

**INTERNATIONAL
STANDARD**

**ISO/IEC
9594-11**

First edition
2020-12

**Information technology — Open
systems interconnection directory —
Part 11:
Protocol specifications for secure
operations**



Reference number
ISO/IEC 9594-11:2020(E)

© ISO/IEC 2020



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier; Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

**INTERNATIONAL STANDARD ISO/IEC 9594-11
RECOMMENDATION ITU-T X.510****Information technology – Open Systems Interconnection –
The Directory: Protocol specifications for secure operations****Summary**

Recommendation ITU-T X.510 | ISO/IEC 9594-11 specifies a general protocol, called the wrapper protocol, that provides cybersecurity for protocols designed for its protection. The wrapper protocol provides authentication, integrity and optionally confidentiality (encryption). The wrapper protocol allows cybersecurity to be provided independently of the protected protocols, which means that security may be enhanced without affecting protected protocol specifications.

The wrapper protocol is specified without specifying specific cryptographic algorithms, but is designed for plucking-in cryptographic algorithms as required.

The wrapper protocol is designed for easy migration of cryptographic algorithms, as stronger cryptographic algorithms become necessary.

Recommendation ITU-T X.510 | ISO/IEC 9594-11 contains recommendations for how other Recommendations and International Standards may include features for migration of cryptographic algorithms, and it includes ASN.1 specifications to be applied for that purpose.

Recommendation ITU-T X.510 | ISO/IEC 9594-11 also specifies three protocols that make use of the wrapper protocol protection. This includes a protocol for maintenance of authorization and validation lists (AVLs), a protocol for subscribing of public-key certificate status and a protocol for accessing a trust broker.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T X.510	2020-08-22	17	11.1002/1000/14320

Keywords

Certification authority, cryptography, cryptographic algorithm, digital signature, public-key certificate, PKI, quantum-safe, trust anchor, validation.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

© ITU 2020

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

CONTENTS

	<i>Page</i>
SECTION 1 – GENERAL	1
1 Scope	1
2 Normative references	1
2.1 Identical Recommendations International Standards	1
2.2 Other references	1
3 Definitions	2
3.1 OSI Reference Model definitions	2
3.2 Directory model definitions	2
3.3 Public-key and attribute certificate definitions	2
3.4 Terms specified by this Recommendation International Standard	2
4 Abbreviations	3
5 Conventions	4
6 Common data types and special cryptographic algorithms	4
6.1 Introduction	4
6.2 ASN.1 information object class specification tool	4
6.3 Multiple-cryptographic algorithm specifications	6
6.4 Key establishment algorithms	7
6.5 Multiple-cryptographic algorithm-value pairs	9
6.6 Formal specification of encipherment	11
7 General concepts for securing protocols	11
7.1 Introduction	11
7.2 Protected protocol plug-in concept	12
7.3 Communications structure	12
7.4 Another view of the relationship between the wrapper protocol and the protected protocol	12
7.5 Structure of application protocol data unit	13
7.6 Exception conditions	13
SECTION 2 – THE WRAPPER PROTOCOL	14
8 Wrapper protocol general concepts	14
8.1 Introduction	14
8.2 UTC time specification	14
8.3 Use of alternative cryptographic algorithms	14
8.4 General on establishing shared keys	14
8.5 Sequence numbers	15
8.6 Use of invocation identification in the wrapper protocol	15
8.7 Mapping to underlying services	15
8.8 Definition of protected protocols	15
8.9 Overview of wrapper protocol data units	15
9 Association management	16
9.1 Introduction to association management	16
9.2 Association handshake request	16
9.3 Association accept	18
9.4 Association reject due to security issues	19
9.5 Association reject by the protected protocol	20
9.6 Handshake security abort	21
9.7 Handshake abort by protected protocol	21
9.8 Data transfer security abort	22
9.9 Abort by protected protocol	22
9.10 Release request WrPDU	23
9.11 Release response WrPDU	23
9.12 Release collision	24

