

O-RAN - SFG Security Task Group (SFG)

Security Protocols Specifications

Prepared by the O-RAN ALLIANCE e.V.
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Chapter 1.Introductory Material

1.1 Scope

This Technical Specification has been produced by the O-RAN.org.

The contents of the present document are subject to continuing work within O-RAN SFG and may change following formal O-RAN approval. Should the O-RAN.org modify the contents of the present document, it will be re-released by O-RAN Alliance with an identifying change of release date and an increase in version number as follows:

Release xx.yy.zz

where:

xx the first digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc. (the initial approved document will have xx=01).

yy the second digit is incremented when editorial only changes have been incorporated in the document.

zz the third digit included only in working versions of the document indicating incremental changes during the editing process.

The present document specifies SSH and TLS as to be used for O-RAN compliant implementation.

1.2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in Release 16

[1] 3GPP TR 21.905: “Vocabulary for 3GPP Specifications”

[2] The Secure Shell (SSH) Authentication Protocol, RFC 4252. <https://tools.ietf.org/html/rfc4252>.

[3] OpenSSH. <https://www.openssh.com/>. September 2020.

[4] moz://a, <https://infosec.mozilla.org/guidelines/openssh.html>.

[5] “Secure Shell (SSH) Protocol Parameters.” <https://www.iana.org/assignments/ssh-parameters/ssh-parameters.xhtml>.

[6] ORAN-WG4.MP.0-v06.00: “O-RAN Alliance Working Group 4; Management Plane Specification v06.00”

[7] Security/Server Side TLS, Mozilla Wiki. https://wiki.mozilla.org/Security/Server_Side_TLS#Cipher_names_correspondence_table. 2 January 2020

[8] Transport Layer Security (TLS) Parameters. <https://www.iana.org/assignments/tls-parameters/tls-parameters.xhtml>. 2021-01-21.

[9] TLS Cipher String Cheat Sheet, OWASP Cheat Sheet Series. https://cheatsheetseries.owasp.org/cheatsheets/TLS_Cipher_String_Cheat_Sheet.html. 2020

[10] O-RAN-WG1.O1-Interface-v04.00: “O-RAN Operations and Maintenance Interface Specification v04.00”.

- [11] SHA-2 Data Integrity Verification for the Secure Shell (SSH) Transport Layer Protocol, IETF RFC 6668. <https://tools.ietf.org/html/rfc6668>. July 2012.
- [12] More Modular Exponentiation (MODP) Diffie-Hellman (DH) Key Exchange (KEX) Groups for Secure Shell (SSH), IETF RFC 8268. <https://tools.ietf.org/html/rfc8268>. December 2017.
- [13] Extension Negotiation in the Secure Shell (SSH) Protocol, IETF RFC 8308. <https://tools.ietf.org/html/rfc8308>. March 2018.
- [14] Use of RSA Keys with SHA-256 and SHA-512 in the Secure Shell (SSH) Protocol, IETF RFC 8332. <https://tools.ietf.org/html/rfc8332>. March 2018.
- [15] Ed25519 and Ed448 Public Key Algorithms for the Secure Shell (SSH) Protocol, IETF RFC 8709, <https://tools.ietf.org/html/rfc8709>. February 2020.
- [16] Deprecating RC4 in Secure Shell (SSH), IETF RFC 8758, <https://tools.ietf.org/html/rfc8758>. April 2020.
- [17] The Transport Layer Security Protocol (TLS) v1.2, RFC 5246. <https://tools.ietf.org/html/rfc5246>
- [18] The Transport Layer Security Protocol (TLS) v1.3, RFC 8446. <https://tools.ietf.org/html/rfc8446>
- [19] Guidelines for the Selection, Configuration, and Use of TLS implementations. SP 800-52 Rev.2. <https://csrc.nist.gov/publications/detail/sp/800-52/rev-2/final>

1.3 Definitions and Abbreviations

1.3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

1.3.2 Abbreviations and acronyms

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

TLS	Transport Layer Security
SSH	Secure Shell
NETCONF	Network Configuration Protocol

Chapter 2. Security protocols specifications for O-RAN compliant implementation

2.1 SSH

2.1.1 General requirements

O-RAN and 3GPP interfaces that implement authentication, confidentiality and integrity using SSH shall:

- Support SSHv2 [2];
- Disable by default cryptographically insecure ciphers as specified in sections 2.1.2.1, 2.1.2.3, 2.1.2.4;
- Enable an O-RAN deployer to configure SSH to offer less secure ciphers using standard SSH configurations to enable backward compatibility with older SSH implementations.

Entities providing O-RAN components that support SSH for authentication, confidentiality or integrity shall:

- Stay current with SSH [5];
- Provide an upgrade path for changes to the SSH protocol and ciphers [5].

