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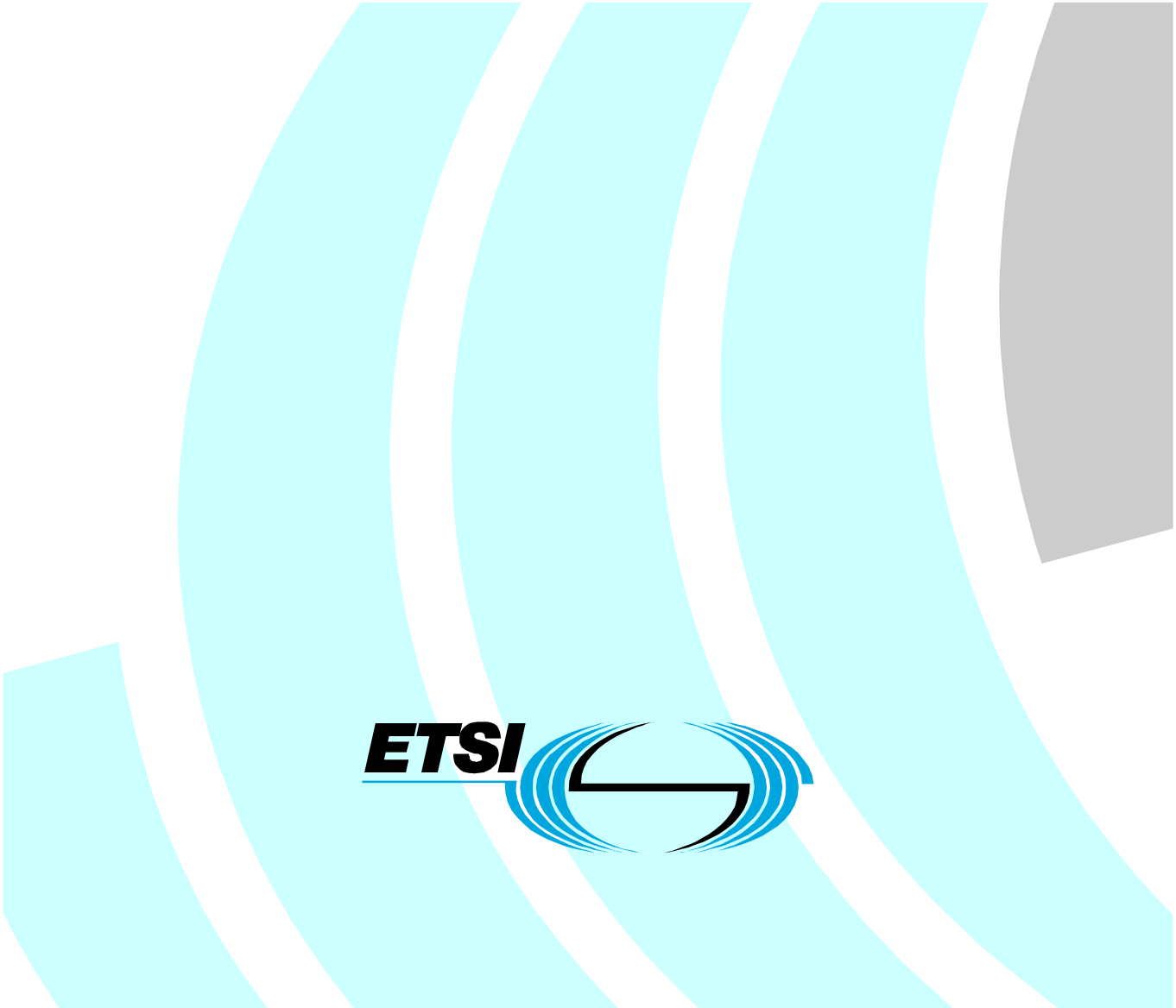
Technical Specification

XML Advanced Electronic Signatures (XAdES)



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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Electronic Signatures and Infrastructures (ESI).

Introduction

Electronic commerce is emerging as the future way of doing business between companies across local, wide area and global networks. Trust in this way of doing business is essential for the success and continued development of electronic commerce. It is therefore important that companies using this electronic means of doing business have suitable security controls and mechanisms in place to protect their transactions and to ensure trust and confidence with their business partners. In this respect the electronic signature is an important security component that can be used to protect information and provide trust in electronic business.

The European Directive on a community framework for Electronic Signatures (also denoted as "the Directive" or the "European Directive" in the rest of the present document) defines an electronic signature as: "data in electronic form which is attached to or logically associated with other electronic data and which serves as a method of authentication".

The present document is intended to cover electronic signatures for various types of transactions, including business transactions (e.g. purchase requisition, contract, and invoice applications). Thus the present document can be used for any transaction between an individual and a company, between two companies, between an individual and a governmental body, etc. The present document is independent of ny environment. It can be applied to any environment e.g. smart cards, GSM SIM cards, special programs for electronic signatures, etc.

The ETSI standard TS 101 733 [1] defines formats for advanced electronic signatures that remain valid over long periods, are compliant with the European Directive and incorporate additional useful information in common use cases (like indication of the commitment got by the signature production). Currently, it uses Abstract Syntax Notation 1 (ASN.1) and is based on the structure defined in RFC 3369 [2] (in the present document the signatures aligned with this RFC will be denoted as CMS signatures).

TS 101 733 [1]:

- Defines new ASN.1 types able to contain information for qualifying the CMS signatures so that they fulfil the aforementioned requirements.
- Specifies how this qualifying information must be incorporated to the CMS signatures.

Currently, the IETF W3C XML-Signature Working Group has developed a syntax for XML signatures: "XML-Signature Core Syntax and Processing" [3] (denoted as XMLDSIG in the present document). This syntax provides a basic functionality for digitally signing several data objects at the same time. It also provides basic means to incorporate any kind of needed qualifying information.

The present document:

- specifies XML schema ([5]) definitions for new XML types that can be used to generate properties that further qualify XMLDSIG signatures with information able to fulfil a number of common requirements such as the long term validity of the signature by usage of time-stamps, etc.
- defines mechanisms for incorporating the aforementioned qualifying information;
- specifies formats for XML advanced electronic signatures that, by using the specified new XML types, remain valid over long periods and incorporate additional useful information in common use cases. These signatures will be built on XMLDSIG by addition of these properties as specified in [3], using the `ds:Object` XML element defined there (here, as for the rest of the document, `ds` has been used as the prefix denoting the namespace defined in [3]. Its value is defined in clause 4);
- defines a set of conformance requirements to claim endorsement to the present document.

The present document specifies two main types of properties: signed properties and unsigned properties. The first ones are additional data objects that are also secured by the signature produced by the signer on the `ds:SignedInfo` element, which implies that the signer gets these data objects, computes a hash for all of them and generates the corresponding `ds:Reference` element. The unsigned properties are data objects added by the signer, by the verifier or by other parties after the production of the signature. They are not secured by the signature in the `ds:Signature` element (the one computed by the signer); however they can be actually signed by other parties (time-stamps, countersignatures, certificates and CRLs are also signed data objects).

The XML advanced electronic signatures defined in the present document will be built by incorporating to the XML signatures as defined in [3] XMLDSIG one new `ds:Object` XML element containing the additional qualifying information.

Editorial conventions

As it has been anticipated in the former clause, throughout the rest of the document the term XMLDSIG will refer to XML signatures with basic functionality, i.e. to XML signatures that do not incorporate the qualifying information on the signature, the signer or the signed data object(s) specified in the present document.

Throughout the rest of the document the terms "qualifying information", "properties" or "qualifying properties" will be used to refer to the information added to the XMLDSIG to get an XML advanced electronic signature as specified in the European Directive and with long term validity.

For the present document the key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in the present document are to be interpreted as described in RFC 2119 [10].

1 Scope

The present document defines XML formats for advanced electronic signatures that remain valid over long periods, are compliant the European Directive and incorporate additional useful information in common uses cases. This includes evidence as to its validity even if the signer or verifying party later attempts to deny (repudiates) the validity of the signature.

The present document is based on the use of public key cryptography to produce digital signatures, supported by public key certificates.

The present document uses a signature policy, implicitly or explicitly referenced by the signer, as one possible basis for establishing the validity of an electronic signature.

The present document uses time-stamps or trusted records (e.g. time-marks) to prove the validity of a signature long after the normal lifetime of critical elements of an electronic signature and to support non-repudiation. It also specifies the optional use of additional time-stamps to provide very long-term protection against key compromise or weakened algorithms.

The present document then, specifies the use of the corresponding trusted service providers (e.g. time-stamping authorities), and the data that needs to be archived (e.g. cross certificates and revocation lists). An advanced electronic signature aligned with the present document can, in consequence, be used for arbitration in case of a dispute between the signer and verifier, which may occur at some later time, even years later.

The present document builds on the standards for Electronic Signatures defined in:

- IETF W3C: "XML-Signature Syntax and Processing" [3];
- TS 101 733: "Electronic Signature Formats" [1];
- ITU-T Recommendation X.509: "Information technology - Open Systems Interconnection - The Directory: Authentication framework" [6];
- TS 101 861: "Time stamping profile" [7].

NOTE: See clause 2 for a full set of references.

The present document, being built on the framework defined in [3] makes use of the terms defined there. Some of the definitions in [3] are repeated in the present document for the sake of completeness.

The present document:

- shows a taxonomy of the qualifying information (properties) that have to be present in an electronic signature to remain valid over long periods, to satisfy common use cases requirements, and to be compliant with the European Directive;
- specifies XML schema definitions for new elements able to carry or to refer to the aforementioned properties;
- specifies two ways for incorporating the qualifying information to XMLDSIG, namely either by direct incorporation of the qualifying information or using references to such information. Both ways make use of mechanisms defined in XMLDSIG.

Clause 2 in the present document contains references to relevant documents and standards.

Clause 4 gives an overview of the various types of advanced electronic signatures defined in the present document.

Clause 5 contains the namespace specification for the XML schema definitions appearing in the present document.

Clause 6 describes how the qualifying information is added to XMLDSIG.

Clause 7 contains the details (including schema definitions) of the elements where the qualifying information is included.

Clause 8 specifies conformance requirements for claiming endorsement to the present document.

Annex A contains definitions for relevant concepts used throughout the present document.

Annex B, which is informative, defines extended formats of advanced electronic signatures that include validation data and time-stamps for archival.

Annex C contains the whole set of schema definitions for the elements defined in the present document.

Annex D contains the non normative DTD corresponding to the aforementioned schema.

Annex E shows examples of how to incorporate qualifying information leading to the XML Advanced Electronic Signatures.

Annex F contains bibliography.

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 and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

[1] ETSI TS 101 733: "Electronic Signatures and Infrastructures (ESI); Electronic Signature Formats".

[2] IETF RFC 3369 (obsoletes RFC 2630): "Cryptographic Message Syntax (CMS)".

[3] W3C/IETF Recommendation (February 2002): "XML-Signature Syntax and Processing".

[4] W3C Recommendation: "XML Schema Part 1: Structures".

[5] W3C Recommendation: "XML Schema Part 2: Datatypes".

[6] ITU-T Recommendation X.509: "Information technology - Open Systems Interconnection - The Directory: Public-key and attribute certificate frameworks".

[7] ETSI TS 101 861: "Time stamping profile".

[8] W3C: "Extensible Markup Language (XML) 1.0".

[9] IETF RFC 2560: "X.509 Internet Public Key Infrastructure Online Certificate Status Protocol - OCSP".

[10] IETF RFC 2119: "Key words for use in RFCs to Indicate Requirement Levels".

[11] IETF RFC 3161: "Internet X.509 Public Key Infrastructure Time Stamp Protocol (TSP)".

[12] ETSI TR 102 038: "TC Security - Electronic Signatures and Infrastructures (ESI); XML format for signature policies".

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ASN1	Abstract Syntax Notation 1
CA	Certification Authority
CARL	Certification Authority Revocation List

CMS	Cryptographic Message Syntax
CRL	Certificate Revocation List
DTD	Document Type Definition
HTTP	Hyper Text Transfer Protocol
OCSP	Online Certificate Status Protocol
OID	Object IDentifier
PKC	Public Key Certificate
SP	Signature Policy
TSA	Time-Stamping Authorities
TSP	Trusted Service Providers
TSU	Time Stamping Unit
URI	Uniform Resource Identifier
URN	Uniform Resource Name
XAdES	XML Advanced Electronic Signature
XAdES-A	XML Advanced Electronic Signature with archiving validation data
XAdES-BES	XAdES Basic Electronic Signature
XAdES-C	XAdES with Complete validation data
XAdES-EPES	XAdES Explicit Policy based Electronic Signature
XAdES-T	XAdES with Time-Stamp
XAdES-X	XML Advanced Electronic Signature with eXtended validation data
XML	extensible Markup Language
XML-DIGSIG	Xml digital signatures
XMLDSIG	XML-Signature Syntax and Processing
XSLT	Extensible Stylesheet Language (XSL) Transformations

4 Overview

4.1 Major Parties

The following are the major parties involved in a business transaction supported by electronic signatures as defined in the present document:

- the Signer;
- the Verifier;
- Trusted Service Providers (TSP);
- the Arbitrator.

The **Signer** is the entity that creates the electronic signature. When the signer digitally signs over data object(s) (see definition) using the prescribed format, this represents a commitment on behalf of the signing entity to the data object(s) being signed.

The **Verifier** is the entity that verifies the electronic signature. It may be a single entity or multiple entities.

The **Trusted Service Providers** (TSPs) are one or more entities that help to build trust relationships between the signer and verifier. They support the signer and verifier by means of supporting services including user certificates, cross-certificates, time-stamping tokens, CRLs, ARLs, OCSP responses. The following TSPs are used to support the functions defined in the present document:

- Certification Authorities;
- Registration Authorities;
- Repository Authorities (e.g. a directory);
- Time-Stamping Authorities;
- Time-Marking Authorities;

- Signature Policy Issuers;
- Attribute Authorities.

Certification Authorities (CA) provide users with public key certificates.

Registration Authorities allow the identification and registration of entities before a CA generates certificates.

Repository Authorities publish CRLs issued by CAs, signature policies issued by signature policy issuers and optionally public key certificates.

Time-Stamping Authorities (TSA) attest that some data object was formed before a given trusted time.

Time-Marking Authorities record that some data was formed before a given trusted time.

Signature Policy Issuers define the technical and procedural requirements for electronic signature creation and validation, in order to meet a particular business need.

Attributes Authorities provide users with attributes linked to public key certificates.

An **Arbitrator** is an entity that arbitrates in disputes between a signer and a verifier.

4.2 Signatures policies

The present document includes the concept of signature policies that can be used to establish technical consistency when validating electronic signatures. When a comprehensive signature policy used by the verifier is either explicitly indicated by the signer or implied by the data being signed, then a consistent result can be obtained when validating an electronic signature. When the signature policy being used by the verifier is neither indicated by the signer nor can be derived from other data, or the signature policy is incomplete then verifiers, including arbitrators, may obtain different results when validating an electronic signature. Therefore, comprehensive signature policies that ensure consistency of signature validation are recommended from both the signers and verifiers point of view.

Specification of the contents of signature policies is outside the scope of the current document. Further information on signature policies is provided in TR 102 038 [12].

4.3 Signature properties and signature forms

The present document defines a set of signature properties that MAY be combined to obtain electronic signature forms providing satisfaction of different requirements. Below follows a short overview of the properties:

- `SignaturePolicyIdentifier`. This property contains information being an **unambiguous way for identifying the signature policy** under which the electronic signature has been produced. This will ensure that the verifier will be able to use the same signature policy during the verification process. A signature policy is useful to clarify the precise role and commitments that the signer intends to assume with respect to the signed data object, and to avoid claims by the verifier that a different signature policy was implied by the signer. Details on this property can be found in clause 7.2.3.
- Validation data properties. The present document defines a number of XML types able to contain both validation data (certificate chains, CRLs, OCSP responses, etc) and references to them (identifiers of certificates, CRLs, OCSP responses, etc). Properties of these types allow the incorporation in a signature of all the material that has been used in its validation. They can be jointly used with time-stamp properties to provide long term validity. Below follows the list of properties:
  - `CompleteCertificateRefs`. It contains references to the CA certificates used to validate the signature. Details on this property can be found in clause 7.4.1.
  - `CompleteRevocationRefs`. It contains references to the full set of revocation information used for the verification of the electronic signature. Details on this property can be found in clause 7.4.2.
  - `AttributeCertficateRefs`. It contains references to the full set of Attribute Authorities certificates that have been used to validate the attribute certificate. Details on this property can be found in clause 7.4.3.

- `AttributeRevocationRefs`. It contains references to the full set the references of Attribute Certificate Revocation List and/or OCSP responses that have been used in the validation of the attribute certificate(s) present in the signature. Details on this property can be found in clause 7.4.4.