	<i>Page</i>
10	Data transfer phase 24
	10.1 Symmetric keys renewal 24
	10.2 Data transfer by the client 24
	10.3 Data transfer by the server 26
11	Information flow..... 28
	11.1 Purpose and general model 28
	11.2 Protected protocol SAOC..... 29
	11.3 Wrapper SAOC 29
12	Wrapper error handling 32
	12.1 General 32
	12.2 Checking of a wrapper handshake request 32
	12.3 Checking of a wrapper handshake accept 33
	12.4 Checking of data transfer WrPDUs..... 34
	12.5 Wrapper diagnostic codes 36
SECTION 3 – PROTECTED PROTOCOLS 37	
13	Authorization and validation list management 37
	13.1 General on authorization and validation management 37
	13.2 Defined protected protocol data unit (PrPDU) types..... 37
	13.3 Authorization and validation management protocol initialization request..... 38
	13.4 Authorization and validation management protocol initialization accept ⁹ 38
	13.5 Authorization and validation management protocol initialization reject..... 38
	13.6 Authorization and validation management protocol initialization abort 38
	13.7 Add authorization and validation list request..... 39
	13.8 Add authorization and validation list response 40
	13.9 Replace authorization and validation list request..... 40
	13.10 Replace authorization and validation list response..... 40
	13.11 Delete authorization and validation list request 41
	13.12 Delete authorization and validation list response..... 41
	13.13 Authorization and validation list abort..... 42
	13.14 Authorization and validation list error codes 42
14	Certification authority subscription protocol..... 43
	14.1 Certification authority subscription introduction 43
	14.2 Defined protected protocol data unit (PrPDU) types..... 43
	14.3 Certification authority subscription protocol initialization request..... 43
	14.4 Certification authority subscription protocol initialization accept 44
	14.5 Certification authority subscription protocol initialization reject..... 44
	14.6 Certification authority subscription protocol initialization abort 44
	14.7 Public-key certificate subscription request..... 44
	14.8 Public-key certificate subscription response 45
	14.9 Public-key certificate un-subscription request 46
	14.10 Public-key certificate un-subscription response..... 46
	14.11 Public-key certificate replacements request 47
	14.12 Public-key certificate replacement response 48
	14.13 End-entity public-key certificate updates request 49
	14.14 End-entity public-key certificate updates response..... 49
	14.15 Certification authority subscription abort..... 50
	14.16 Certification authority subscription error codes 50
15	Trust broker protocol..... 51
	15.1 Introduction 51
	15.2 Defined protected protocol data unit (PrPDU) types..... 51
	15.3 Trust broker protocol initialization request 51
	15.4 Trust broker protocol initialization accept 52
	15.5 Trust broker protocol initialization reject..... 52

	<i>Page</i>
15.6 Trust broker protocol initialization abort	52
15.7 Trust broker request syntax	52
15.8 Trust broker response syntax.....	53
15.9 Trust broker error information	53
Annex A – Crypto Tools in ASN.1	55
Annex B – Wrapper protocol in ASN.1	58
Annex C – Protected protocol interface to the wrapper protocol	63
Annex D – Cryptographic algorithms	65
Annex E – Authorization and validation list management in ASN.1	67
Annex F – Certification authority subscription in ASN.1	70
Annex G –Trust broker in ASN.1.....	74
Annex H – Migration of cryptographic algorithms	76
H.1 Introduction.....	76
H.2 Negotiation of cryptographic algorithms	76
H.3 Non-negotiable digital signature algorithms	77
Annex I – Auxiliary specifications.....	80
Bibliography	85

Introduction

The Internet Engineering Task Force (IETF) maintains a substantial set of protocols for supporting public-key infrastructure (PKI). Recommendation ITU-T X.510 | ISO/IEC 9594-11 provides protocols to supplement those protocols developed by IETF, especially for:

- a) supporting new functions specified by Rec. ITU-T X.509 | ISO/IEC 9594-8, for which IETF has not provided support, e.g., support for authorization and validation list (AVL) maintenance;
- b) constraint environments, where lean protocols are required.

In addition, it specifies:

- c) a wrapper protocol that provides security services for other protocols.

This Recommendation | International Standard consist of three sections as follows.

Section 1 gives general specifications for this Recommendation | International Standard.

Section 2 is the wrapper protocol specification.

Section 3 specifies some protocols to be protected by the wrapper protocol:

- a) a protocol for maintaining authorization and validation lists (AVLs);
- b) a protocol for subscribing public-key certificate status information from certification authorities (CAs); and
- c) a protocol for accessing a trust broker.

The following annexes are included.

Annex A, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module for specifications to be imported by protocols providing a migration path for cryptographic algorithms.

Annex B, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module for the wrapper protocol.

Annex C, which is an integral part of this Recommendation | International Standard, provides specifications for how a protected protocol is wrapped by the wrapper protocol.

Annex D, which is an integral part of this Recommendation | International Standard, provides cryptographic algorithm specification.

Annex E, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module for maintenance of the authorization and validation lists (AVLs) protocol.

Annex F, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module for certification authority subscription protocol.

Annex G, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module for the trust broker protocol.

Annex H, which is not an integral part of this Recommendation | International Standard, provides guidance for cryptographic algorithm migration.