2.1.2 Required ciphers

As of the first release of this document, O-RAN specifies the use of the following ciphers when using SSH. For more information see [2][5][Error! Reference source not found.](#)[Error! Reference source not found.](#)[\[11\]\[11\]\[11\]\[12\]\[12\]\[13\]\[13\]\[13\]\[14\]\[14\]\[14\]\[15\]](#). See the Security chapter of the O-RAN Working Group 4 Management Plane Specification for the M-plane mandated SSH ciphers [6].

2.1.2.1 Key agreement

Note that this document uses the IANA cipher naming convention [5].

- Required
 - a. ecdsa-sha2-nistp256
 - b. ecdsa-sha2-nistp384
 - c. ecdsa-sha2-nistp521
 - d. ssh-ed25519 (support began in OpenSSH 6.5)
 - e. ssh-ed448
- Cryptographically Insecure
 - o ssh-rsa
 - o ssh-dss

2.1.2.2 Symmetric algorithms for encrypting transferred data

- Required
 - a. chacha20-poly1305@openssh.com

- b. aes256-gcm@openssh.com
- c. aes128-gcm@openssh.com
- d. aes256-ctr
- e. aes192-ctr
- f. aes128-ctr

2.1.2.3 Key exchange algorithms (KexAlgorithms)

- Required
 - a. ecdh-sha2-nistp521
 - b. ecdh-sha2-nistp384
 - c. ecdh-sha2-nistp256
 - d. diffie-hellman-group-exchange-sha256
 - e. curve25519-sha256@libssh.org
- Cryptographically Insecure
 - a. Diffie-hellman-group1-sha1

2.1.2.4 Message authentication codes (MACs)

- Required
 - a. hmac-sha2-512-etm@openssh.com
 - b. hmac-sha2-512
 - c. hmac-sha2-256-etm@openssh.com
 - d. hmac-sha2-256
 - e. umac-128@openssh.com
- Cryptographically Insecure
 - a. hmac-sha1

2.2 TLS

2.2.1 General requirements

O-RAN and 3GPP interfaces that implement authentication, confidentiality and integrity using Transport Layer Security (TLS) shall:

- Support TLS 1.2 [17];
- Configure the TLS 1.2 Intermediate server ciphers as specified in [7] [8]
- Enable an O-RAN deployer to configure TLS to offer less secure ciphers using standard TLS configurations to enable backward compatibility with weaker TLS ciphers.
- Disable by default cryptographically insecure ciphers identified in [8] [9];

O-RAN and 3GPP interfaces that implement authentication, confidentiality and integrity using TLS should:

- Support TLS 1.3 ~~Error! Reference source not found.~~~~Error! Reference source not found.~~[18];
- Configure the TLS 1.3 Modern server ciphers as specified in [7][8] ;
- Configure the TLS 1.3 Intermediate server ciphers as specified in [7][8].
- Disable by default cryptographically insecure ciphers identified in [9] ;

Entities providing O-RAN components that support TLS for authentication, confidentiality or integrity shall:

- Stay current with the latest release of the TLS software used to implement the protocol, such as OpenSSL;
- Provide an upgrade path for new software releases;
- Provide an upgrade path to TLS 1.3.

See the Security chapter of the O-RAN Working Group 4 Management Plane Specification for the M-plane mandated TLS ciphers [6].

2.2.2 TLS Protocol profiles specifications

The Mozilla Operations Security and Enterprise Information Security teams maintains a web page [7] that serves as a reference guide for navigating the TLS landscape. Mozilla divides the TLS ciphers into three classifications: Modern, Intermediate and Old.

- **Modern:** Modern clients that support TLS 1.3, with no need for backwards compatibility
- **Intermediate:** Recommended configuration for a general-purpose server
- **Old:** Services accessed by very old clients or libraries, such as Internet Explorer 8 (Windows XP), Java 6, or OpenSSL 0.9.8

O-RAN shall support all Intermediate ciphers, and should support all Modern ciphers. O-RAN implementations that use TLS 1.3 shall use Modern ciphers.

