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OPC unified architecture – Part 6: Mappings

Architecture unifiée OPC – Partie 6: Correspondances

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OPC unified architecture – Part 6: Mappings

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OPC UNIFIED ARCHITECTURE –

Part 6: Mappings

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65E/193/FDIS	65E/215/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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A list of all parts of the IEC 62541 series, published under the general title *OPC Unified Architecture*, can be found on the IEC website.

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INTRODUCTION

This International Stadard is the specification for developers of OPC UA applications. The specification is a result of an analysis and design process to develop a standard interface to facilitate the development of applications by multiple vendors that will inter-operate seamlessly together.

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OPC UNIFIED ARCHITECTURE –

Part 6: Mappings

1 Scope

This part of IEC 62541 specifies the OPC Unified Architecture (OPC UA) mapping between the security model described in IEC 62541-2, the abstract service definitions, described in IEC 62541-4, the data structures defined in IEC 62541-5 and the physical network protocols that can be used to implement the OPC UA specification.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC/TR 62541-1, *OPC Unfied architecture: Part 1 – Overview and Concepts*

IEC 62541-2, *OPC Unified architecture: Part 2 – Security Model*

IEC 62541-3, *OPC Unified architecture: Part 3 – Address Space Model*

IEC 62541-4[1]:----, *OPC Unified architecture: Part 4 – Services*

IEC 62541-5[2], *OPC Unified architecture: Part 5 – Information Model*

IEC 62541-7[3], *OPC Unified architecture: Part 7 – Profiles*

ITU-T X.690: *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

available at <http://www.itu.int/ITU-T/studygroups/com17/languages/X.690-0207.pdf>

ITU-T X.200: *Information technology – Open Systems Interconnection – Basic Reference Model*

available at <http://www.itu.int/rec/T-REC-X.200-199407-I/en>

ITU-T X.509: *Information technology – Open Systems Interconnection – The directory: Public Key and Attribute Certificate Frameworks*

available at <http://www.itu.int/rec/T-REC-X.509/en>

XML Schema Part 1: *XML Schema Part 1: Structures (Second Edition)*

available at <http://www.w3.org/TR/xmlschema-1/>

XML Schema Part 2: *XML Schema Part 2: Datatypes (Second Edition)*

available at <http://www.w3.org/TR/xmlschema-2/>

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SOAP Part 1: *SOAP Version 1.2 Part 1: Messaging Framework (Second Edition)*
available at <http://www.w3.org/TR/soap12-part1/>

SOAP Part 2: *SOAP Version 1.2 Part 2: Adjuncts (Second Edition)*
available at <http://www.w3.org/TR/soap12-part2/>

XML Encryption: *XML Encryption Syntax and Processing*
available at <http://www.w3.org/TR/xmlenc-core/>

XML Signature: *XML-Signature Syntax and Processing (Second Edition)*
available at <http://www.w3.org/TR/xmldsig-core/>

WS Security: *SOAP Message Security 1.1*
available at <http://www.oasis-open.org/committees/download.php/16790/wss-v1.1-spec-os-SOAPMessageSecurity.pdf>

WS Addressing: *Web Services Addressing (WS-Addressing)*
available at <http://www.w3.org/Submission/ws-addressing/>

WS Trust: *WS Trust 1.3*
available at <http://docs.oasis-open.org/ws-sx/ws-trust/v1.3/ws-trust.html>

WS Secure Conversation: *WS Secure Conversation 1.3*
available at <http://docs.oasis-open.org/ws-sx/ws-secureconversation/v1.3/ws-secureconversation.html>

WS Security Policy: *WS Security Policy 1.2*
available at <http://docs.oasis-open.org/ws-sx/ws-securitypolicy/200702/ws-securitypolicy-1.2-spec-os.html>

SSL/TLS: RFC 2246 - *The TLS Protocol Version 1.0*
available at <http://www.ietf.org/rfc/rfc2246.txt>

WS-I *Basic Profile Version 1.1*
available at <http://www.ws-i.org/Profiles/BasicProfile-1.1.html>

WS-I *Basic Security Profile Version 1.1*
available at <http://www.ws-i.org/Profiles/BasicSecurityProfile-1.1.html>

HTTP: RFC 2616 - *Hypertext Transfer Protocol - HTTP/1.1*
available at <http://www.ietf.org/rfc/rfc2616.txt>

HTTPS: RFC 2818 - *HTTP Over TLS*
available at <http://www.ietf.org/rfc/rfc2818.txt>

Base64: RFC 3548 - *The Base16, Base32, and Base64 Data Encodings*
availble at <http://www.ietf.org/rfc/rfc3548.txt>