- `CertificateValues`. It contains the values of certificates used to validate the signature. Details on this property can be found in clause 7.6.1.

- `RevocationValues`. It contains the full set of revocation information used for the verification of the electronic signature. Details on this property can be found in clause 7.6.2.

- `Time`-stamp properties. The present document defines a XML type (`TimeStampType`) for allowing the inclusion of a time-stamps in a XMLDSIG signature. `TimeStampType` is defined in clause 7.1.4. The present document uses `TimeStampType` for defining several time-stamp properties, each one containing a time-stamp that covers different parts of the signature (common elements defined in XMLDSIG, validation data, qualifying properties, etc). Below follows the list:

  - `SignatureTimeStamp`. Its time-stamp covers the digital signature value element. Details on this property can be found in clause 7.3.

  - `AllDataObjectsTimeStamp`. Its time-stamp covers all the signed data objects. Details on this property can be found in clause 7.2.9.

  - `IndividualDataObjectsTimeStamp`. Its time-stamp covers selected signed data objects. Details on this property can be found in clause 7.2.10

  - `SigAndRefsTimeStamp`. Its time-stamp covers the signature and references to validation data. Details on this property can be found in clause 7.5.1.

  - `RefsOnlyTimeStamp`. Its time-stamp covers only references to validation data. Details on this property can be found in clause 7.5.2.

  - `ArchiveTimeStamp`. Its time-stamp covers signature and other properties required for providing long-term validity. Details on this property can be found in clause 7.7.

- Other properties. The present document defines a number of additional properties that can be useful in a wide range of environments, namely:

  - `SigningCertificate`. This property contains an unambiguous **reference to the signer's certificate**, formed by its identifier and the digest value of the certificate. Its usage is particularly important when a signer holds a number of different certificates containing the same public key, to avoid claims by a verifier that the signature implies another certificate with different semantics. This is also important when the signer holds different certificates containing different public keys in order to provide the verifier with the correct signature verification data. Finally, it is also important in case the issuing key of the CA providing the certificate would be compromised. Details on this property can be found in clause 7.2.2.

  - `SigningTime`. This property contains the time at which the signer claims to have performed the signing process. Details on this property can be found in clause 7.2.1.

  - `DataObjectFormat`. This property identifies the format of a signed data object (when electronic signatures are not exchanged in a restricted context) to enable the verifier to be presented or use it (text, sound or video) in exactly the same way as intended by the signer. Details on this property can be found in clause 7.2.5.

  - `CommitmentTypeIndication`. This property identifies the commitment undertaken by the signer in signing (a) signed data object(s) in the context of the selected signature policy (when an explicit commitment is being used). This will be required where a Signature Policy specifies more than a single commitment type, each of which might have different legal interpretations of the intent of the signature (e.g. proof of origin, proof of receipt, proof of creation, etc.). Details on this property can be found in clause 7.2.6.

  - `SignatureProductionPlace`. This property contains the indication of the purported place where the signer claims to have produced the signature. Details on this property can be found in clause 7.2.7.

- `SignerRole`. This property contains claimed or certified roles assumed by the signer in creating the signature. Details on this property can be found in clause 7.2.8.

- `CounterSignature`. This property contains signature(s) produced on the signature. Details on this property can be found in clause 7.2.4.

The aforementioned properties are defined in the normative part of the present document. They can be combined to generate different electronic signature forms. Some of them are defined in clause 4.3 of its normative part. Additional extended forms are defined in the informative annex B. Clause 8 specifies conformance requirements for claiming endorsement to the present technical specification.

4.4 Electronic signature forms

The current clause specifies three forms of XML advanced electronic signatures, namely the **Basic Electronic Signature** (XAdES-BES), the **Explicit Policy based Electronic Signature** (XAdES-EPES), and the **Electronic Signature with Complete Validation Data** (XAdES-C). Conformance to the present document mandates the signer to create one of these formats.

The informative annex B defines extended forms of XAdES. Conformance to the present document does not mandate the signer to create none of the forms defined in annex B.

4.4.1 Basic electronic signature (XAdES-BES)

A Basic Electronic Signature (XAdES-BES) in accordance with the present document will build on a XMLDSIG by incorporating qualifying properties defined in the present specification. They will be added to XMLDSIG within one `ds:Object` acting as the bag for the whole set of qualifying properties, or by using the mechanism defined in clause 6.3.2 that allows further distribution of the properties.

Some properties defined for building up this form will be covered by the signer's signature (signed qualifying information grouped within one new element, `SignedProperties`, see clause 6.2.1). Other ones will be not covered by the signer's signature.

In a XAdES-BES the signature value SHALL be computed in the usual way of XMLDSIG over the data object(s) to be signed **and on the whole set of signed properties when present** (`SignedProperties` element).

For this form it is mandatory to protect the signing certificate with the signature, in one of the two following ways:

- Either incorporating the `SigningCertificate` signed property, or

- Not incorporating the `SigningCertificate` but incorporating the signing certificate within the `ds:KeyInfo` element and signing it.

A XAdES-BES signature MUST, in consequence, contain at least one of the following elements with the specified contents:

- The `SigningCertificate` signed property. This property MUST contain the reference and the digest value of the signing certificate. It MAY contain references and digests values of other certificates (that MAY form a chain up to the point of trust).

- The `ds:KeyInfo` element. If `SigningCertificate` is present in the signature, no restrictions apply to this element. If `SigningCertificate` element is not present in the signature, then the following restrictions apply:

  - the `ds:KeyInfo` element MUST include a `ds:X509Data` containing the signing certificate;

  - the `ds:KeyInfo` element also MAY contain other certificates forming a chain that MAY reach the point of trust;

  - the `ds:SignedInfo` element MUST contain a `ds:Reference` element referencing `ds:KeyInfo`, so that the last one is included in the signature value computation. In this way, the signing certificate is secured by the signature.

By incorporating one of these elements, XAdES-BES prevents the simple substitution of the signer's certificate (see clause 7.2.2).

A XAdES-BES signature MAY also contain the following properties:

- the `SigninTime` signed property;
- the `DataObjectFormat` signed property;
- the `CommitmentTypeIndication` signed;
- the `SignerRole` signed property;
- the `SignatureProductionPlace` signed property;
- one or more `IndividualDataObjectsTimeStamp` or `AllDataObjectTimeStamp` signed properties;
- one or more `CounterSignature` unsigned properties.

Below follows the structure of the XAdES-BES built **by direct incorporation** of the qualifying information in the corresponding new XML elements to the XMLDSIG (see clause 6.3.1 for further details). In the example "?" denotes zero or one occurrence; "+" denotes one or more occurrences; and "*" denotes zero or more occurrences.

The XML schema definition in clause 5 defines the prefix "`ds`" for all the XML elements already defined in XMLDSIG, and states that the default namespace is the one defined for the present document. In consequence, in the example of this clause, the elements already defined in XMLDSIG appear with the prefix "`ds`", whereas the new XML elements defined in the present document appear without prefix.

```
                              XMLDSIG
                                |
<ds:Signature ID?>- - - - - - - -+- - - - -+
  <ds:SignedInfo>               |         |
    <ds:CanonicalizationMethod/>|         |
    <ds:SignatureMethod/>       |         |
    (<ds:Reference URI? >       |         |
      (<ds:Transforms>)?        |         |
      <ds:DigestMethod>         |         |
      <ds:DigestValue>          |         |
    </ds:Reference>)+           |         |
  </ds:SignedInfo>              |         |
  <ds:SignatureValue>           |         |
  (<ds:KeyInfo>)?- - - - - - - - +        |
                                          |
  <ds:Object>                             |
                                          |
    <QualifyingProperties>                |
                                          |
      <SignedProperties>                  |
                                          |
        <SignedSignatureProperties>       |
          (SigningTime)?                  |
          (SigningCertificate)?           |
          (SignatureProductionPlace)?     |
          (SignerRole)?                   |
        </SignedSignatureProperties>      |
                                          |
        <SignedDataObjectProperties>      |
          (DataObjectFormat)*             |
          (CommitmentTypeIndication)*     |
          (AllDataObjectsTimeStamp)*      |
          (IndividualDataObjectsTimeStamp)*|
        </SignedDataObjectProperties>     |
                                          |
      </SignedProperties>                 |
                                          |
      <UnsignedProperties>                |
                                          |
```

```
        <UnsignedSignatureProperties>          |
          (CounterSignature)*                  |
        </UnsignedSignatureProperties>         |
                                               |
      </UnsignedProperties>                    |
                                               |
    </QualifyingProperties>                    |
                                               |
  </ds:Object>                                 |
                                               |
</ds:Signature>- - - - - - - - - - - - - - - - +
                                               |
                                          XAdES-BES
```

Other XMLDSIG `ds:Object` elements with different contents MAY be added within the structure shown above to satisfy requirements other than the ones expressed in the present document. This also applies to the rest of the examples of structures of XAdES forms shown in this clause.

The signer's conformance requirements of a XAdES-BES are defined in clause 8.1.

NOTE: The XAdES-BES is the minimum format for an electronic signature to be generated by the signer. On its own, it does not provide enough information for it to be verified in the longer term. For example, revocation information issued by the relevant certificate status information issuer needs to be available for long term validation (see clause 4.3.3).

The XAdES-BES satisfies the legal requirements for electronic signatures as defined in the European Directive on electronic signatures. It provides basic authentication and integrity protection.

The semantics of the signed data of a XAdES-BES or its context may implicitly indicate a signature policy to the verifier.

4.4.2 Explicit policy electronic signatures (XAdES-EPES)

An **Explicit Policy based Electronic Signature** (XAdES-EPES) form in accordance with the present document, extends the definition of an electronic signature to conform to the identified signature policy. A XAdES-EPES builds up on a XMLDSIG or XAdES-BES forms by incorporating a signed property (`SignaturePolicyIdentifier`) indicating that a signature policy that is mandatory to use to validate the signature and specifies explicitly the signature policy that shall be used. This signed attribute is protected by the signer's signature. The signature may also have other signed properties required to conform to the mandated signature policy.

Clause 7.2.3 provides the details on the specification of `SignaturePolicyIdentifier` property. Specification of the contents of signature policies is outside the scope of the current document.

Further information on signature policies is provided in TR 102 038 [12].

The structure of the XAdES-EPES built on XAdES-BES **by direct incorporation** of the qualifying information to a XAdES-BES form, is illustrated below:

```
                              XMLDSIG
                                |
<ds:Signature ID?>- - - - - - - -+- - - - -+
  <ds:SignedInfo>               |         |
    <ds:CanonicalizationMethod/>|         |
    <ds:SignatureMethod/>       |         |
    (<ds:Reference URI? >       |         |
      (<ds:Transforms>)?        |         |
      <ds:DigestMethod>         |         |
      <ds:DigestValue>          |         |
    </ds:Reference>)+           |         |
  </ds:SignedInfo>              |         |
  <ds:SignatureValue>           |         |
  (<ds:KeyInfo>)?- - - - - - - - +        |
                                          |
  <ds:Object>                             |
```

```
                                                    |
    <QualifyingProperties>                          |
                                                    |
      <SignedProperties>                            |
                                                    |
        <SignedSignatureProperties>                 |
          (SigningTime)?                            |
          (SigningCertificate)?                     |
          (SignaturePolicyIdentifier)               |
          (SignatureProductionPlace)?               |
          (SignerRole)?                             |
        </SignedSignatureProperties>                |
                                                    |
        <SignedDataObjectProperties>                |
          (DataObjectFormat)*                       |
          (CommitmentTypeIndication)*               |
          (AllDataObjectsTimeStamp)*                |
          (IndividualDataObjectsTimeStamp)*         |
        </SignedDataObjectProperties>               |
                                                    |
      </SignedProperties>                           |
                                                    |
      <UnsignedProperties>                          |
                                                    |
        <UnsignedSignatureProperties>               |
          (CounterSignature)*                       |
        </UnsignedSignatureProperties>              |
                                                    |
      </UnsignedProperties>                         |
                                                    |
    </QualifyingProperties>                         |
                                                    |
  </ds:Object>                                      |
                                                    |
</ds:Signature>- - - - - - - - - - - - - - - - - - - +
                                                    |
                                          XAdES-PES
```

The signer's conformance requirements of XAdES-EPES are defined in clause 8.2.

4.4.3 Electronic signature formats with validation data

Validation of an electronic signature in accordance with the present document requires additional data needed to validate the electronic signature. This additional data is called **validation data**; and includes:

- Public Key Certificates (PKCs);
- revocation status information for each PKC;
- trusted time-stamps applied to the digital signature or a time-mark that shall be available in an audit log;
- when appropriate, the details of a signature policy to be used to verify the electronic signature.

The **validation data** may be collected by the signer and/or the verifier. When the signature policy identifier is present, it shall meet the requirements of the signature policy. Validation data includes CA certificates as well as revocation status information in the form of Certificate Revocation Lists (CRLs) or certificate status information (OCSP) provided by an on-line service. Validation data also includes evidence that the signature was created before a particular point in time this may be either a time-stamp token or time-mark.

The present document defines properties able to contain validation data. Clauses below summarize some signature formats that incorporate them and their most relevant characteristics.

4.4.3.1 Electronic signature with time (XAdES-T)

XML Advanced Electronic Signature with Time (XAdES-T) is a signature for which there exists a trusted time associated to the signature. The trusted time may be provided by two different means:

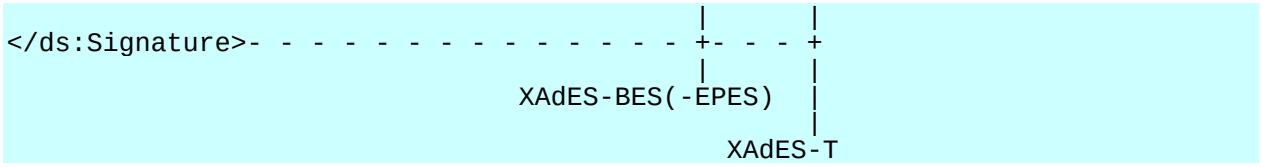
- the `SignatureTimeStamp` as an unsigned property added to the electronic signature;
- a time mark of the ES provided by a trusted service provider.

A time-mark provided by a Trusted Service would have similar effect to the `SignatureTimeStamp` property but in this case no property is added to the electronic signature as it is the responsibility of the TSP to provide evidence of a time mark when required to do so. The management of time marks is outside the scope of the current document.

Trusted time provides the initial steps towards providing long term validity.

Below follows the structure of a XAdES-T form built on a XAdES-BES or a XAdES-EPES, by direct incorporation of a time-stamp token within the `SignatureTimeStamp` element. A XAdES-T form based on time-marks MAY exist without such an element.

```
                              XMLDISG
                                |
<ds:Signature ID?>- - - - - - - +- - - - +- - - +
  <ds:SignedInfo>               |        |     |
    <ds:CanonicalizationMethod/>|        |     |
    <ds:SignatureMethod/>       |        |     |
    (<ds:Reference URI? >       |        |     |
      (<ds:Transforms>)?        |        |     |
      <ds:DigestMethod>         |        |     |
      <ds:DigestValue>          |        |     |
    </ds:Reference>)+           |        |     |
  </ds:SignedInfo>              |        |     |
  <ds:SignatureValue>           |        |     |
  (<ds:KeyInfo>)? - - - - - - - +        |     |
                                         |     |
  <ds:Object>                            |     |
                                         |     |
    <QualifyingProperties>               |     |
                                         |     |
      <SignedProperties>                 |     |
                                         |     |
        <SignedSignatureProperties>      |     |
          (SigningTime)?                 |     |
          (SigningCertificate)?          |     |
          (SignaturePolicyIdentifier)?   |     |
          (SignatureProductionPlace)?    |     |
          (SignerRole)?                  |     |
        </SignedSignatureProperties>     |     |
                                         |     |
        <SignedDataObjectProperties>     |     |
          (DataObjectFormat)*            |     |
          (CommitmentTypeIndication)*    |     |
          (AllDataObjectsTimeStamp)*     |     |
          (IndividualDataObjectsTimeStamp)*|    |
        </SignedDataObjectProperties>    |     |
                                         |     |
      </SignedProperties>                |     |
                                         |     |
      <UnsignedProperties>               |     |
                                         |     |
        <UnsignedSignatureProperties>    |     |
          (CounterSignature)*- - - - - - - +     |
          (SignatureTimeStamp)+          |     |
        </UnsignedSignatureProperties>- - -+     |
                                         |     |
      </UnsignedProperties>              |     |
                                         |     |
    </QualifyingProperties>              |     |
                                         |     |
  </ds:Object>                           |     |
```



4.4.3.2 Electronic signature with complete validation data references (XAdES-C)

XML Advanced Electronic Signature with Complete validation data references (XAdES-C) in accordance with the present document adds to the XAdES-T the `CompleteCertificateRefs` and `CompleteRevocationRefs` unsigned properties as defined by the present document. If attribute certificates appear in the signature, then XAdES-C also incorporates the `AttributeCertificateRefs` and the `AttributeRevocationRefs` elements.