Note that TLS1.3 will be made mandatory in O-RAN future specifications. (as per NIST guidelines [19])

2.2.2.1 Intermediate Ciphers for TLS 1.2

This is the required set of ciphers, protocols, TLS curves, supported certificate types, Diffie-Hellman parameter size, etc. The Intermediate ciphers and configuration parameters are highly secure and compatible with nearly every client released in the last five (or more) years. Note that this document uses the IANA cipher naming conventions [5]

- Cipher suites (TLS 1.2):
 - TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
 - TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
 - TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
 - TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
 - TLS_ECDHE_ECDSA_WITH_CHACHA20_POLY1305_SHA256
 - TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256
 - TLS_DHE_RSA_WITH_AES_128_GCM_SHA256
 - TLS_DHE_RSA_WITH_AES_256_GCM_SHA384
 - TLS_DHE_PSK_WITH_AES_128_GCM_SHA256
 - TLS_DHE_PSK_WITH_AES_256_GCM_SHA384
- Protocols: TLS 1.2
- TLS curves: X25519, prime256v1 (also called secp256r1), secp384r1 [15] [15]

- Certificate type: ECDSA (P-256) (recommended), or RSA (2048 bits)
- DH parameter size: 2048 (ffdhe2048, RFC 7919)
- HTTP Strict Transport Security (HSTS): max-age=63072000 (two years)
- Maximum certificate lifespan: 90 days (recommended) to 2 years
- Cipher preference: client chooses

2.2.2.2 Intermediate Ciphers for TLS 1.3

The following ciphers and are considered Intermediate for TLS 1.3.

- Cipher suites (TLS 1.3):
 - TLS_AES_128_GCM_SHA256
 - TLS_AES_256_GCM_SHA384
 - TLS_CHACHA20_POLY1305_SHA256
- Protocols: TLS 1.3
- TLS curves: X25519, prime256v1, secp384r1
- Certificate type: ECDSA (P-256) (recommended), or RSA (2048 bits)
- DH parameter size: 2048 (ffdhe2048, RFC 7919)
- HTTP Strict Transport Security (HSTS): max-age=63072000 (two years)
- Maximum certificate lifespan: 90 days (recommended) to 2 years
- Cipher preference: client chooses

2.2.2.3 Modern Ciphers for TLS 1.3

For services with clients that support TLS 1.3 and do not need backward compatibility, the Modern configuration provides an extremely high level of security.

- Cipher suites (TLS 1.3):
 - TLS_AES_128_GCM_SHA256
 - TLS_AES_256_GCM_SHA384
 - TLS_CHACHA20_POLY1305_SHA256
- Cipher suites (TLS 1.2): (none)
- Protocols: TLS 1.3
- Certificate type: ECDSA (P-256)
- TLS curves: X25519, prime256v1, secp384r1
- HSTS: max-age=63072000 (two years)
- Maximum certificate lifespan: 90 days
- Cipher preference: client chooses

2.3 Support NETCONF over secure Transport

NETCONF Service management service providers and consumers [10] that use TLS SHALL follow the cipher requirements defined in section 2.2 (TLS) of this document.

As exception, see the Security chapter of the O-RAN Working Group 4 Management Plane Specification for the M-plane mandated TLS ciphers [6] to be used with NETCONF.

Annex A (informative): Change history

Date	Meeting	CRs	Subject/Comment	New version
2020-04-28	#8		Initial skeleton	01
2020-05-03			Adaptations in preparation for meeting and CR work style.	02
2020-05-06	#9	DTAG-2020.05.03-STG-Chapter_O-RAN-Security-CR0001.docx, ORA-2020.05.03-STG-Chapter_O-RAN-Security-CR0002.docx ORA-2020.05.03-STG-Chapter_O-RAN-Security-CR0004.docx	CRs merged	03
2020-08-12	#20	DEL-2020.08.12-STG-Chapter_O-RAN-Security-CR0012.docx	CR merged	04
2020-08-23	%	Name of document changed to express common work.	Renamed	1.00
		Use of O-RAN Template		V00.02
		AT&T comments received 2021.02.22	Changed both SSH and TLS ciphers to use IANA notation o Added references for the IANA SSH ciphers and TLS elliptic curves Answered the "?" in Section 2.4: Include Certificate management requirements in this release.	V00.03
	#37	Commscope comments received 24/02/2021	Title change. Removed all references to SSH; added reference to IANA and the IETF RFCs updating RFC 4252 and RFC 4253. Changed the upgrade path requirement to maintain currency with updates to RFC 4252 and RFC 4253. Changed mandate to support ciphers in the latest release of OpenSSH to stay current with all updates to RFC 4252 and RFC 4253 Remove Certificate enrolment section.	V00.04
	#38	Nokia comments received 02/03/2021	Editorial (clear marking of requirements for further version) Make sure WG4 exception is clear for TLS ciphers Clarification on insecure ciphers Remove "O-RAN implementations shall support TLS 1.3 and Modern ciphers"	
	#38	Comment resolution proposal + Editorial updates	Captures Commscope & Nokia comments References links cleaning	V00.05
		V01.00.01 for review	Reference links updated	V01.00.01
			Capturing Amy Zwarico editorial comments & change file name from v1.00.01 to v01.00.02	V01.00.02
			Updating History table	V01.00.03
			Editorial changes in title page footer + Section 1.1	V01.00.04

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