The content of this Rec. ITU-T X.510 | ISO/IEC 9594-11 was moved to here from Rec. ITU-T X.509 (2016) | ISO/IEC 9594-8:2017 and subsequently updated.

**INTERNATIONAL STANDARD ISO/IEC 9594-11
RECOMMENDATION ITU-T X.510****Information technology – Open Systems Interconnection –
The Directory: Protocol specifications for secure operations****SECTION 1 – GENERAL****1 Scope**

The scope of this Recommendation | International Standard is threefold.

This Recommendation | International Standard provides guidance on how to prepare new and old protocols for cryptographic algorithm migration, and defines auxiliary cryptographic algorithms to be used for migration purposes.

This Recommendation | International Standard specifies a general wrapper protocol that provides authentication, integrity and confidentiality (encryption) protection for other protocols. This wrapper protocol includes a migration path for cryptographic algorithms allowing for smooth migration to stronger cryptographic algorithms as such requirements evolve. This will allow migration to quantum-safe cryptographic algorithms. Protected protocols can then be developed without taking security and cryptographic algorithms into consideration.

This Recommendation | International Standard also includes some protocols to be protected by the wrapper protocol primarily for support of public-key infrastructure (PKI). Other specifications, e.g., Recommendations or International Standards, may also develop protocols designed to be protected by the wrapper protocol.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- Recommendation ITU-T X.500 (2019) | ISO/IEC 9594-1:2020, *Information technology - Open Systems Interconnection - The Directory: Overview of concepts, models and services.*
- Recommendation ITU-T X.501 (2019) | ISO/IEC 9594-2:2020, *Information technology – Open Systems Interconnection – The Directory: Models.*
- Recommendation ITU-T X.509 (2019) | ISO/IEC 9594-8:2020, *Information technology – Open Systems Interconnection – The Directory: Public-key and attribute certificate frameworks.*
- Recommendation ITU-T X.511 (2019) | ISO/IEC 9594-3:2020, *Information technology - Open Systems Interconnection - The Directory: Abstract service definition.*
- Recommendation ITU-T X.518 (2019) | ISO/IEC 9594-4:2020, *Information technology - Open Systems Interconnection - The Directory: Procedures for distributed operation.*
- Recommendation ITU-T X.519 (2019) | ISO/IEC 9594-5:2020, *Information technology - Open Systems Interconnection - The Directory: Protocol specifications.*
- Recommendation ITU-T X.520 (2019) | ISO/IEC 9594-6:2020, *Information technology – Open Systems Interconnection – The Directory: Selected attribute types.*
- Recommendation ITU-T X.521 (2019) | ISO/IEC 9594-7:2020, *Information technology - Open Systems Interconnection - The Directory: Selected object classes.*
- Recommendation ITU-T X.525 (2019) | ISO/IEC 9594-9:2020, *Information technology - Open Systems Interconnection - The Directory: Replication.*
- Recommendation ITU-T X.680 (2015) | ISO/IEC 8824-1:2015, *Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation.*

- Recommendation ITU-T X.681 (2015) | ISO/IEC 8824-2:2015, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification.*
- Recommendation ITU-T X.682 (2015) | ISO/IEC 8824-3:2015, *Information technology - Abstract Syntax Notation One (ASN.1): Constraint specification.*
- Recommendation ITU-T X.683 (2015) | ISO/IEC 8824-4:2015, *Information technology - Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications.*
- Recommendation ITU-T X.690 (2015) | ISO/IEC 8825-1:2015, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*
- Recommendation ITU-T X.691 (2015) | ISO/IEC 8825-2:2015, *Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER).*

2.2 Paired Recommendations | International Standards equivalent in technical content

- Recommendation ITU-T X.800 (1991), *Security architecture for Open Systems Interconnection for CCITT applications.*
ISO 7498-2:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 2: Security Architecture.*

2.3 Other references

- IETF RFC 793 (1981), *Transmission Control Protocol.*
- IETF RFC 2104 (1997), *HMAC: Keyed-Hashing for Message Authentication.*
- IETF RFC 3526 (2003), *More Modular Exponential (MODP) Diffie-Hellman groups for Internet Key Exchange (IKE).*
- IETF RFC 5084 (2007), *Using AES-CCM and AES-GCM Authenticated Encryption in the Cryptographic Message Syntax (CMS).*
- IETF RFC 5114 (2008), *Additional Diffie-Hellman Groups for Use with IETF Standards.*
- IETF RFC 5869 (2010), *HMAC-based Extract-and-Expand Key Derivation Function (HKDF).*
- IETF RFC 6932 (2013), *Brainpool Elliptic Curves for the Internet Key Exchange (IKE) Group Description Registry.*