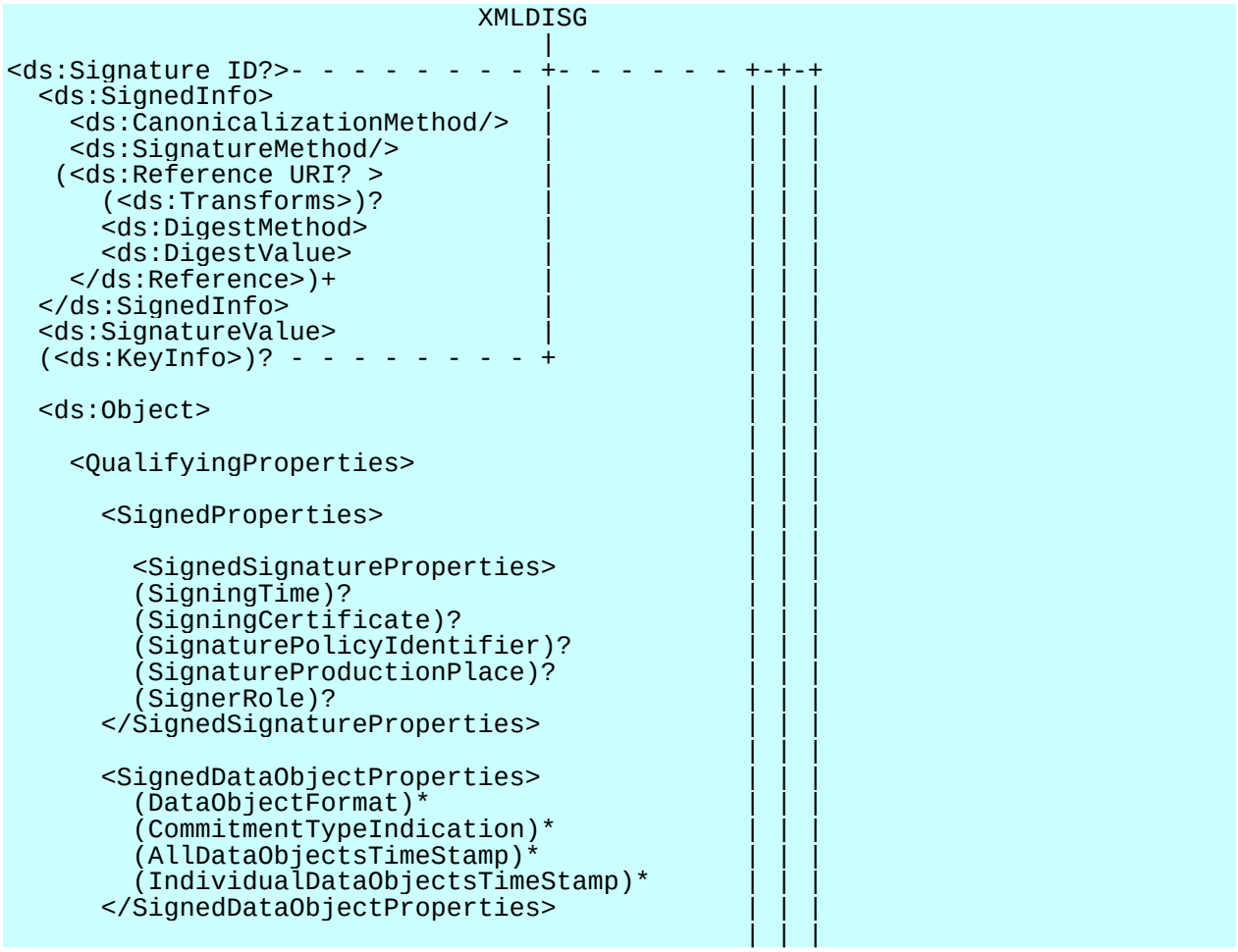
CompleteCertificateRefs element contains a sequence of references to the full set of CA certificates that have been used to validate the electronic signature up to (but not including) the signing certificate.

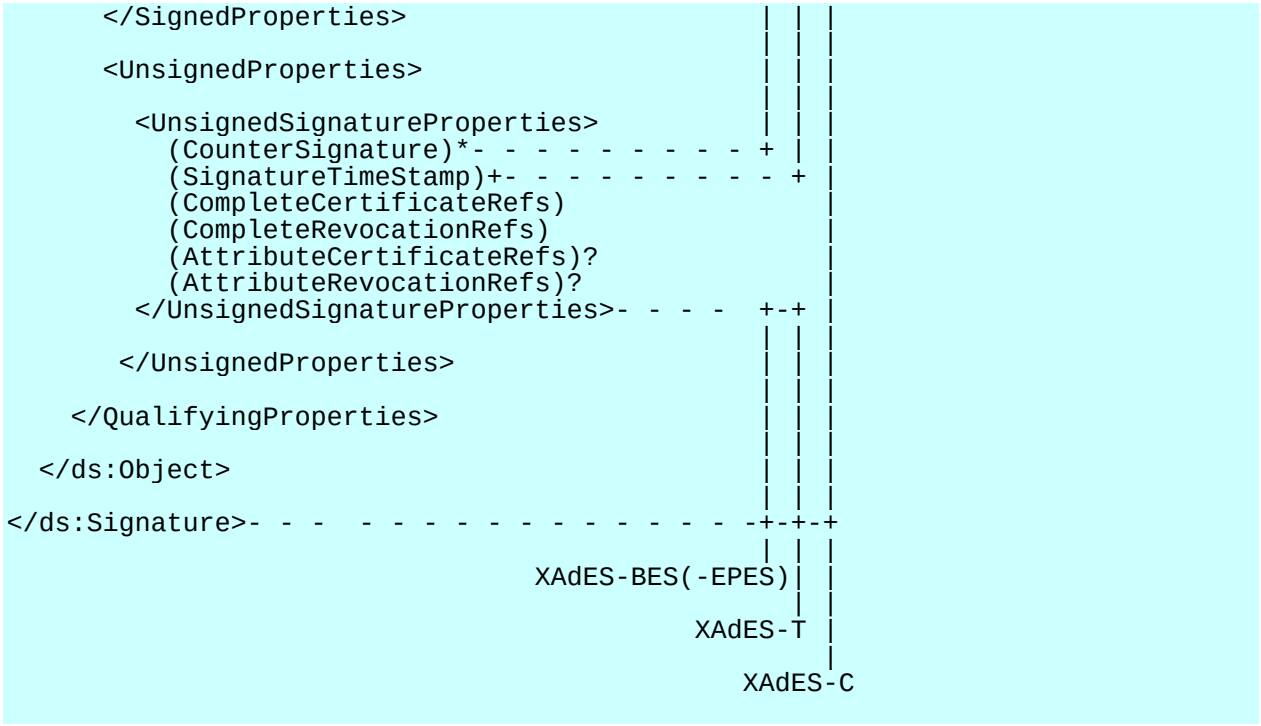
CompleteRevocationRefs element contains a full set of references to the revocation data that have been used in the validation of the signer and CA certificates.

`AttributeCertificateRefs` and `AttributeRevocationRefs` elements contain references to the full set of Attribute Authorities certificates and references to the full set of revocation data that have been used in the validation of the attribute certificates present in the signature, respectively.

Storing the references allows the values of the certification path, the CRLs or OCSPs responses, Attribute Authorities certificates and Attribute Certificate Revocation List and/or OCSP responses, to be stored elsewhere, reducing the size of a stored electronic signature format.

Below follows the structure for XAdES-C built on a XAdES-T that incorporates the `SignatureTimeStamp` signed property. A XAdES-C form based on time-marks MAY exist without such element.





NOTE 1: As a minimum, the signer will provide the XAdES-BES or when indicating that the signature conforms to an explicit signing policy the XAdES-EPES.

NOTE 2: To reduce the risk of repudiating signature creation, the trusted time indication needs to be as close as possible to the time the signature was created. The signer or a TSP could provide the XAdES-T, if not the verifier should create the XAdES-T on first receipt of an electronic signature because the XAdES-T provides independent evidence of the existence of the signature prior to the trusted time indication.

NOTE 3: The XAdES-T trusted time indications MUST be created before a certificate has been revoked or expired.

NOTE 4: The signer and TSP MAY provide the XAdES-C to minimize this risk and when the signer does not provide the XAdES-C, the verifier should create the XAdES-C when the required component of revocation and validation data become available. This may require a grace period.

NOTE 5: A grace period permits certificate revocation information to propagate through the revocation processes. This period could extend from the time an authorized entity requests certificate revocation, to when relying parties may be expected to have accessed the revocation information (for example, by contractual requirements placed on relying parties). In order to make sure that the certificate was not revoked at the time the signature was time-marked or time-stamped, verifiers should wait until the end of the grace period An illustration of a grace period is provided figure 1.

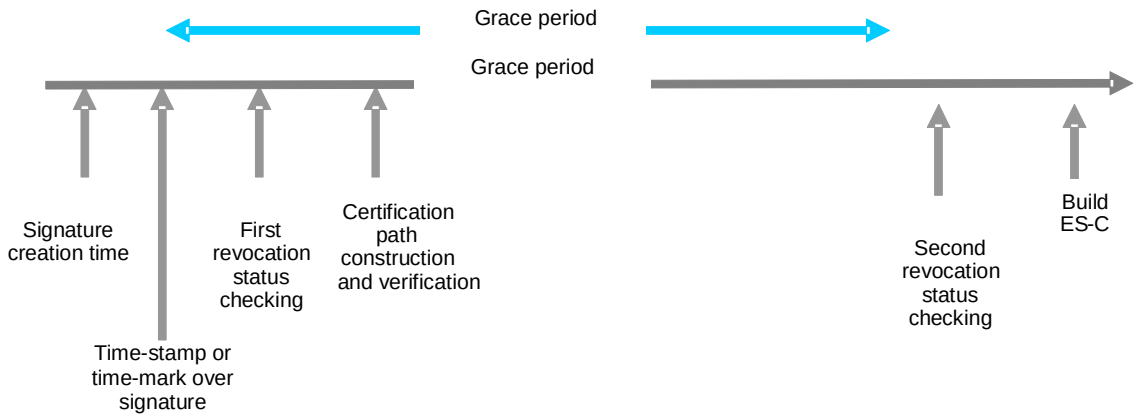


Figure 1: Illustration of a Grace Period

The verifier's conformance requirements are defined in clause 8.3 for time stamped ES-C and clause 8.4 for time marked XAdES-C signatures.

4.5 Validation process

The **Validation Process** validates an electronic signature, the output status of the validation process can be:

- invalid;
- incomplete validation;
- valid.

An **Invalid** response indicates that either the signature format is incorrect or that the digital signature value fails verification (e.g. the integrity check on the digital signature value fails or any of the certificates on which the digital signature verification depends is known to be invalid or revoked).

An **Incomplete Validation** response indicates that the format and digital signature verifications have not failed but there is insufficient information to determine if the electronic signature is valid. For example; all the required certificates are not available or the grace period is not completed. In the case of Incomplete Validation, the electronic signature may be checked again at some later time when additional validation information becomes available. Also, in the case of incomplete validation, additional information may be made available to the application or user, thus allowing the application or user to decide what to do with partially correct electronic signatures.

A **Valid** response indicates that the signature has passed verification and it complies with the signature validation policy.

4.6 Arbitration

XAdES-C form may be used for arbitration should there be a dispute between the signer and verifier, provided that:

- the arbitrator knows where to retrieve the signer's certificate (if not already present), all the cross-certificates and the required CRLs, ACRLs or OCSP responses referenced in the XAdES-C;
- when time-stamping in the XAdES-T is being used, the certificate from the TSU that has issued the time-stamp token in the ES-T format is still within its validity period;
- when time-stamping in the XAdES-T is being used, the certificate from the TSU that has issued the time-stamp token in the XAdES-T format is not revoked at the time of arbitration;
- when time-marking in the XAdES-T is being used, a reliable audit trail from the Time-Marking Authority is available for examination regarding the time;

- none of the private keys corresponding to the certificates used to verify the signature chain have ever been compromised;
- the cryptography used at the time the XAdES-C was built has not been broken at the time the arbitration is performed.

If the signature policy can be explicit or implicitly identified then an arbitrator is able to determine the rules required to validate the electronic signature.

5 XML namespace for the present document

The XML namespace URI that MUST be used by implementations of the present document:

http://uri.etsi.org/01903/v1.2.1#

The following namespace declarations apply for the XML Schema definitions throughout the present document:

```
<?xml version="1.0"?>
<schema
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns="http://uri.etsi.org/01903/v1.2.1#"
  targetNamespace="http://uri.etsi.org/01903/v1.2.1#"
  xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
  elementFormDefault="qualified"
>
<xsd:import namespace="http://www.w3.org/2000/09/xmldsig#"
schemaLocation="http://www.w3.org/TR/2002/REC-xmldsig-core-20020212/xmldsig-
core-schema.xsd"/>
```

6 Syntax overview

This clause introduces the syntax for adding qualifying information to an XML signature.

Clause 6.1 lists a set of technical criteria that has been taken into account for this syntax proposal.

Clause 6.2 specifies an XML element that acts as a container for the qualifying information. Additionally it describes the connection between the XML signature and this container element.

Clause 6.3 shows two ways of incorporating such qualifying information to XMLDSIG.

6.1 Technical criteria

The following considerations have been taken into account for the syntax specification for qualifying information on XML signatures:

- The present document specifies how to add qualifying information to an XML signature such that it satisfies both the requirements for an Advanced Electronic Signature according to the European Directive On Electronic Signatures and for remaining valid over long period of time. TS 101 733 [1] identifies all the required information to be added in order to satisfy those requirements. Additionally it defines appropriate data structures for those qualifying properties using ASN.1, that fit for CMS [2] style electronic signatures. The aim of the present document is to specify similar XML qualifying properties that carry such qualifying information and are used to amend XMLDSIG.
- The new XML qualifying properties should not be the result of a stubborn translation process from ASN.1 to XML. This would mean neglecting syntactic differences between CMS [2] and XMLDSIG such as the possible number of signers and multiple signed data objects covered by a single signature, as well as ignoring powerful features of the XML environment such as linking information by using Uniform Resource Identifiers (URI).

- XML Schema [5] has been chosen as the normative language for defining the new XML structures in the present document rather than the DTD vocabulary defined in XML 1.0 [8], since it is namespace aware, allows reuse of existing structures and allows a stricter definition of the allowed contents.
- XML structures that have been defined in related XML standards such as XML Schema [5] and XML-Signature Syntax and Processing [3] have been reused where appropriate.

6.2 The `QualifyingProperties` element

The `QualifyingProperties` element acts as a container element for all the qualifying information that should be added to an XML signature. The element has the following structure:

```
<xsd:element name="QualifyingProperties" type="QualifyingPropertiesType"/>
<xsd:complexType name="QualifyingPropertiesType">
  <xsd:sequence>
    <xsd:element name="SignedProperties" type="SignedPropertiesType"
      minOccurs="0"/>
    <xsd:element name="UnsignedProperties"
      type="UnsignedPropertiesType"
      minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="Target" type="xsd:anyURI" use="required"/>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The qualifying properties are split into properties that are cryptographically bound to (i.e. signed by) the XML signature (`SignedProperties`), and properties that are not cryptographically bound to the XML signature (`UnsignedProperties`). The `SignedProperties` MUST be covered by a `ds:Reference` element of the XML signature. Alignment with the present document mandates that one `SignedProperties` element MUST exist.

The mandatory `Target` attribute MUST refer to the `Id` attribute of the corresponding `ds:Signature`.

The optional `Id` attribute can be used to make a reference to the `QualifyingProperties` container.

6.2.1 The `SignedProperties` element

The `SignedProperties` element contains a number of properties that are collectively signed by the XMLDSIG signature.

Alignment with the present document mandates that an element `SignedSignatureProperties` MUST appear.

Below follows the schema definition for `SignedProperties` element:

```
<xsd:element name="SignedProperties" type="SignedPropertiesType" />

<xsd:complexType name="SignedPropertiesType">
  <xsd:sequence>
    <xsd:element name="SignedSignatureProperties"
      type="SignedSignaturePropertiesType"/>
      <xsd:element name="SignedDataObjectProperties"
        type="SignedDataObjectPropertiesType" minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The `SignedProperties` element MUST contain properties that qualify the XMLDSIG signature itself or the signer. They are included as content of the `SignedSignatureProperties` element.

The `SignedProperties` element MAY also contain properties that qualify some of the signed data objects. These properties appear as content of the `SignedDataObjectProperties` element.