IEEE-754: *Standard for Binary Floating-Point Arithmetic*
available at <http://grouper.ieee.org/groups/754/>

HMAC: RFC 2104 - *HMAC - Keyed-Hashing for Message Authentication*
available at <http://www.ietf.org/rfc/rfc2104.txt>

PKCS #1 : RFC 2437 - *PKCS #1 - RSA Cryptography Specifications Version 2.0*
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PKCS #12 : *PKCS 12 v1.0: Personal Information Exchange Syntax*
available at <ftp://ftp.rsasecurity.com/pub/pkcs/pkcs-12/pkcs-12v1.pdf>

FIPS 180-2: *Secure Hash Standard (SHA)*
available at <http://csrc.nist.gov/publications/fips/fips180-2/fips180-2.pdf>

FIPS 197: *Advanced Encyption Standard (AES)*
available at <http://www.csrc.nist.gov/publications/fips/fips197/fips-197.pdf>

UTF8: RFC 3629 - *UTF-8, a transformation format of ISO 10646*
available at <http://tools.ietf.org/html/rfc3629>

RFC 3280: *Internet X.509 Public Key Infrastructure Certificate and CRL Profile*
available at <http://www.ietf.org/rfc/rfc3280.txt>

RFC 4514: *LDAP: String Representation of Distinguished Names*
available at <http://www.ietf.org/rfc/rfc4514.txt>

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and defintions given in IEC 62541-1, IEC 62541-2 and IEC 62541-3 and the following apply.

3.1.1
Data Encoding
Data Encoding is a way to serialize OPC UA messages and data structures

3.1.2
Mapping
specifies how to implement an OPC UA feature with a specific technology

NOTE For example, the OPC UA Binary Encoding is a *Mapping* that specifies how to serialize OPC UA data structures as sequences of bytes.

3.1.3
Security Protocol
ensures the integrity and privacy of UA messages that are exchanged between OPC UA applications

3.1.4
Stack
collection of software libraries that implement one or more *Stack Profiles*; *Stacks* have an API which hides the implementation details from the application developer

3.1.5
Stack Profile
combination of *DataEncodings, SecurityProtocol* and *TransportProtocol Mappings*

NOTE OPC UA applications implement one or more *StackProfiles* and can only communicate with OPC UA applications that support a *StackProfile* that they support.

3.1.6
Transport Protocol
represents a way to exchange serialized OPC UA messages between OPC UA applications

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3.2 Abbreviations

API	Application Programming Interface
ASN.1	Abstract Syntax Notation #1 (used in ITU-T X.690)
BP	WS-I Basic Profile Version
BSP	WS-I Basic Security Profile
CSV	Comma Separated Value (File Format)
HTTP	Hypertext Transfer Protocol
IPSec	Internet Protocol Security
RST	Request Security Token
OID	Object Identifier (used with ASN.1)
RSTR	Request Security Token Response
SCT	Security Context Token
SHA1	Secure Hash Algorithm
SOAP	Simple Object Access Protocol
SSL	Secure Sockets Layer (Defined in SSL/TLS)
TCP	Transmission Control Protocol
TLS	Transport Layer Security (Defined in SSL/TLS)
UTF8	Unicode Transformation Format (8-bit) (Defined in UTF8)
UA	Unified Architecture
UASC	UA Secure Conversation
WS-*	The XML Web Services Specifications
WSS	WS Security
WS-SC	WS Secure Conversation
XML	Extensible Markup Language

4 Overview

Other parts of this series of standards are written to be independent of the technology used for implementation. This approach means OPC UA is a flexible specification that will continue to be applicable as technology evolves. On the other hand, this approach means that it is not possible to build an OPC UA application with the information contained in IEC 62541-1 through to IEC 62541-5 because important implementation details have been left out.

This standard defines *Mappings* between the abstract specifications and technologies that can be used to implement them. The *Mappings* are organized into three groups: *DataEncodings, SecurityProtocols* and *TransportProtocols*. Different *Mappings* are combined together to create *StackProfiles*. All OPC UA applications shall implement at least one *StackProfile* and can only communicate with other OPC UA applications that implement the same *StackProfile.*

This standard defines the *DataEncodings* in Clause 5, the *SecurityProtocols* in Clause 6 and the *TransportProtocols* in Clause 7. The *StackProfiles* are defined in IEC 62541-7.

All communication between OPC UA applications is based on the exchange of *Messages*. The parameters contained in the *Messages* are defined in IEC 62541-4. However, their format is specified by the *DataEncoding* and *TransportProtocol*. For this reason, each *Message* defined in IEC 62541-4 shall have a normative description which specifies exactly what shall be put on the wire. The normative descriptions are defined in the annexes.

