.

The test case EMAIL_TSP_B_02_T is dedicated to the ability of the test object to actually process the TSLA Resource Record with all declared parameters from Section 3.7. Therefore, it MUST be repeated for any parameter listed there.

6.3 Module C – DANE/DNSSEC – Incoming Connections

The DUT provides several online interfaces serving incoming connections. The availability and correct functionality will be covered in this module.

ID	Description	Profiles
EMAIL_TS P_C_01	Positive test evaluating the correct resolution and authentication of the DUT IP address using DNSSEC.	DNSSEC_SERVER
EMAIL_TS P_C_02_T	Positive test evaluating the availability and the correct implementation of the DUT services and interfaces for end users. The test case is executed	DNSSEC_SERVER

ID	Description	Profiles
	with the {T} protocol/interface	
EMAIL_TS P_C_03	Positive test evaluating the presence and correctness of the TLSA Resource Record in the DNSSEC resolution of the service name of the EMSP.	DNSSEC_SERVER, DANE_SERVER

Table 33: List of test cases in Module C

The test case EMAIL_TSP_C_02_T is a template. It MUST be repeated for all online interfaces listed in the ICS (see Section 3.2). Essentially, no network interfaces relevant for [TR-03108-1] are allowed to be left untested.

6.4 Module D – TLS for Incoming Connections to the DUT

All network communication interfaces of the DUT MUST support TLS. For connections to the interfaces WebUser-IF and MUAUser-IF, the use of TLS is mandatory. There are variable requirements for the TLS behaviour to be tested. This module covers the TLS connections established from remote partners towards the DUT. Here the DUT plays the role of a TLS server. All tests MUST be carried out for each incoming interface of the DUT.

ID	Description	Profiles
EMAIL_TS P_D_01_T	This positive test evaluates the ability of the DUT to establish a TLS connection with valid parameters.	CRYPTO_SERVER
EMAIL_TS P_D_02_T	This positive test evaluates the ability of the DUT to establish a TLS connection with valid parameters using elliptic curves and PFS.	CRYPTO_SERVER
EMAIL_TS P_D_03_T	This test cases verifies that the Encrypt then MAC extension is used if the clients offers it.	CRYPTO_SERVER
EMAIL_TS P_D_04_T	This test case checks that the Truncated HMAC extension is not selected by the server.	CRYPTO_SERVER
EMAIL_TS P_D_05	This test case checks the server certificate used by the DUT. In particular, the domain name and the signature is verified.	CRYPTO_SERVER
EMAIL_TS P_D_06	This test case checks the server certificate used by the DUT. The server certificate must be signed by a CA certified according to [TR-03145].	CRYPTO_SERVER, CERTIFIED_CA
EMAIL_TS P_D_07	This tests verifies that it is not possible to reestablish a TLS connection that is older than 2 days.	CRYPTO_SERVER
EMAIL_TS P_D_08	This test verifies that the connection is not established if the client offers only ciphersuites that are not listed in the ICS.	CRYPTO_SERVER
EMAIL_TS P_D_09_T	This positive test verifies that the DUT supports the signature algorithms extension.	CRYPTO_SERVER, TLS_1.2
EMAIL_TS P_D_10	This test ensures that the connection is not established if the client offers only elliptic curve cipher suites and unsupported curves according to the ICS.	CRYPTO_SERVER
EMAIL_TS P_D_11	This test verifies that no downgrade to a TLS version that is not supported according to the ICS is possible.	CRYPTO_SERVER
EMAIL_TS P_D_12	This test case verifies that a STARTTLS command is sent when a client establishes a connection to a non-TLS port. Furthermore, a TLS connection is established.	STARTTLS, CRYPTO_SERVER

Table 34: List of test cases in Module D

The test case EMAIL_TSP_D_1_T and EMAIL_TSP_D_4_T MUST be repeated for each TLS version [TLS_VERSION] and non-ECC algorithm [CIPHERSUITE] combination supported by the DUT for incoming TLS connections.

The test case EMAIL_TSP_D_2_T MUST be repeated for each combination of TLS version [TLS_VERSION], PFS algorithm [CIPHERSUITE] and elliptic curve domain parameters [ECDHE_GROUP] supported by the DUT for incoming TLS connections.

The test case EMAIL_TSP_D_3_T MUST be repeated for each combination of TLS version [TLS_VERSION] and CBC-based cipher suites [CIPHERSUITE] supported by the DUT for incoming TLS connections.

The test case EMAIL_TSP_D_9_T MUST be repeated for each signature algorithm [SIG_ALGORITHM] supported by the DUT according to the ICS.