The optional `Id` attribute can be used to make a reference to the `SignedProperties` element.

6.2.2 The `UnsignedProperties` element

The `UnsignedProperties` element contains a number of properties that are not signed by the XMLDSIG signature.

```
<xsd:element name="UnsignedProperties" type="UnsignedPropertiesType" />

<xsd:complexType name="UnsignedPropertiesType">
  <xsd:sequence>
    <xsd:element name="UnsignedSignatureProperties"
      type="UnsignedSignaturePropertiesType" minOccurs="0"/>
      <xsd:element name="UnsignedDataObjectProperties"
        type="UnsignedDataObjectPropertiesType" minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The `UnsignedProperties` element MAY contain properties that qualify XML signature itself or the signer. They are included as content of the `UnsignedSignatureProperties` element.

The `UnsignedProperties` element MAY also contain properties that qualify some of the signed data objects. These properties appear as content of the `UnsignedDataObjectProperties` element.

The optional `Id` attribute can be used to make a reference to the `UnsignedProperties` element.

6.2.3 The `SignedSignatureProperties` element

This element contains properties that qualify the XML signature that has been specified with the `Target` attribute of the `QualifyingProperties` container element.

```
<xsd:element name="SignedSignatureProperties"
  type="SignedSignaturePropertiesType" />

<xsd:complexType name="SignedSignaturePropertiesType">
  <xsd:sequence>
    <xsd:element name="SigningTime" type="xsd:dateTime"
     minOccurs="0"/>
    <xsd:element name="SigningCertificate" type="CertIDListType"
     minOccurs="0"/>
    <xsd:element name="SignaturePolicyIdentifer"
     type="SignaturePolicyIdentifierType" minOccurs="0"/>
    <xsd:element name="SignatureProductionPlace"
     type="SignatureProductionPlaceType"
      minOccurs="0"/>
    <xsd:element name="SignerRole" type="SignerRoleType"
     minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The optional `Id` attribute can be used to make a reference to the `UnsignedProperties` element.

The qualifying property `SigningTime` is described in detail in clause 7.2.1, `SigningCertificate` in clause 7.2.2, `SignaturePolicyIdentifier` in clause 7.2.3, `SignatureProductionPlace` in clause 7.2.7, and `SignerRole` in clause 7.2.8.

6.2.4 The SignedDataObjectProperties element

This element contains properties that qualify some of the signed data objects.

```
<xsd:element name="SignedDataObjectProperties"
  type="SignedDataObjectPropertiesType"/>

<xsd:complexType name="SignedDataObjectPropertiesType">
  <xsd:sequence>
    <xsd:element name="DataObjectFormat" type="DataObjectFormatType"
      minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="CommitmentTypeIndication"
      type="CommitmentTypeIndicationType" minOccurs="0"
      maxOccurs="unbounded"/>
    <xsd:element name="AllDataObjectsTimeStamp" type="TimeStampType"
      minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="IndividualDataObjectsTimeStamp"
      type="TimeStampType"
      minOccurs="0" maxOccurs="unbounded"/>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The optional `Id` attribute can be used to make a reference to the `UnsignedProperties` element.

The qualifying property `AllDataObjectsTimeStamp` is described in detail in clause 7.2.9, `IndividualDataObjectsTimeStamp` in clause 7.2.10, `DataObjectFormat` in clause 7.2.5, and `CommitmentTypeIndication` in clause 7.2.6.

All these properties qualify the signed data object after all the required transforms have been made.

6.2.5 The UnsignedSignatureProperties element

This element contains properties that qualify the XML signature that has been specified with the `Target` attribute of the `QualifyingProperties` container element. The content of this element is not covered by the XML signature.

```
<xsd:element name="UnsignedSignatureProperties"
  type="UnsignedSignaturePropertiesType"/>

<xsd:complexType name="UnsignedSignaturePropertiesType">
  <xsd:sequence>
    <xsd:element name="CounterSignature" type="CounterSignatureType"
      minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="SignatureTimeStamp" type="TimeStampType"
      minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="CompleteCertificateRefs"
      type="CompleteCertificateRefsType" minOccurs="0"/>
    <xsd:element name="CompleteRevocationRefs"
      type="CompleteRevocationRefsType" minOccurs="0"/>
    <xsd:element name="AttributeCertificateRefs"
      type="CompleteCertificateRefsType" minOccurs="0"/>
    <xsd:element name="AttributeRevocationRefs"
      type="CompleteRevocationRefsType" minOccurs="0"/>
    <xsd:choice>
      <xsd:element name="SigAndRefsTimeStamp" type="TimeStampType"
        minOccurs="0" maxOccurs="unbounded"/>
      <xsd:element name="RefsOnlyTimeStamp" type="TimeStampType"
        minOccurs="0" maxOccurs="unbounded"/>
    </xsd:choice>
    <xsd:element name="CertificateValues" type="CertificateValuesType"
      minOccurs="0"/>
    <xsd:element name="RevocationValues" type="RevocationValuesType"
      minOccurs="0"/>
    <xsd:element name="ArchiveTimeStamp" type="TimeStampType"
      minOccurs="0" maxOccurs="unbounded"/>
```

```
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The optional `Id` attribute can be used to make a reference to the `UnsignedProperties` element.

The qualifying property `CounterSignature` is described in detail in clause 7.2.4, `SignatureTimeStamp` in clause 7.3, `CompleteCertificateRefs` in clause 7.4.1, `CompleteRevocationRefs` in clause 7.4.2, `AttributeCertificateRefs` in clause 7.4.3, `AttributeRevocationRefs` in clause 7.4.4, `SigAndRefsTimeStamp` in clause 7.5.1, `RefsOnlyTimeStamp` in clause 7.5.2, `CertificateValues` in clause 7.6.1, `RevocationValues` in clause 7.6.2, and `ArchiveTimeStamp` in clause 7.7.1.

6.2.6 The `UnsignedDataObjectProperties` element

This element contains properties that qualify some of the signed data objects. The signature generated by the signer does not cover the content of this element.

```
<xsd:element name="UnsignedDataObjectProperties"
  type="UnsignedDataObjectPropertiesType" />

<xsd:complexType name="UnsignedDataObjectPropertiesType">
  <xsd:sequence>
    <xsd:element name="UnsignedDataObjectProperty" type="AnyType"
      minOccurs="0" maxOccurs="unbounded"/>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The optional `Id` attribute can be used to make a reference to the `UnsignedProperties` element.

TS 101 733 [1] does not specify the usage of any unsigned property qualifying the signed data object. The present document, however, incorporates this element for the shake of completeness and to cope with potential future needs for inclusion of such kind of properties. The schema definition leaves open the definition of the contents of this type. The type AnyType is defined in clause 7.1.1.

6.3 Incorporating qualifying properties into an XML signature

The present document utilizes the `ds:Object` auxiliary element from XMLDSIG [3]. It MUST be used to incorporate the qualifying properties into the XMLDSIG signature. In principle, two different means are provided for this incorporation:

- direct incorporation means that a `QualifyingProperties` element is put as a child of the `ds:Object`;
- indirect incorporation means that a `QualifyingPropertiesReference` element is put as a child of the `ds:Object`. This element contains information about a `QualifyingProperties` element that is stored in place different from the signature (see clause 6.3.2).

However, the following restrictions apply for using `ds:Object`, `QualifyingProperties` and `QualifyingPropertiesReference`:

- all instances of the `QualifyingProperties` and the `QualifyingPropertiesReference` element MUST occur within a single `ds:Object` element;
- at most one instance of the `QualifyingProperties` element MAY occur within this single `ds:Object` element;

- all signed properties MUST occur within a single QualifyingProperties element. This element can either be a child of the `ds:Object` element (direct incorporation), or it can be referenced by a `QualifyingPropertiesReference` element. See clause 6.3.1 for information how to sign properties;
- zero or more instances of the `QualifyingPropertiesReference` element MAY occur within the single `ds:Object` element.

No restrictions apply to the relative position of the `ds:Object` containing the `QualifyingProperties` or `QualifyingPropertiesReference` with respect to others `ds:Object` elements present within `ds:Signature`.

It is out of the scope of the present document to specify the mechanisms required to guarantee the correct storage of the distributed `QualifyingProperties` elements (i.e. that the properties are stored by the entity that has to store them and that they are not undetectable modified).

6.3.1 Signing properties

As has already been stated, all the properties that should be protected by the signature have to be collected in a single instance of the `QualifyingProperties` element. Actually these properties are children of the `SignedProperties` child of this element.

In order to protect the properties with the signature, a `ds:Reference` element MUST be added to the XMLDSIG signature. This `ds:Reference` element MUST be composed in such a way that it uses the `SignedProperties` element mentioned above as the input for computing its corresponding digest.

Additionally, the present document MANDATES the use of the `Type` attribute of this particular `ds:Reference` element, with its value set to:

`http://uri.etsi.org/01903/v1.2.1#SignedProperties`

This value indicates that the data used for hash computation is a `SignedProperties` element and therefore helps a verifying application to detect the signed properties of a signature conforming to the present document.

If the `QualifyingProperties` element containing the `SignedProperties` element is stored in a place different from the signature (indirect incorporation), the result of processing the URI and transforms in this `ds:Reference` element MUST be the same as the result of processing the URI and transforms in the `QualifyingPropertiesReference` element pointing to the aforementioned `QualifyingProperties` element.

6.3.2 The `QualifyingPropertiesReference` element

This element contains information about a `QualifyingProperties` element that is stored in place different from the signature, for instance in another XML document.

```
<xsd:element name="QualifyingPropertiesReference"
  type="QualifyingPropertiesReferenceType"/>

<xsd:complexType name="QualifyingPropertiesReferenceType">
  <xsd:sequence>
    <xsd:element ref="ds:Transforms" minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The mandatory `URI` attribute provides an identifier for the location of the `QualifyingProperties` element. This could be for instance a URL to a web site where the information can be retrieved, or a name that the participating applications can use to identify a particular `QualifyingProperties` element.

The optional `ds:Transforms` element can be used to specify a chain of transformations that has to be applied to the data referenced by the URI attribute in order to get the actual representation of the `QualifyingProperties` element. The processing model for the chain of transformations is as defined in clause 4.3.3.2 of XMLDSIG [3].

The optional `Id` attribute can be used to make a reference to the `QualifyingPropertiesReference` element.

7 Qualifying properties syntax

This clause describes in detail all qualifying properties which have been introduced in clause 5. It provides a rationale for each property as well as its XML Schema definition together with explanatory textual information.

Clause 7.1 summarizes a set of auxiliary structures that will be needed later on, while the remaining clauses corresponds to a certain qualifying property.

Clause 7.2 describes in detail the qualifying properties that can appear in XAdES-BES and XAdES-EPES electronic signatures forms as described in clause 4.

Clause 7.3 describes in detail the `SignatureTimeStamp`.

Clause 7.4 describes in detail properties that contain references to validation data.

Clause 7.5 describes in detail properties that can contain time-stamps covering references to validation data.

Clause 7.6 describes in detail properties that can contain validation data values.

Clause 7.7 describes in detail the `ArchivalTimeStamp`.

7.1 Auxiliary syntax

The following three auxiliary XML structures are utilized in several cases in the subsequent clauses.

7.1.1 The AnyType data type

The `AnyType` Schema data type has a content model that allows a sequence of arbitrary XML elements that (mixed with text) is of unrestricted length. It also allows for text content only. Additionally, an element of this data type can bear an unrestricted number of arbitrary attributes. It is used throughout the remaining parts of this clause wherever the content of an XML element has been left open.

```
<xsd:complexType name="AnyType" mixed="true">
  <xsd:sequence minOccurs="0" maxOccurs="unbounded">
    <xsd:any namespace="##any" processContents="lax"/>
  </xsd:sequence>
  <xsd:anyAttribute namespace="##any"/>
</xsd:complexType>
```

7.1.2 The ObjectIdentifierType data type

The `ObjectIdentifierType` data type can be used to identify a particular data object.

It allows the specification of an unique and permanent identifier of an object. In addition, a textual description of the nature of the data object, and a number of references to documents where additional information about the nature of the data object can be found.

```
<xsd:complexType name="ObjectIdentifierType">
  <xsd:sequence>
    <xsd:element name="Identifier" type="IdentifierType"/>
    <xsd:element name="Description" type="xsd:string" minOccurs="0"/>
    <xsd:element name="DocumentationReferences"
```

```
      type="DocumentationReferencesType" minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>
```

The `Identifier` element contains a permanent identifier. Once assigned the identifier can never be re-assigned again. It supports both the mechanism that is used to identify objects in ASN.1 and the mechanism that is usually used to identify objects in an XML environment:

- in an XML environment objects are typically identified by means of an Uniform Resource Identifier, URI. In this case, the content of `Identifier` consists of the identifying URI, and the optional `Qualifier` attribute is not specified;
- in ASN.1 an Object IDentifier (OID) is used to identify an object. To support an OID, the content of Identifier consists of an OID, either encoded as Uniform Resource Name (URN) or as Uniform Resource Identifier (URI). The optional `Qualifier` attribute can be used to provide a hint about the applied encoding (values `OIDAsURN` or `OIDAsURI`).

Should an OID and an URI exist identifying the same object, the present document encourages the use of the URI as explained in the first bullet above.

```
<xsd:complexType name="IdentifierType">
  <xsd:simpleContent>
    <xsd:extension base="xsd:anyURI">
      <xsd:attribute name="Qualifier" type="QualifierType"
        use="optional"/>
    </xsd:extension>
  </xsd:simpleContent>
</xsd:complexType>
<xsd:simpleType name="QualifierType">
  <xsd:restriction base="xsd:string">
    <xsd:enumeration value="OIDAsURI"/>
    <xsd:enumeration value="OIDAsURN"/>
  </xsd:restriction>
</xsd:simpleType>
```

The optional `Description` element contains an informal text describing the object identifier.

The optional `DocumentationReferences` element consists of an arbitrary number of references pointing to further explanatory documentation of the object identifier.

```
<xsd:complexType name="DocumentationReferencesType">
  <xsd:sequence maxOccurs="unbounded">
    <xsd:element name="DocumentationReference" type="xsd:anyURI"/>
  </xsd:sequence>
</xsd:complexType>
```

7.1.3 The `EncapsulatedPKIDataType` data type

The `EncapsulatedPKIDataType` is used to incorporate a piece of PKI data into an XML structure whereas the PKI data is encoded using an ASN.1 encoding mechanism. Examples of such PKI data that are widely used at the time being include X.509 certificates and revocation lists, OCSP responses, attribute certificates and time-stamps.

```
<xsd:complexType name="EncapsulatedPKIDataType">
  <xsd:simpleContent>
    <xsd:extension base="xsd:base64Binary">
      <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
      <xsd:attribute name="Encoding" type="xsd:anyURI"
        use="optional"/>
    </xsd:extension>
  </xsd:simpleContent>
</xsd:complexType>
```

The content of this data type is the piece of PKI data, base64 encoded as defined in [3].

The `Encoding` attribute is an URI identifying the encoding used in the original PKI data. So far, the two following URIs have been identified:

http://uri.etsi.org/01903/v1.2.1#DER for denoting that the original PKI data were ASN.1 data encoded in DER.

http://uri.etsi.org/01903/v1.2.1#BER for denoting that the original PKI data were ASN.1 data encoded in BER.

http://uri.etsi.org/01903/v1.2.1#CER for denoting that the original PKI data were ASN.1 data encoded in CER.

http://uri.etsi.org/01903/v1.2.1#PER for denoting that the original PKI data were ASN.1 data encoded in PER.

http://uri.etsi.org/01903/v1.2.1#XER for denoting that the original PKI data were ASN.1 data encoded in XER.

If the `Encoding` attribute is not present, then it is assumed that the PKI data is ASN.1 data encoded in DER.

The optional `ID` attribute can be used to make a reference to an element of this data type.

7.1.4 The `TimeStampType` data type

Time-Stamps shall be used with XML Advanced Electronic Signatures in a number of use cases. The present document proposes a number of different properties able to contain time-stamp tokens. Each time-stamp token included in these properties will cover a specific set of elements and properties of an electronic signature and will satisfy, in this way, different requirements:

- One property that contains a time-stamp over the `SignatureValue` element to protect against repudiation in case of a key compromise.
- Two properties contain time-stamp tokens provided for protection against fraudulence in case of a CA key compromise:
  - a time-stamp only over all certificate and revocation information references;
  - a time-stamp computed over the signature value, the signature time-stamp and the certificate and revocation information references.
- To provide for long term validity of an XML signature, a time-stamp can be applied over a signature including validation data values. One property is defined for this purpose. More than one instance of this property can be added as time goes on to the archived electronic signature.
- Additionally, properties that contain time-stamp tokens proving that some or all the data objects to be signed have been created before some time, can also be added as signed properties to the XAdES.