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A *Stack* is a collection of software libraries that implement one or more *StackProfiles*. The interface between an OPC UA application and the *Stack* is a non-normative API which hides the details of the *Stack* implementation. An API depends on a specific *DevelopmentPlatform*. Note that the datatypes exposed in the API for a *DevelopmentPlatform* may not match the datatypes defined by the specification because of limitations of the *DevelopmentPlatform.* For example, Java does not support unsigned integers which means any Java API will need to map unsigned integers onto a signed integer type.

Figure 1 illustrates the relationships between the different concepts defined in this standard.

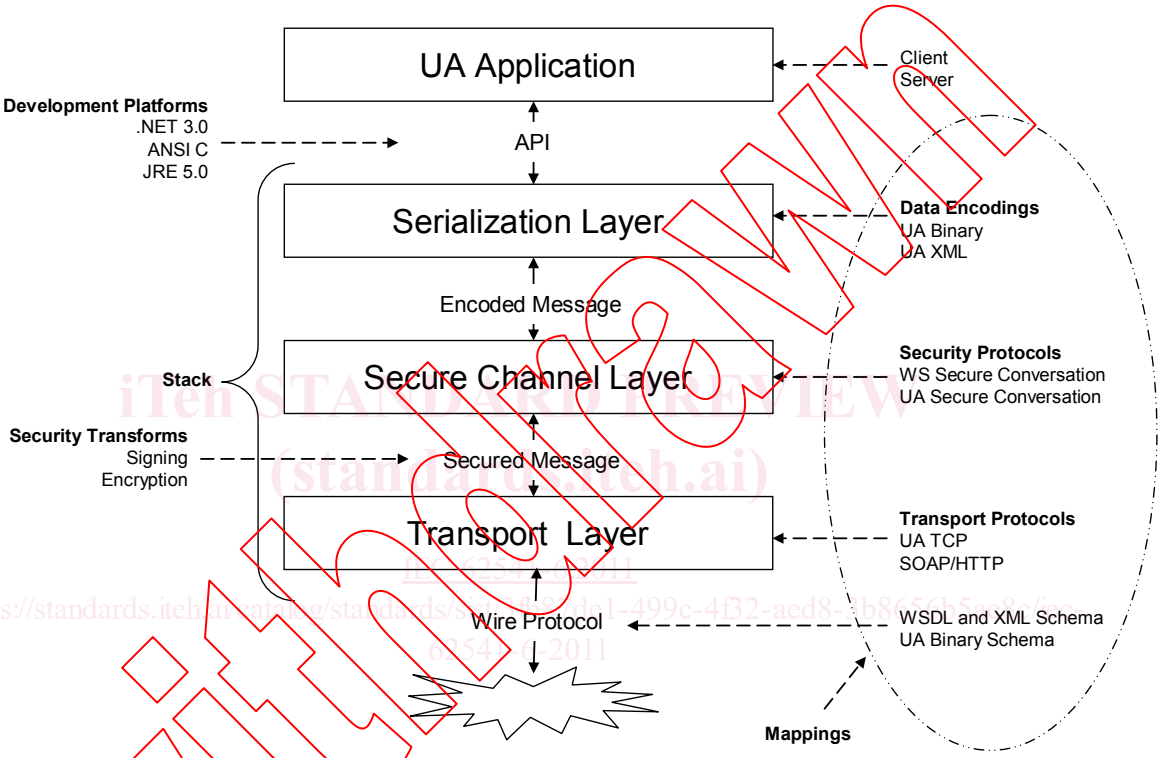

Figure 1 – The OPC UA Stack Overview

The layers described in this specification do not correspond to layers in the OSI 7 layer model [ITU-T X.200]. Each OPC UA *StackProfile* should be treated as a single Layer 7 (Application) protocol that is built on an existing Layer 5, 6 or 7 protocol such as TCP/IP, TLS or HTTP.The *SecureChannel* layer is always present even if the *SecurityMode* is None. In this situation, no security is applied but the *SecurityProtocol* implementation shall maintain a logical channel with a unique identifier. Users and Administrators are expected to understand that a *SecureChannel* with *SecurityMode* set to None cannot be trusted unless the Application is operating on a physically secure network or a low level protocol such as IPSec is being used.

5 Data Encoding

5.1 General

5.1.1 Overview

This standard defines two data encodings: OPC UA Binary and OPC UA XML. It describes how to construct messages using each of these encodings.