6.5 Module E – TLS for Outgoing Connections from the DUT

All network communication performed on the DUT interfaces MUST support TLS. There are variable requirements for the TLS behaviour to be tested. This module covers the TLS connections established from the DUT towards remote partners. Here the DUT plays the role of a TLS client.

ID	Description	Profiles
EMAIL_TS P_E_01_T	This positive test verifies that the offered TLS version, ciphersuites, the order of the suites and extensions match the ICS. Furthermore, a TLS connection is possible.	CRYPTO_CLIENT
EMAIL_TS P_E_02	This test verifies that the offered signature_algorithm extension matches the declaration in the ICS. Furthermore, a TLS connection is possible.	CRYPTO_CLIENT, TLS_1.2
EMAIL_TS P_E_03_T	This test verifies that the offered Supported Elliptic Curves extension matches the declaration in the ICS. Furthermore, a TLS connection is possible.	CRYPTO_CLIENT
EMAIL_TS P_E_04	This test checks the correct behaviour of the TLS client in case the server selects an unsupported cipher suite according to the ICS.	CRYPTO_CLIENT
EMAIL_TS P_E_05	This test verifies that no downgrade to a TLS version that is not supported according to the ICS is possible.	CRYPTO_CLIENT
EMAIL_TS P_E_06	The test case verifies the correct behaviour of the TLS client in case the server sends a certificate with an invalid signature.	CRYPTO_CLIENT
EMAIL_TS P_E_07	The test case verifies the correct behaviour of the TLS client in case the server sends an expired certificate.	CRYPTO_CLIENT
EMAIL_TS P_E_08	The test case verifies that the TLS client does not accept a self-signed certificate when it is connecting to a server that does not use DANE.	CRYPTO_CLIENT
EMAIL_TS P_E_09	The test case verifies the correct behaviour of the TLS client in case the server sends a certificate that does not match the domain the client wanted to connect to.	CRYPTO_CLIENT
EMAIL_TS P_E_10	The test case verifies the correct behaviour of the TLS client in case the server sends a corrupt certificate.	CRYPTO_CLIENT
EMAIL_TS P_E_11	This test verifies the behaviour of the TLS client in case the server presents a certificate that uses an unsupported signature algorithm.	CRYPTO_CLIENT, TLS_1.2
EMAIL_TS P_E_12	This test verifies that a TLS connection is established when the server sends a STARTTLS command.	STARTTLS, CRYPTO_CLIENT

Table 35: List of test cases in Module E

The test case EMAIL_TSP_E_01_T MUST be performed for all TLS versions [TLS_VERSION] and non-ECC cipher suites [CIPHERSUITE] listed in the ICS of the DUT.

The test case EMAIL_TSP_E_02_T MUST be repeated for all supported signature algorithms [SIG_ALGORITHM].

The test case EMAIL_TSP_E_03_T MUST be carried out for all supported elliptic curves [ECDHE_GROUP].

Reference Documentation

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TR-03116-4	BSI: Kryptographische Vorgaben für Projekte der Bundesregierung; Teil 4 – Kommunikationsverfahren in Anwendungen
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RFC6698	P. Hoffman, J. Schlyter: The DNS-Based Authentication of Named Entities (DANE) Transport Layer Security (TLS) Protocol: TLSA
RFC2595	C. Newman: Using TLS with IMAP, POP3 and ACAP
RFC3207	P. Hoffman: SMTP Service Extension for Secure SMTP over Transport Layer Security
RFC2119	S. Bradner: Key words for use in RFCs to Indicate Requirement Levels
TR-03145	BSI: BSI TR-03145 Secure Certification Authority operation
EVCERT	CA/BrowserForum: Guidelines For The Issuance And Management Of Extended Validation Certificates

Keywords and Abbreviations

Abbreviations

Abbreviation	Meaning
CA	Certificate Authority
CETI	Conformity E-mail Test Infrastructure
DANE	DNS-based Authentication of Named Entities
DNS	Domain Name System
DNSSEC	Domain Name System Security Extensions
DUT	Device Under Test
EMSP	E-Mail Service Providers
EV	Extended Validation
ICS	Implementation Conformance Statement
IMAP	Internet Message Access Protocol
KSK	Key Signing Key
MUA	Mail User Agent
MX	Mail Exchanger Record
PFS	Perfect Forward Secrecy
POP	Post Office Protocol
RR	Resource Record
SEP	Secure Entry Point
SMTP	Simple Mail Transfer Protocol
TLS	Transport Layer Security
TTL	Time To Live
ZSK	Zone Signing Key

Keywords

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