A time-stamp is obtained by sending the digest value of the given data to the Time-Stamp Authority (TSA). The returned time-stamp is a signed data that contains the digest value, the identity of the TSA, and the time of stamping. This proves that the given data existed *before* the time of stamping.

Time-Stamps specified in the present document will be generated on selected parts of the XAdES signature element.

Below follows the schema definition for the data type used for all the time-stamps mentioned above:

```
<xsd:complexType name="TimeStampType">
  <xsd:sequence>
    <xsd:element name="Include" type="IncludeType"
      maxOccurs="unbounded"/>
    <xsd:element ref="ds:CanonicalizationMethod" minOccurs="0"/>

    <xsd:choice>
      <xsd:element name="EncapsulatedTimeStamp"
       type="EncapsulatedPKIDataType"/>
      <xsd:element name="XMLTimeStamp" type="AnyType"/>
    </xsd:choice>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>

  <xsd:complexType name="IncludeType">
```

```
    <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
    <xsd:attribute name="referencedData" type="xsd:boolean"
      use="optional"/>
  </xsd:complexType>
```

The sequence of `Include` elements is used to produce the input for the computation of the digest value that is sent to the TSA and is present in the time-stamp token.

The `URI` attribute references the elements that are time-stamped. In time-stamps that cover `ds:Reference` elements, the attribute `referencedData` MAY be present. If present with value set to `"true"`, the time-stamp is computed on the result of processing the corresponding `ds:Reference` element according to the XMLDSIG processing model. If the attribute is not present or is present with value `"false"`, the time-stamp is computed on the `ds:Reference` element itself.

When present, the optional `ds:CanonicalizationMethod` element will indicate the canonicalization method used for canonicalizing XML contents resulting after dereferencing (and processing when required) the data objects. When not present, the standard canonicalization method as specified by XMLDSIG MUST be used.

The actual input to the digest computation is obtained as follows. Each `Include` element MUTS be processed as detailed below:

1) Retrieve the data referenced in the `URI` attribute.

2) If the retrieved data is a `ds:Reference` element and the `referencedData` attribute is set to `"true"` value, take the result of processing the retrieved `ds:Reference` element according to the reference processing model of the XMLDSIG; otherwise take the `ds:Reference` element itself.

3) If the resulting data is a XML nodeset, canonicalize it. If `ds:Canonicalization` is present, the algorithm indicated by this element is used. If not, the standard canonicalization method specified by XMLDSIG is used.

4) Concatenate the resulting octets to those ones that come from processing previous `Include` elements present in the property.

The concatenated octets are the actual input to the digest computation. The time-stamp generated by the TSA can be either an ASN.1 data object (as defined in [11], use `EncapsulatedTimeStamp`), or it can be encoded as XML (use `XMLTimeStamp`). Since at the time being there is no standard for an XML time-stamp, we provide a placeholder for future use.

7.2 Properties for XAdES-BES and XAdES-EPES forms

This clause describes in detail the qualifying properties that can appear in XAdES-BES and XAdES-EPEST forms as described in clause 4.

7.2.1 The `SigningTime` element

The signing time property specifies the time at which the signer (purportedly) performed the signing process.

The XML Schema recommendation [5] defines an XML type `xsd:dateTime` that allows for the inclusion of the required information. This is the type selected for the `SigningTime` element.

This is a signed property that qualifies the whole signature.

At most one `SigningTime` element MAY be present in the signature.

Below follows the Schema definition for this element:

```
<xsd:element name="SigningTime" type="xsd:dateTime"/>
```

7.2.2 The `SigningCertificate` element

In many real life environments users will be able to get from different CAs or even from the same CA, different certificates containing the same public key for different names. The prime advantage is that a user can use the same private key for different purposes. Multiple use of the private key is an advantage when a smart card is used to protect the private key, since the storage of a smart card is always limited. When several CAs are involved, each different certificate may contain a different identity, e.g. as a national or as an employee from a company. Thus when a private key is used for various purposes, the certificate is needed to clarify the context in which the private key was used when generating the signature. Where there is the possibility of multiple use of private keys it is necessary for the signer to indicate to the verifier the precise certificate to be used.

Many current schemes simply add the certificate after the signed data and thus are subject to various substitution attacks. An example of a substitution attack is a "bad" CA that would issue a certificate to someone with the public key of someone else. If the certificate from the signer was simply appended to the signature and thus not protected by the signature, any one could substitute one certificate by another and the message would appear to be signed by some one else. In order to counter this kind of attack, the identifier of the certificate has to be protected by the digital signature from the signer.

The `SigningCertificate` property is designed to prevent the simple substitution of the certificate. This property contains references to certificates and digest values computed on them.

The certificate used to verify the signature SHALL be identified in the sequence; the signature policy MAY mandate other certificates be present, that MAY include all the certificates up to the point of trust.

This is a signed property that qualifies the signature.

At most `SigningCertificate` element MAY be present in the signature.

Below follows the Schema definition:

```
<xsd:element name="SigningCertificate" type="CertIDListType"/>

<xsd:complexType name="CertIDListType">
  <xsd:sequence>
    <xsd:element name="Cert" type="CertIDType"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="CertIDType">
  <xsd:sequence>
    <xsd:element name="CertDigest" type="DigestAlgAndValueType"/>
    <xsd:element name="IssuerSerial" type="ds:X509IssuerSerialType"/>
  </xsd:sequence>
  <xsd:attribute name="URI" type="xsd:anyURI" use="optional"/>
</xsd:complexType>

<xsd:complexType name="DigestAlgAndValueType">
  <xsd:sequence>
    <xsd:element ref="ds:DigestMethod"/>
    <xsd:element ref="ds:DigestValue"/>
  </xsd:sequence>
</xsd:complexType>
```

The `SigningCertificate` element contains the aforementioned sequence of certificate identifiers and digests computed on the certificates (`Cert` elements).

The element `IssuerSerial` contains the identifier of one of the certificates referenced in the sequence. Should the `ds:X509IssuerSerial` element appear in the signature to denote the same certificate, its value MUST be consistent with the corresponding `IssuerSerial` element.

The element `CertDigest` contains the digest of one of the certificates referenced in the sequence. It contains two elements: `ds:DigestMethod` indicates the digest algorithm and `ds:DigestValue` contains the value of the digest.

The optional `URI` attribute serves to indicate where the referenced certificate can be found.

7.2.3 The `SignaturePolicyIdentifier` element

The signature policy is a set of rules for the creation and validation of an electronic signature, under which the signature can be determined to be valid. A given legal/contractual context MAY recognize a particular signature policy as meeting its requirements.

The signature policy needs to be available in human readable form so that it can be assessed to meet the requirements of the legal and contractual context in which it is being applied.

To facilitate the automatic processing of an electronic signature the parts of the signature policy which specify the electronic rules for the creation and validation of the electronic signature also need to be in a computer processable form.

If no signature policy is identified then the signature may be assumed to have been generated/verified without any policy constraints, and hence may be given no specific legal or contractual significance through the context of a signature policy.

The present document specifies two unambiguous ways for identifying the signature policy that a signature follows:

- The electronic signature can contain an explicit and unambiguous identifier of a Signature Policy together with a hash value of the signature policy, so it can be verified that the policy selected by the signer is the one being used by the verifier. An explicit signature policy has a globally unique reference, which, in this way, is bound to an electronic signature by the signer as part of the signature calculation. In these cases, for a given explicit signature policy there shall be one definitive form that has a unique binary encoded value. Finally, a signature policy identified in this way MAY be qualified by additional information.

- Alternatively, the electronic signature can avoid the inclusion of the aforementioned identifier and hash value. This will be possible when the signature policy can be unambiguously derived from the semantics of the type of data object(s) being signed, and some other information, e.g. national laws or private contractual agreements, that mention that a given signature policy MUST be used for this type of data content. In such cases, the signature will contain a specific empty element indicating that this implied way to identify the signature policy is used instead the identifier and hash value.

The signature policy identifier is a signed property qualifying the signature.

At most one `SignaturePolicyIdentifier` element MAY be present in the signature.

Below follows the Schema definition for this type:

```
<xsd:element name="SignaturePolicyIdentifier"
type="SignaturePolicyIdentifierType"/>

<xsd:complexType name="SignaturePolicyIdentifierType">
  <xsd:choice>
    <xsd:element name="SignaturePolicyId" type="SignaturePolicyIdType"/>
    <xsd:element name="SignaturePolicyImplied"/>
  </xsd:choice>
</xsd:complexType>

<xsd:complexType name="SignaturePolicyIdType">
  <xsd:sequence>
    <xsd:element name="SigPolicyId" type="ObjectIdentifierType"/>
    <xsd:element ref="ds:Transforms" minOccurs="0"/>
    <xsd:element name="SigPolicyHash" type="DigestAlgAndValueType"/>
    <xsd:element name="SigPolicyQualifiers"
      type="SigPolicyQualifiersListType" minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="SigPolicyQualifiersListType">
  <xsd:sequence>
    <xsd:element name="SigPolicyQualifier" type="AnyType"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
```

The `SignaturePolicyId` element will appear when the signature policy is identified using the first alternative. The `SigPolicyId` element contains an identifier that uniquely identifies a specific version of the signature policy. The `SigPolicyHash` element contains the identifier of the hash algorithm and the hash value of the signature policy. The `SigPolicyQualifier` element can contain additional information qualifying the signature policy identifier. The optional `ds:Transforms` element can contain the transformations performed on the signature policy document before computing its hash. The processing model for these transformations is described in [3].

Alternatively, the `SignaturePolicyImplied` element will appear when the second alternative is used. This empty element indicates that the data object(s) being signed and other external data imply the signature policy.

7.2.3.1 Signature Policy qualifiers

Two qualifiers for the signature policy have been identified so far:

- a URL where a copy of the Signature Policy (SP) MAY be obtained;
- a user notice that should be displayed when the signature is verified.

Below follows the Schema definition for these two elements:

```
<xsd:element name="SPURI" type="xsd:anyURI"/>
<xsd:element name="SPUserNotice" type="SPUserNoticeType"/>

<xsd:complexType name="SPUserNoticeType">
  <xsd:sequence>
    <xsd:element name="NoticeRef" type="NoticeReferenceType"
      minOccurs="0"/>
    <xsd:element name="ExplicitText" type="xsd:string"
      minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="NoticeReferenceType">
  <xsd:sequence>
    <xsd:element name="Organization" type="xsd:string"/>
    <xsd:element name="NoticeNumbers" type="IntegerListType"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="IntegerListType">
  <xsd:sequence>
    <xsd:element name="int" type="xsd:integer" minOccurs="0"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
```

The `SPUserNotice` element is intended for being displayed whenever the signature is validated. The `ExplicitText` element contains the text of the notice to be displayed. Other notices could come from the organization issuing the signature policy. The `NoticeRef` element names an organization and identifies by numbers (`NoticeNumbers` element) a group of textual statements prepared by that organization, so that the application could get the explicit notices from a notices file.

7.2.4 The `CounterSignature` element

Some electronic signatures may only be valid if they bear more than one signature. This is the case generally when a contract is signed between two parties. The ordering of the signatures may or may not be important, i.e. one may or may not need to be applied before the other.

Several forms of multiple and counter signatures need to be supported, which fall into two basic categories:

- independent signatures;
- embedded signatures.

Independent signatures are parallel signatures where the ordering of the signatures is not important. Therefore an independent signature will not appear as a CounterSignature property of another independent one.

Embedded signatures are applied one after the other and are used where the order the signatures are applied is important. Multiple embedded signatures are supported using the `CounterSignature` unsigned property. Each countersignature is carried in one `Countersignature` element added to the `Signature` element to which the countersignature is applied.

In a qualified `Signature` the contents of the `CounterSignature` element are one or more signatures (i.e. `ds:Signature` elements) of the `SignatureValue` in the qualified `Signature`.

A countersignature can itself be qualified by a `CounterSignature` property. Thus it is possible to construct arbitrarily long series of countersignatures.

This is a unsigned property that qualifies the signature.

Below follows the Schema definition for this element:

```
<xsd:element name="CounterSignature" type="CounterSignatureType" />

<xsd:complexType name="CounterSignatureType">
  <xsd:sequence>
    <xsd:element ref="ds:Signature"/>
  </xsd:sequence>
</xsd:complexType>
```

Figure 2 shows a countersigned `Signature`:

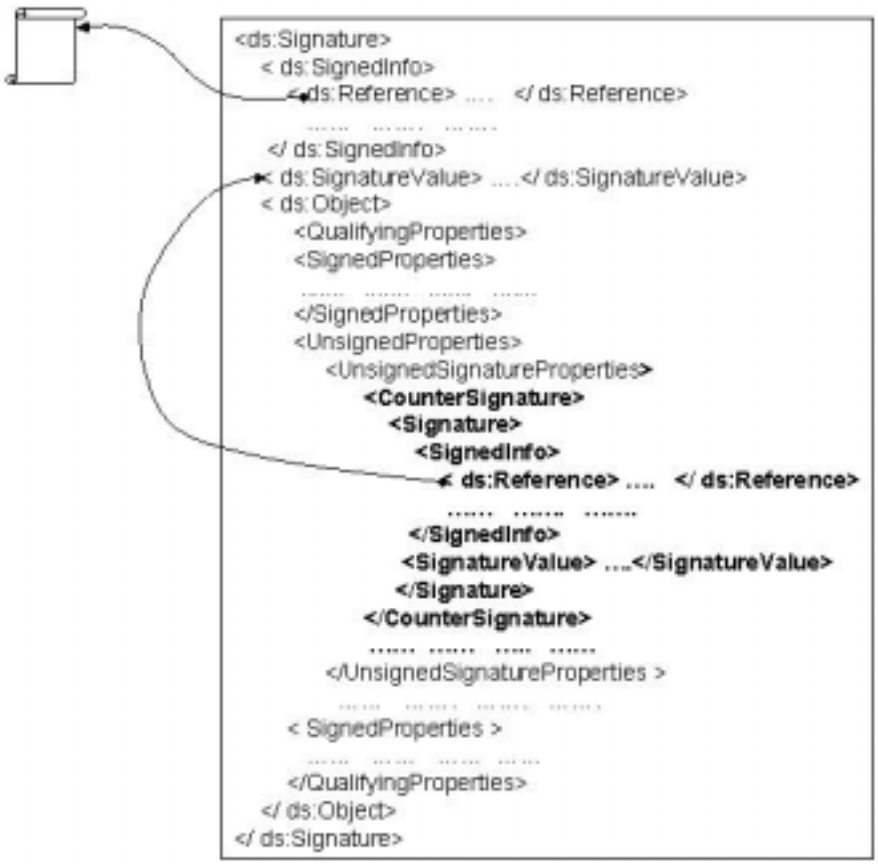


Figure 2: Use of CounterSignature element

7.2.5 The `DataObjectFormat` element

When presenting signed data to a human user it may be important that there is no ambiguity as to the presentation of the signed data object to the relying party. In order for the appropriate representation (text, sound or video) to be selected by the relying party a content hint MAY be indicated by the signer. If a relying party system does not use the format specified to present the data object to the relying party, the electronic signature may not be valid. Such a behaviour may have been established by the signature policy, for instance.

The `DataObjectFormat` element provides information that describes the format of the signed data object. This element SHOULD be present when the signed data is to be presented to human users on verification if the presentation format is not implicit within the data that has been signed. This is a signed property that qualifies one specific signed data object. In consequence, an XML electronic signature aligned with the present document MAY contain more than one `DataObjectFormat` elements, each one qualifying one signed data object.

Below follows the schema definition for this element:

```
<xsd:element name="DataObjectFormat" type="DataObjectFormatType"/>

<xsd:complexType name="DataObjectFormatType">
  <xsd:sequence>
    <xsd:element name="Description" type="xsd:string" minOccurs="0"/>
    <xsd:element name="ObjectIdentifier" type="ObjectIdentifierType"
     minOccurs="0"/>
    <xsd:element name="MimeType" type="xsd:string" minOccurs="0"/>
    <xsd:element name="Encoding" type="xsd:anyURI" minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="ObjectReference" type="xsd:anyURI"
   use="required"/>
</xsd:complexType>
```

The mandatory `ObjectReference` attribute MUST reference the `ds:Reference` element of the `ds:Signature` corresponding with the data object qualified by this property.

This element can convey:

- textual information related to the signed data object in element `Description`;
- an identifier indicating the type of the signed data object in element `ObjectIdentifier`;
- an indication of the MIME type of the signed data object in element `MimeType`;
- an indication of the encoding format of the signed data object in element `Encoding`.

At least one element of `Description`, `ObjectIdentifier` and `MimeType` MUST be present within the property.

7.2.6 The `CommitmentTypeIndication` element

The commitment type can be indicated in the electronic signature either:

- explicitly using a commitment type indication in the electronic signature;
- implicitly or explicitly from the semantics of the signed data object.

If the indicated commitment type is explicit by means of a commitment type indication in the electronic signature, acceptance of a verified signature implies acceptance of the semantics of that commitment type. The semantics of explicit commitment types indications shall be specified either as part of the signature policy or MAY be registered for generic use across multiple policies.

If a signature includes a commitment type indication other than one of those recognized under the signature policy the signature shall be treated as invalid.

How commitment is indicated using the semantics of the data object being signed is outside the scope of the present document.

The commitment type MAY be:

- defined as part of the signature policy, in which case the commitment type has precise semantics that is defined as part of the signature policy;
- a registered type, in which case the commitment type has precise semantics defined by registration, under the rules of the registration authority. Such a registration authority may be a trading association or a legislative authority.

The definition of a commitment type includes:

- the object identifier for the commitment;
- a sequence of qualifiers.

The qualifiers can provide more information about the commitment, it could provide, for example, information about the context be it contractual/legal/application specific.

If an electronic signature does not contain a recognized commitment type then the semantics of the electronic signature is dependent on the data object being signed and the context in which it is being used.

This is a signed property that qualifies signed data object(s). In consequence, an XML electronic signature aligned with the present document MAY contain more than one `CommitmentTypeIndication` elements.

Below follows the schema definition for this element:

```
<xsd:element name="CommitmentTypeIndication"
type="CommitmentTypeIndicationType"/>

<xsd:complexType name="CommitmentTypeIndicationType">
  <xsd:sequence>
    <xsd:element name="CommitmentTypeId"
      type="ObjectIdentifierType"/>
    <xsd:choice>
      <xsd:element name="ObjectReference" type="xsd:anyURI"
        minOccurs="0" maxOccurs="unbounded"/>
      < xsd:element name="AllSignedDataObjects"/>
    </xsd:choice>
    <xsd:element name="CommitmentTypeQualifiers"
     type="CommitmentTypeQualifiersListType" minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="CommitmentTypeQualifiersListType">
  <xsd:sequence>
    <xsd:element name="CommitmentTypeQualifier"
     type="AnyType" minOccurs="0" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
```

The `CommitmentTypeId` element univocally identifies the type of commitment made by the signer. A number of commitments have been already identified in TS 101 733 [1], namely:

- **Proof of origin** indicates that the signer recognizes to have created, approved and sent the signed data object. The URI for this commitment is http://uri.etsi.org/01903/v1.2.1#ProofOfOrigin.
- **Proof of receipt** indicates that signer recognizes to have received the content of the signed data object. The URI for this commitment is http://uri.etsi.org/01903/v1.2.1#ProofOfReceipt.
- **Proof of delivery** indicates that the TSP providing that indication has delivered a signed data object in a local store accessible to the recipient of the signed data object. The URI for this commitment is http://uri.etsi.org/01903/v1.2.1#ProofOfDelivery.
- **Proof of sender** indicates that the entity providing that indication has sent the signed data object (but not necessarily created it). The URI for this commitment is http://uri.etsi.org/01903/v1.2.1#ProofOfSender.
- **Proof of approval** indicates that the signer has approved the content of the signed data object. The URI for this commitment is http://uri.etsi.org/01903/v1.2.1#ProofOfApproval.
- **Proof of creation** indicates that the signer has created the signed data object (but not necessarily approved, nor sent it). The URI for this commitment is http://uri.etsi.org/01903/v1.2.1#ProofOfCreation.

One `ObjectReference` element refers to one `ds:Reference` element of the `ds:SignedInfo` corresponding with one data object qualified by this property. If some but not all the signed data objects share the same commitment, one `ObjectReference` element MUST appear for each one of them. However, if all the signed data objects share the same commitment, the `AllSignedDataObjects` empty element MUST be present.

The `CommitmentTypeQualifiers` element provides means to include additional qualifying information on the commitment made by the signer.

7.2.7 The `SignatureProductionPlace` element

In some transactions the purported place where the signer was at the time of signature creation MAY need to be indicated. In order to provide this information a new property MAY be included in the signature.

This property specifies an address associated with the signer at a particular geographical (e.g. city) location.

This is a signed property that qualifies the signer.

An XML electronic signature aligned with the present document MAY contain at most one `SignatureProductionPlace` element.

Below follows the schema definition for this element:

```
<xsd:element name="SignatureProductionPlace"
type="SignatureProductionPlaceType"/>

<xsd:complexType name="SignatureProductionPlaceType">
  <xsd:sequence>
    <xsd:element name="City" type="xsd:string" minOccurs="0"/>
    <xsd:element name="StateOrProvince" type="xsd:string"
      minOccurs="0"/>
    <xsd:element name="PostalCode" type="xsd:string" minOccurs="0"/>
    <xsd:element name="CountryName" type="xsd:string" minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>
```

7.2.8 The `SignerRole` element

While the name of the signer is important, the position of the signer within a company or an organization can be even more important. Some contracts may only be valid if signed by a user in a particular role, e.g. a Sales Director. In many cases who the sales Director really is, is not that important but being sure that the signer is empowered by his company to be the Sales Director is fundamental.

The present document defines two different ways for providing this feature:

- using a claimed role name;
- using an attribute certificate containing a *certified* role.

The signer MAY state his own role without any certificate to corroborate this claim. In which case the claimed role can be added to the signature as a signed qualifying property.

Unlike public key certificates that bind an identifier to a public key, Attribute Certificates bind the identifier of a certificate to some attributes of its owner, like a role. The Attribute Authority will be most of the time under the control of an organization or a company that is best placed to know which attributes are relevant for which individual. The Attribute Authority MAY use or point to public key certificates issued by any CA, provided that the appropriate trust may be placed in that CA. Attribute Certificates MAY have various periods of validity. That period may be quite short, e.g. one day. While this requires that a new Attribute Certificate is obtained every day, valid for that day, this can be advantageous since revocation of such certificates may not be needed. When signing, the signer will have to specify which Attribute Certificate it selects.

This is a signed property that qualifies the signer.

An XML electronic signature aligned with the present document MAY contain at most one `SignerRole` element.

Below follows the Schema definition for this element:

```
<xsd:element name="SignerRole" type="SignerRoleType"/>

<xsd:complexType name="SignerRoleType">
  <xsd:sequence>
    <xsd:element name="ClaimedRoles" type="ClaimedRolesListType"
      minOccurs="0"/>
    <xsd:element name="CertifiedRoles" type="CertifiedRolesListType"
      minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="ClaimedRolesListType">
  <xsd:sequence>
    <xsd:element name="ClaimedRole" type="AnyType"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="CertifiedRolesListType">
  <xsd:sequence>
    <xsd:element name="CertifiedRole" type="EncapsulatedPKIDataType"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
```

This property contains a sequence of roles that the signer can play (element `SignerRole`). At least one of the two elements `ClaimedRoles` or `CertifiedRoles` MUST be present.

The `ClaimedRoles` element contains a sequence of roles claimed by the signer but not certified. Additional contents types MAY be defined on a domain application basis and be part of this element. The namespaces given to the corresponding XML schemas will allow their unambiguous identification in the case these roles use XML.

The `CertifiedRoles` element contains one or more wrapped DER-encoded attribute certificates for the signer.

7.2.9 The `AllDataObjectsTimeStamp` element

The `AllDataObjectsTimeStamp` element contains the time-stamp computed before the signature production, over the sequence formed by ALL the `ds:Reference` elements within the `ds:SignedInfo` referencing whatever the signer wants to sign except the `SignedProperties` element.

The application MUST compose the `Include` elements to refer to all the `ds:Reference` elements except the one referencing the `SignedProperties` element. Their corresponding `referencedData` attribute MUST be present and set to `"true"`.

The `AllDataObjectsTimeStamp` element is a signed property.

Several instances of this property from different TSAs can occur within the same XAdES.

Below follows the schema definition for this element:

```
<xsd:element name="AllDataObjectsTimeStamp" type="TimeStampType"/>
```

7.2.10 The `IndividualDataObjectsTimeStamp` element

The `IndividualDataObjectsTimeStamp` element contains the time-stamp computed before the signature production, over a sequence formed by SOME `ds:Reference` elements within the `ds:SignedInfo`. Note that this sequence cannot contain a `ds:Reference` computed on the `SignedProperties` element.

The application MUST compose the `Include` elements to refer to those `ds:Reference` elements that are to be time-stamped. Their corresponding `referencedData` attribute MUST be present and set to `"true"`.

The `IndividualDataObjectsTimeStamp` element is a signed property that qualifies the signed data object(s).

Several instances of this property can occur within the same XAdES.

Below follows the schema definition for this element:

```
<xsd:element name="IndividualDataObjectsTimeStamp" type="TimeStampType"/>
```

7.3 The `SignatureTimeStamp` element

An important property for long standing signatures is that a signature, having been found once to be valid, shall continue to be so months or years later.

A signer, verifier or both MAY be required to provide on request, proof that a digital signature was created or verified during the validity period of the all the certificates that make up the certificate path. In this case, the signer, verifier or both will also be required to provide proof that all the user and CA certificates used were not revoked when the signature was created or verified.

It would be quite unacceptable, to consider a signature as invalid even if the keys or certificates were later compromised. Thus there is a need to be able to demonstrate that the signature key was valid around the time that the signature was created to provide long term evidence of the validity of a signature.

Time-stamping by a Time-Stamping Authority (TSA) can provide such evidence. A time-stamp is obtained by sending the hash value of the given data to the TSA. The returned time-stamp is a signed data object that contains the hash value, the identity of the TSA, and the time of stamping. This proves that the given data existed *before* the time of stamping.

Time-stamping an electronic signature before the revocation of the signer's private key and before the end of the validity of the certificate, provides evidence that the signature has been created while the certificate was valid and before it was revoked.

If a recipient wants to hold a valid electronic signature he will have to ensure that he has obtained a valid time-stamp for it, before that key (and any key involved in the validation) is revoked. The sooner the time-stamp is obtained after the signing time, the better.

It is important to note that signatures MAY be generated "off-line" and time-stamped at a later time by anyone, for example by the signer or any recipient interested in the value of the signature. The time-stamp can thus be provided by the signer together with the signed data object, or obtained by the recipient following receipt of the signed data object.

The validation mandated by the signature policy can specify a maximum acceptable time difference which is allowed between the time indicated in the `SigningTime` element and the time indicated by the `SignatureTimeStamp` element. If this delay is exceeded then the electronic signature shall be considered as invalid.

The `SignatureTimeStamp` encapsulates the time-stamp over the `ds:SignatureValue` element.

The `SignatureTimeStamp` element is an unsigned property qualifying the signature. A XAdES-T form MAY contain several `SignatureTimeSamp` elements, obtained from different TSAs.

Below follows the schema definition for this element:

```
<xsd:element name="SignatureTimeStamp" type="TimeStampType"/>
```

The application MUST compose one `Include` element with an URI referencing the `ds:SignatureValue` element. The input for the time-stamp has is, in consequence, the `ds:SignatureValue` element.

7.4 Properties for references to validation data

The following sub-clauses describe in detail qualifying properties that can contain references to certificates and revocation values that have been used in the validation of the electronic signature.

When dealing with long term electronic signatures, all the data used in the verification (namely, certificate path and revocation information) of such signatures MUST be stored and conveniently time-stamped as has been stated in clause 4 for arbitration purposes. Similar considerations apply to attribute certificates if they appear within the signature.

In some environments, it can be convenient to add these data to the electronic signature (as unsigned properties) for archival purposes (see electronic signature form for archival in clause B.3.3).

Alternatively, other systems can consider convenient, for the purpose of arbitration, to archive them elsewhere. In such cases each electronic signature MUST incorporate references to all these data within the signature, reducing accordingly the size of the stored electronic signature. This format builds up taking XAdES-T signature by incorporating additional data required for validation:

- the sequence of references to the full set of CA certificates that have been used to validate the electronic signature up to (but not including) the signer's certificate;
- a full set of references to the revocation data that have been used in the validation of the signer and CA certificates.

7.4.1 The `CompleteCertificateRefs` element

This clause defines the XML element able to carry the aforementioned references to the certificates: the `CompleteCertificateRefs` element.

This is an unsigned property that qualifies the signature.

An XML electronic signature aligned with the present document MAY contain at most one `CompleteCertificateRefs` element.

Below follows the schema definition for this element:

```
<xsd:element name="CompleteCertificateRefs"
type="CompleteCertificateRefsType"/>

<xsd:complexType name="CompleteCertificateRefsType">
  <xsd:sequence>
    <xsd:element name="CertRefs" type="CertIDListType" />
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The `CertRefs` element contains a sequence of `Cert` elements already defined in clause 7.2.2, incorporating the digest of each certificate and the issuer and serial number identifier.

7.4.2 The `CompleteRevocationRefs` element

As it was stated in the previous clause, the addition, to an electronic signature, of the full set of references to the revocation data that have been used in the validation of the signer and CAs certificates, provide means to retrieve the actual revocation data archived elsewhere in case of dispute and, in this way, to illustrate that the verifier has taken due diligence of the available revocation information.

Currently two major types of revocation data are managed in most of the systems, namely CRLs and responses of on-line certificate status servers, obtained through protocols designed for these purposes, like OCSP protocol.

This clause defines the `CompleteRevocationRefs` element that will carry the full set of revocation information used for the verification of the electronic signature.

This is an unsigned property that qualifies the signature.

An XML electronic signature aligned with the present document MAY contain at most one `CompleteRevocationRefs` element.

Below follows the Schema definition for this element:

```
<xsd:element name="CompleteRevocationRefs"
  type="CompleteRevocationRefsType"/>

<xsd:complexType name="CompleteRevocationRefsType">
  <xsd:sequence>
    <xsd:element name="CRLRefs" type="CRLRefsType" minOccurs="0"/>
    <xsd:element name="OCSPRefs" type="OCSPRefsType" minOccurs="0"/>
    <xsd:element name="OtherRefs" type="OtherCertStatusRefsType"
      minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>

<xsd:complexType name="CRLRefsType">
  <xsd:sequence>
    <xsd:element name="CRLRef" type="CRLRefType"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="CRLRefType">
  <xsd:sequence>
    <xsd:element name="DigestAlgAndValue"
      type="DigestAlgAndValueType"/>
    <xsd:element name="CRLIdentifier" type="CRLIdentifierType"
      minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="CRLIdentifierType">
  <xsd:sequence>
    <xsd:element name="Issuer" type="xsd:string"/>
    <xsd:element name="IssueTime" type="xsd:dateTime" />
    <xsd:element name="Number" type="xsd:integer"  minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="URI" type="xsd:anyURI" use="optional"/>
</xsd:complexType>

<xsd:complexType name="OCSPRefsType">
  <xsd:sequence>
    <xsd:element name="OCSPRef" type="OCSPRefType"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="OCSPRefType">
  <xsd:sequence>
    <xsd:element name="OCSPIdentifier" type="OCSPIdentifierType"/>
    <xsd:element name="DigestAlgAndValue"
      type="DigestAlgAndValueType"
      minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="OCSPIdentifierType">
  <xsd:sequence>
    <xsd:element name="ResponderID" type="xsd:string"/>
    <xsd:element name="ProducedAt" type="xsd:dateTime"/>
  </xsd:sequence>
  <xsd:attribute name="URI" type="xsd:anyURI" use="optional"/>
</xsd:complexType>

<xsd:complexType name="OtherCertStatusRefsType">
  <xsd:sequence>
    <xsd:element name="OtherRef" type="AnyType"
      maxOccurs="unbounded"/>
```

```
  </xsd:sequence>
</xsd:complexType>
```

The `CompleteRevocationRefs` element can contain:

- sequences of references to CRLs (`CRLRefs` element);
- sequences of references to `OCSPResponse` data as defined in [9] (`OCSPRefs` element);
- other references to alternative forms of revocation data (`OtherRefs` element).

Each element in a `CRLRefs` sequence (`CrlRef` element) identifies one CRL. This identification is made by means of:

- the digest of the entire DER encoded CRL (`DigestAlgAndValue` element);
- a set of data (`CRLIdentifier` element) including the issuer (`Issuer` element), the time when the CRL was issued (`IssueTime` element) and optionally the number of the CRL (`Number` element). The `Identifier` element can be dropped if the CRL could be inferred from other information. Its `URI` attribute could serve to indicate where the identified CRL is archived.

Each element in a `OCSPRefs` sequence (`OcspRef` element) identifies one OCSP response. This identification is made by means of:

- a set of data (`OCSPIdentifier` element) including the name of the server that has produced the referenced response (`ResponderID` element) and the time indication in the "ProducedAt" field of the referenced response (`ProducedAt` element). The optional `URI` attribute could serve to indicate where the OCSP response identified is archived;
- the digest computed on the DER encoded `OCSPResponse` as defined in [9] (`DigestAlgAndValue` element) response, since it MAY be needed to differentiate between two OCSP responses by the same server with their "ProducedAt" fields within the same second.

Alternative forms of validation data can be included in this property making use of the `OtherRefs` element, a sequence whose items (`OtherRef` elements) can contain any kind of information.

7.4.3 The `AttributeCertificateRefs` element

This clause defines the `AttributeCertificateRefs` element that will carry the references to the full set of Attribute Authorities certificates that have been used to validate the attribute certificate.

This property MAY be used only when a user attribute certificate is present in the signature within the signature. It is an unsigned property that qualifies the signature.

An XML electronic signature aligned with the present document MAY contain at most one `AttributeCertificateRefs` element.

Below follows the schema definition for this element:

```
<xsd:element name="AttributeCertificateRefs"
type="CompleteCertificateRefsType"/>
```

7.4.4 The `AttributeRevocationRefs` element

This property MAY be used only when a user attribute certificate is present in the signature within the signature.

This clause defines the `AttributeRevocationRefs` element able to carry the references to the full set of Attribute Certificate Revocation List and/or OCSP responses that have been used in the validation of the attribute certificate(s) present in the signature. This is an unsigned property that qualifies the signature.

An XML electronic signature aligned with the present document MAY contain at most one `AttributeRevocationRefs` element.

Below follows the schema definition for this element:

```
<xsd:element name="AttributeRevocationRefs"
type="CompleteRevocationRefsType"/>
```

7.5 Time-stamps on references to validation data

This clause discusses the suitability of time-stamping the references to validation data defined in clause 7.4.

Electronic signatures incorporating time-stamps on validation data references are needed when there is a requirement to safeguard against the possibility of a CA key in the certificate chain ever being compromised. A verifier MAY be required to provide on request, proof that the certification path and the revocation information used a the time of the signature were valid, even in the case where one of the issuing keys or OCSP responder keys is later compromised.

The current document defines two ways of using time-stamps to protect against this compromise:

- Time-stamp the sequence formed by the digital signature (`ds:Signature` element), the `SignatureTimeStamp` element when present in the XAdES-T form, the certification path references, the Attribute Authorities certificate references and the revocation status references (for both the certificates in the certification path and in the list of Attribute Authorities certificate), when an OCSP response is used to get the status of the certificate from the signer.

- Time-stamp only the references when CRLs are used to get the status of the certificate from the signer and the status of the attribute certificates present in the signature.

The signer, verifier or both MAY obtain the time-stamp.

7.5.1 The `SigAndRefsTimeStamp` element

When an OCSP response is used, it is necessary to time-stamp in particular that response in the case the key from the responder would be compromised. Since the information contained in the OCSP response is user specific and time specific, an individual time-stamp is needed for every signature received. Instead of placing the time-stamp only over the certification path references and the revocation information references, which include the OCSP response, the time-stamp is placed on the digital signature (`ds:Signature` element), the signature time-stamp(s) present in the XAdES-T form, the certification path references and the revocation status references. For the same cryptographic price, this will provide an integrity mechanism over the electronic signature. Any modification can be immediately detected. It should be noticed that other means of protecting/detecting the integrity of the electronic signature exist and could be used.

The `SigAndRefsTimeStamp` element is an unsigned property qualifying the signature. Clause B.3.1 proposes a XAdES form that can incorporate one or more `SigAndRefsTimeStamp` elements.

Below follows the schema definition for this element:

```
<xsd:element name="SigAndRefsTimeStamp" type="TimeStampType"/>
```

The application MUST compose the following sequence of `Include` elements:

- one `Include` element whose `URI` attribute references the `ds:SignatureValue` element of the qualified XMLDSIG signature;

- one `Include` element per each present `SignatureTimeStamp`. The `URI` attribute in each `Include` element will reference one `SignatureTimeStamp` element;

- one `Include` element whose `URI` attribute references the `CompleteCertificateRefs` property element;

- one `Include` element whose `URI` attribute references the `CompleteRevocationRefs` property element;

- one element whose `URI` attribute references the `AttributeCertificateRefs` element if this property is present;
- one element whose `URI` attribute references the `AttributeRevocationRefs` element if this property is present.

That is, the input for the timestamp hash computation is a sequence of the following XML elements:

(`ds:SignatureValue, SignatureTimeStamp+, CompleteCertificateRefs, CompleteRevocationRefs, AttributeCertificateRefs?, AttributeRevocationRefs?`).

7.5.2 The `RefsOnlyTimeStamp` element

Time-Stamping each ES with Complete Validation Data as defined above may not be efficient, particularly when the same set of CA certificates and CRL information is used to validate many signatures.

Time-Stamping CA certificates will stop any attacker from issuing bogus CA certificates that could be claimed to exist before the CA key was compromised. Any bogus time-stamped CA certificates will show that the certificate was created after the legitimate CA key was compromised. In the same way, time-stamping CA CRLs, will stop any attacker from issuing bogus CA CRLs which could be claimed to exist before the CA key was compromised.

Time-Stamping of commonly used certificates and CRLs can be done centrally, e.g. inside a company or by a service provider. This method reduces the amount of data the verifier has to time-stamp, for example it could reduce to just one time-stamp per day (i.e. in the case were all the signers use the same CA and the CRL applies for the whole day). The information that needs to be time-stamped is not the actual certificates and CRLs but the unambiguous references to those certificates and CRLs.

The hash sent to the TSA will be computed then over the concatenation of `CompleteCertificateRefs` and `CompleteRevocationRefs` elements.

The `RefsOnlyTimeStamp` element is an unsigned property qualifying the signature

Clause B.3.1 proposes a XAdES form that can incorporate one or more `RefsOnlyTimeStamp` elements.

Below follows the schema definition for this element:

```
<xsd:element name="RefsOnlyTimeStamp" type="TimeStampType"/>
```

The application MUST compose the following sequence of `Include` elements:

- one `Include` element whose `URI` attribute references the `CompleteCertificateRefs` property element;
- one `Include` element whose `URI` attribute references the `CompleteRevocationRefs` property element;
- one element whose `URI` attribute references the `AttributeCertificateRefs` element if this property is present;
- one element whose `URI` attribute references the `AttributeRevocationRefs` element if this property is present.

That is, the input for the timestamp hash computation is a sequence of the following XML elements:

(`CompleteCertificateRefs, CompleteRevocationRefs, AttributeCertificateRefs?, AttributeRevocationRefs?`))

7.6 Properties for validation data values

This clause describes in detail those properties that allow the incorporation of validation data values to the electronic signature. Clause B.3.2 proposes a XAdES form for adding these values to the electronic signature.

7.6.1 The CertificateValues Property element

A verifier will have to prove that the certification path was valid, at the time of the validation of the signature, up to a trust point according to the naming constraints and the certificate policy constraints from an optionally specified signature validation policy. It will be necessary to capture all the certificates from the certification path, starting with those from the signer and ending up with those of the certificate from one trusted root.

When dealing with long term electronic signatures, all the data used in the verification (including the certificate path) MUST be conveniently archived. In principle, the `CertificateValues` element contains the full set of certificates that have been used to validate the electronic signature, including the signer's certificate. However, it is not necessary to include one of those certificates into this property, if the certificate is already present in the `ds:KeyInfo` element of the signature. The `CertificateValues` element MAY also include the certification information for any TSUs that have provided the time-stamp tokens if these certificates are not already included in the time-stamp tokens as part of the TSUs signatures.

In fact, both the signer certificate and all certificates referenced in the `CompleteCertificateRefs` property (when present) element MUST be present either in the `ds:KeyInfo` element of the signature or in the `CertificateValues` property element. In addition, all the certificates referenced in AttributeCertificateRefs when present, MUST also be present in the `CertificateValues` element.

The `CertificateValues` is an unsigned property and qualifies the XML signature.

An XML electronic signature aligned with the present document MAY contain at most one `CertificateValues` element.

```
<xsd:element name="CertificateValues" type="CertificateValuesType"/>

<xsd:complexType name="CertificateValuesType">
    <xsd:choice minOccurs="0" maxOccurs="unbounded">
        <xsd:element name="EncapsulatedX509Certificate"
          type="EncapsulatedPKIDataType"/>
        <xsd:element name="OtherCertificate" type="AnyType"/>
    </xsd:choice>
    <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>
```

The `EncapsulatedX509Certificate` element is able to contain the base64 encoding of a DER-encoded X.509 certificate. The `OtherCertificate` element is a placeholder for potential future new formats of certificates.

7.6.2 The RevocationValues property element

One way of dealing with long term electronic signatures (for instance for arbitration purposes), is to store and conveniently time-stamp all the revocation data used in the verification of such signatures.

Currently two major types of revocation data are managed in most of the systems, namely CRLs and responses of on-line certificate status servers, obtained through protocols designed for these purposes, like OCSP protocol.

When using CRLs to get revocation information, a verifier will have to make sure that he or she gets at the time of the first verification the appropriate certificate revocation information from the signer's CA. This should be done as soon as possible, after the grace period (section 4.4.3.2 – Note 5), to minimize the time delay between the generation and verification of the signature. This involves checking that the signer certificate serial number is not included in the CRL. The signer, the verifier or any other third party may obtain either this CRL. If obtained by the signer, then it shall be conveyed to the verifier. Additional CRLs for the CA certificates in the certificate path MUST also be checked by the verifier. It MAY be convenient to archive these CRLs within an archived electronic signature for ease of subsequent verification or arbitration.

When using OCSP to get revocation information, a verifier will have to make sure that she or he gets at the time of the first verification an OCSP response that contains the status "valid". This should be done as soon as possible after the generation of the signature, after the grace period (section 4.4.3.2 – Note 5). The signer, the verifier or any other third party MAY fetch this OCSP response. Since OCSP responses are transient and thus are not archived by any TSP including CA, it is the responsibility of every verifier to make sure that it is stored in a safe place

The RevocationValues property element is used to hold the values of the revocation information which are to be shipped with the electronic signature. This property MAY also include the revocation data for any TSUs that have provided the time-stamp tokens if this information are not already included in the time-stamp token as part of the TSUs signatures.

This is a unsigned property that qualifies the signature.

An XML electronic signature aligned with the present document MAY contain at most one RevocationValues element.

Below follows the Schema definition for this element:

```
<xsd:element name="RevocationValues" type="RevocationValuesType"/>

<xsd:complexType name="RevocationValuesType">
  <xsd:sequence>
    <xsd:element name="CRLValues" type="CRLValuesType"
      minOccurs="0"/>
    <xsd:element name="OCSPValues" type="OCSPValuesType"
      minOccurs="0"/>
    <xsd:element name="OtherValues" type="OtherCertStatusValuesType"
      minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID"  use="optional"/>
</xsd:complexType>
```

Revocation information can include Certificate Revocation Lists (CRLValues) or responses from an online certificate status server (OCSPValues). Additionally a placeholder for other revocation information (OtherValues) is provided for future use.

```
<xsd:complexType name="CRLValuesType">
  <xsd:sequence>
     <xsd:element name="EncapsulatedCRLValue"
       type="EncapsulatedPKIDataType"
       maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
```

Certificate Revocation Lists (CRLValues) consist of a sequence of at least one Certificate Revocation List. Each EncapsulatedCRLValue will contain the base64 encoding of a DER-encoded X.509 CRL.

```
<xsd:complexType name="OCSPValuesType">
  <xsd:sequence>
      <xsd:element name="EncapsulatedOCSPValue"
        type="EncapsulatedPKIDataType" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
```

OCSP Responses (OCSPValues) consist of a sequence of at least one OCSP Response. The EncapsulatedOCSPValue element contains the base64 encoding of a DER-encoded OCSPResponse as defined in [9].

```
<xsd:complexType name="OtherCertStatusValuesType">
  <xsd:sequence>
    <xsd:element name="OtherValue" type="AnyType"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
```

The OtherValues element provides a placeholder for other revocation information that can be used in the future. The ObjectIdentifier element is used to specify the type of revocation information that is contained by the subsequent Value element.

7.7 The ArchiveTimeStamp element

Advances in computing increase the probability of being able to break algorithms and compromise keys. There is therefore a requirement to be able to protect electronic signatures against this possibility.

Over a period of time weaknesses may occur in the cryptographic algorithms used to create an electronic signature (e.g. due to the time available for cryptoanalysis, or improvements in cryptoanalytical techniques). Before such weaknesses become likely, a verifier should take extra measures to maintain the validity of the electronic signature. Several techniques could be used to achieve this goal depending on the nature of the weakened cryptography. In order to simplify matters, a single technique, called Archive validation data, covering all the cases is being presented in the present document.

Archive validation data consists of the complete validation data and the complete certificate and revocation data, time-stamped together with the electronic signature. The Archive validation data is necessary if the hash function and the crypto algorithms that were used to create the signature are no longer secure. Also, if it cannot be assumed that the hash function used by the Time-Stamping Authority is secure, then nested time-stamps of Archived Electronic Signature are required.

The potential for Trusted Service Provider (TSP) key compromise should be significantly lower than for user keys, because TSP(s) are expected to use stronger cryptography and better key protection. It can be expected that new algorithms (or old ones with greater key lengths) will be used. In such a case, a sequence of time-stamps will protect against forgery. Each time-stamp needs to be affixed before either the compromise of the signing key or of the cracking of the algorithms used by the TSA. TSAs (Time-Stamping Authorities) should have long keys (e.g. which at the time of drafting the present document was 2 048 bits for the signing RSA algorithm) and/or a "good" or different algorithm.

Nested time-stamps will also protect the verifier against key compromise or cracking the algorithm on the old electronic signatures.

The process will need to be performed and iterated before the cryptographic algorithms used for generating the previous time-stamp are no longer secure. Archive validation data MAY thus bear multiple embedded time-stamps.

The hash sent to the TSA (messageImprint) will be computed the sequence formed as explained below.

The `ArchiveTimeStamp` element is an unsigned property qualifying the signature. Below follows the schema definition for this element:

```
<xsd:element name="ArchiveTimeStamp" type="TimeStampType"/>
```

The application MUST compose the following sequence of `Include` elements:

- one `Include` element per each `ds:Reference` present within the `ds:SignedInfo` element. The `URI` attribute in each `Include` element will reference one of these `ds:Reference` elements. Their corresponding `referencedData` attribute MUST be present and set to `"true"`;
- one `Include` element whose `URI` attribute references the `ds:SignedInfo` element;
- one `Include` element whose `URI` attribute references the `ds:SignatureValue` element;
- one `Include` element whose `URI` attribute references the `ds:KeyInfo` element if this element is present;
- one `Include` element whose `URI` attribute references the `SignatureTimeStamp` element if this element is present;
- one `Include` element per each `CounterSignature` property, when present. The `URI` attribute of each `Include` element references one `CounterSignature` element;
- one `Include` element whose `URI` attribute references the `CompleteCertificateRefs` element if this element is present;
- one `Include` element whose `URI` attribute references the `CompleteRevocationRefs` element if this element is present;

- one `Include` element whose `URI` attribute references the `AttributeCertificateRefs` element if this element is present;
- one `Include` element whose `URI` attribute references the `AttributeRevocationRefs` element if this element is present;
- one `Include` element whose `URI` attribute references the `CertificateValues` element. This property MUST be added if it is not already present;
- one `Include` element whose `URI` attribute references the `RevocationValues` element. This property MUST be added if it is not already present;
- one `Include` element per each `SigAndRefsTimeStamp` element if these elements are present. The `URI` attribute in each `Include` element will reference one `SigAndRefsTimeStamp` element;
- one `Include` element per each `RefsOnlyTimeStamp` element if these elements are present. The `URI` attribute in each `Include` element will reference one `RefsOnlyTimeStamp` element;
- one `Include` element per each already present `XAdESArchiveTimestamp` element. The `URI` attribute in each `Include` element will reference one `XAdESArchiveTimestamp` element;
- one `Include` element per each present `ds:Object` element in the signature that is not referenced by any `ds:Reference` within `ds:SignedInfo`. The `URI` attribute in each `Include` element will reference one `ds:Object` element.

8 Conformance requirements

The present document defines conformance requirements for the generation of XAdES-BES and XAdES-EPES. At least one of these two forms must be implemented.

The present document defines conformance requirements for the verification of XAdES-BES and XAdES-EPES. At least one of the two forms must be implemented.

The present document only defines conformance requirements up to an XAdES electronic signature with complete validation data (XAdES-C). This means that none of the extended and archive forms of Electronic Signature, specified in annex B, need to be implemented to get conformance to the present document.

On verification the inclusion of optional signed and unsigned properties must be supported only to the extended that the signature is verifiable. The semantics of optional properties may be unsupported, unless specified otherwise by a signature policy.

8.1 Basic Electronic Signature (XAdES-BES)

A system supporting XAdES-BES signers according to the present document shall, at a minimum, support generation of a XML electronic signature consisting of the following components:

- The `ds:Signature` element as specified in [3].
- At least one of the following:
  - the `SigningCertificate` signed property (as defined in clause 7.2.2) incorporated to the signature as defined in clause 6.3;
  - the `ds:KeyInfo` element whose contents satisfy the restrictions specified in clause 4.3.1.

8.2 Explicit policy based Electronic Signature (XAdES-EPES)

A system supporting policy based signers according to the present document shall, at a minimum, support generation of XAdES-BES, plus:

- The `SignaturePolicyIdentifier` signed property (as defined in clause 7.2.3).

8.3 Verification using time-stamping

A system supporting verifiers according to the present document with time-stamping facilities shall, at a minimum, support:

- Verification of the mandated components of a XAdES-BES electronic signature, as defined in clause 8.1.
- `SignatureTimeStamp` unsigned property, as defined in clause 7.3.
- `CompleteCertificateReferences` unsigned property as defined in clause 7.4.1.
- `CompleteRevocationReferences` unsigned property, as defined in clause 7.4.2.
- Public Key Certificates, as defined in ITU-T Recommendation X.509 [6] (see clause 8.1).
- Either of:
  - Certificate Revocation Lists. as defined in ITU-T Recommendation X.509 [6] (see clause 8.2); or
  - On-line Certificate Status Protocol, as defined in RFC 2560 [9] (see clause 8.3).

8.4 Verification using secure records

A system supporting verifiers according to the present document shall, at a minimum, support:

- Verification of the mandated components of a XAdES-BES, as defined in clause 8.1.
- `CompleteCertificateReferences` unsigned property as defined in clause 7.4.1.
- `CompleteRevocationReferences` unsigned property, as defined in clause 7.4.2.
- A record must be maintained and cannot be undetectable modified, of the electronic signature and the time when the signature was first validated using the referenced certificates and revocation information.
- Public Key Certificates, as defined in ITU-T Recommendation X.509 [6] (see clause 8.1).
- Either of:
  - Certificate Revocation Lists. as defined in ITU-T Recommendation X.509 [6] (see clause 8.2); or
  - On-line Certificate Status Protocol, as defined in RFC 2560 [9](see clause 8.3).

Annex A (informative): Definitions

Data Object (Content/Document) (source W3C/IETF Recommendation February 2002: "XML-Signature Syntax and Processing")

The actual binary/octet data being operated on (transformed, digested or signed) by an application, frequently an HTTP entity. Note that the proper noun Object designates a specific XML element. Occasionally we refer to a data object as a document or as a resource's content. The term element content is used to describe the data between XML start and end tags. The term XML document is used to describe data objects which conform to the XML specification.

Signature (source W3C/IETF Recommendation February 2002: "XML-Signature Syntax and Processing")

Formally speaking, a value generated from the application of a private key to a message via a cryptographic algorithm such that it has the properties of signer authentication and message authentication (integrity). (However, we sometimes use the term signature generically such that it encompasses AuthenticationCode values as well, but we are careful to make the distinction when the property of AuthenticationSigner is relevant to the exposition.) A signature may be (non-exclusively) described as detached, enveloping or enveloped.

Transform (source W3C/IETF Recommendation February 2002: "XML-Signature Syntax and Processing")

The processing of a data from its source to its derived form. Typical transforms include XML Canonicalization, XPath and XSLT.

Attribute Certificate (source ITU-T Recommendation X.509 [6]:"DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS.DIRECTORY")

A set of attributes of a user together with some other information, rendered unforgeable by the digital signature created using the private key of the certification authority which issued it.

Annex B (informative): Extended electronic signature forms

The XAdES forms specified in clause 4.3 can be extended by addition of certain unsigned properties that are defined in the present document. These properties are applicable for very long term verification, and for preventing some disaster situations which have been identified in the normative part of the present document. The clauses below give an overview of the various forms of extended signature formats in the present document.

B.1 Extended signatures with time forms (XAdES-X)

Extended signatures with time indication forms (XAdES-X) in accordance with the present document build on signatures containing `CompleteCertificateRefs` and `CompleteRevocationRefs` properties, by adding one or more time-stamps unsigned properties.

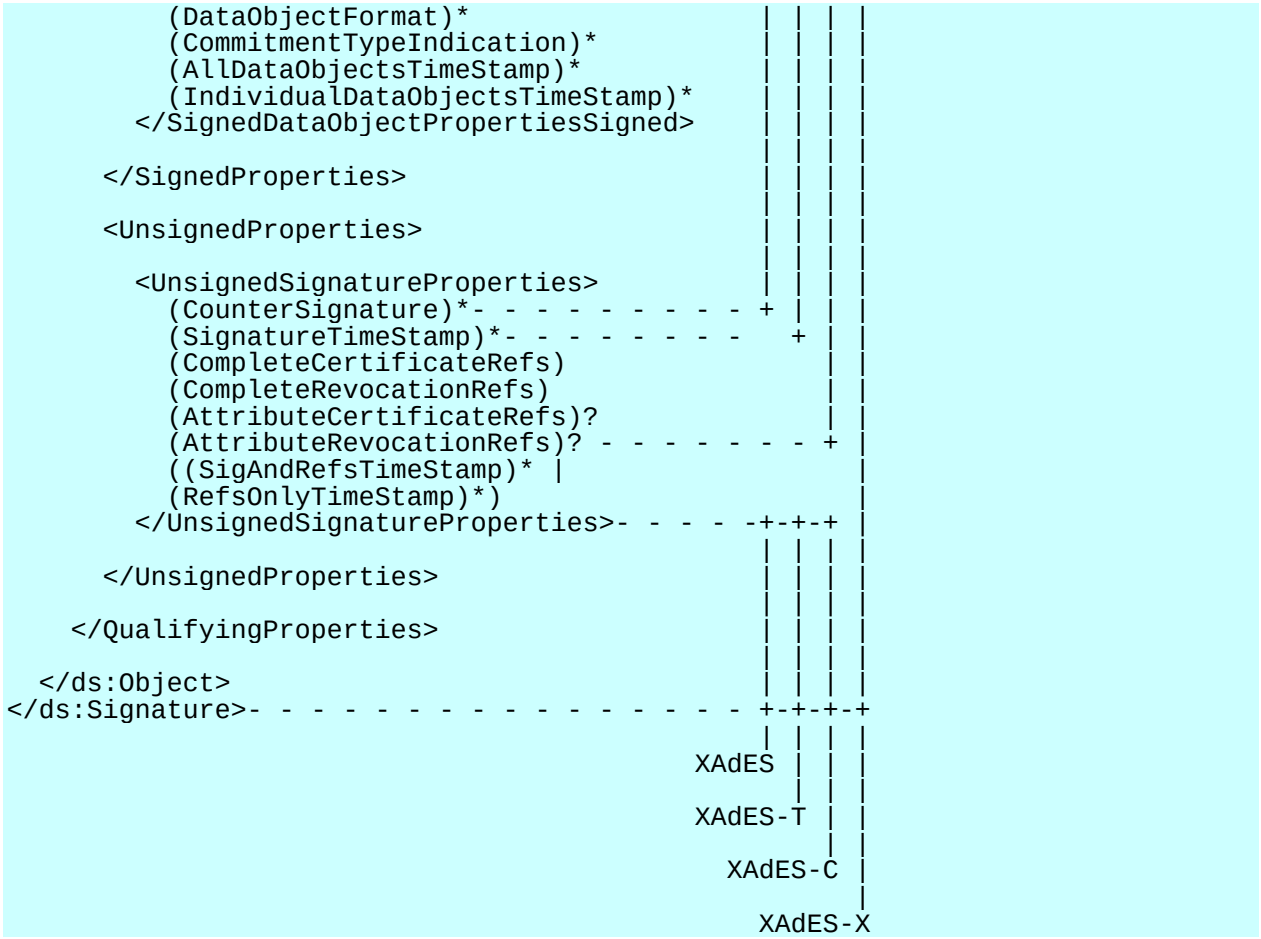
Depending of what is time-stamped, there are two different types of XAdES-X signatures, namely, XAdES-X type 1 and XAdES-X type 2. Time-stamps in both types cover, among other elements, `CompleteCertificateRefs` and `CompleteRevocationRefs` properties. Time-stamps provide an integrity and trusted time protection over everything that is time-stamped. They protect the referenced certificates, CRLs and OCSP responses in case of a later compromise of a CA key, CRL key or OCSP issuer key.

XAdES-X type 1 is built by adding one or more `SigAndRefsTimeStamp` properties each containing one time-stamp obtained from different TSAs. These time-stamps are computed on the `SignatureValue` element, `SignatureTimeStamp` if present, `CompleteCertificateRefs` and `CompleteRevocationRefs` properties.

XAdES-X type 2 is built by adding one or more `RefsOnlyTimeStamp` properties each containing one time-stamp obtained from different TSAs. These time-stamps are computed on the `CompleteCertificateRefs` and `CompleteRevocationRefs` properties.

Below follows the most complete XAdES-X structure, which builds on a XAdES-C signature:

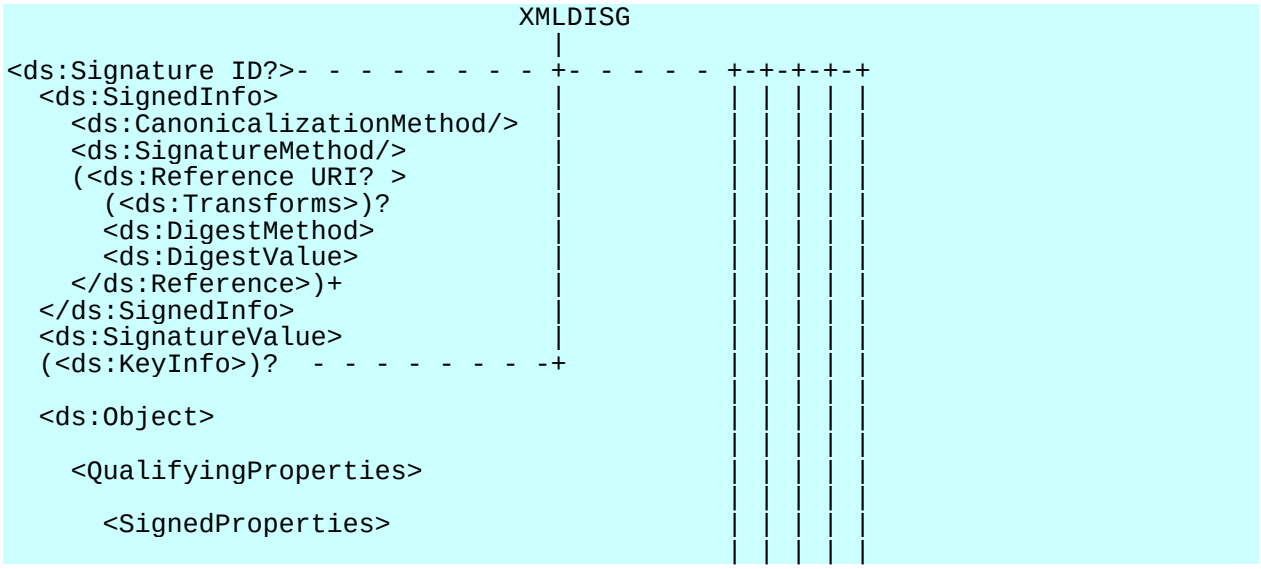
```
                              XMLDISG
                                |
<ds:Signature ID?>- - - - - - - +- - - - - - +-+-+-+
  <ds:SignedInfo>               |           | | | |
    <ds:CanonicalizationMethod/>|           | | | |
    <ds:SignatureMethod/>       |           | | | |
    (<ds:Reference URI? >       |           | | | |
      (<ds:Transforms>)?        |           | | | |
      <ds:DigestMethod>         |           | | | |
      <ds:DigestValue>          |           | | | |
    </ds:Reference>)+           |           | | | |
  </ds:SignedInfo>              |           | | | |
  <ds:SignatureValue>           |           | | | |
  (<ds:KeyInfo>)? - - - - - - - +           | | | |
                                            | | | |
  <ds:Object>                               | | | |
                                            | | | |
    <QualifyingProperties>                  | | | |
                                            | | | |
      <SignedProperties>                    | | | |
                                            | | | |
        <SignedSignatureProperties>         | | | |
          (SigningTime)?                    | | | |
          (SigningCertificate)?             | | | |
          (SignaturePolicyIdentifier)?      | | | |
          (SignatureProductionPlace)?       | | | |
          (SignerRole)?                     | | | |
        </SignedSignatureProperties>        | | | |
                                            | | | |
        <SignedDataObjectProperties>        | | | |
```

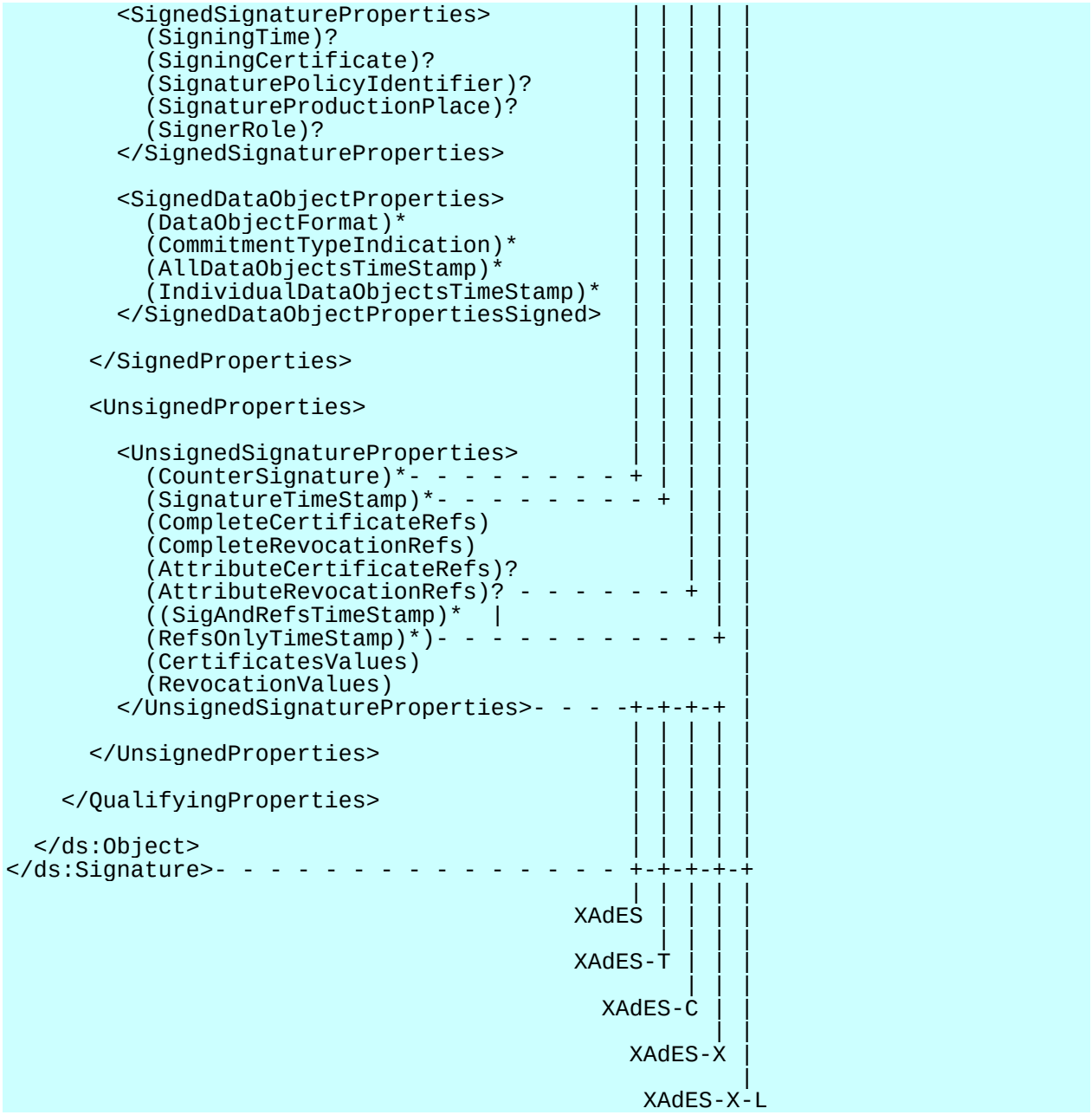


B.2 Extended long electronic signatures with time (XAdES-X-L)

Extended long electronic signatures with time (XAdES-X-L) forms in accordance with the present document build up on XAdES-X types 1 or 2 by adding the `CertificateValues` and `RevocationValues` unsigned properties aforementioned.

The structure for the most complete XAdES-X-L, built on the most complete XAdES-X signature, is shown below:

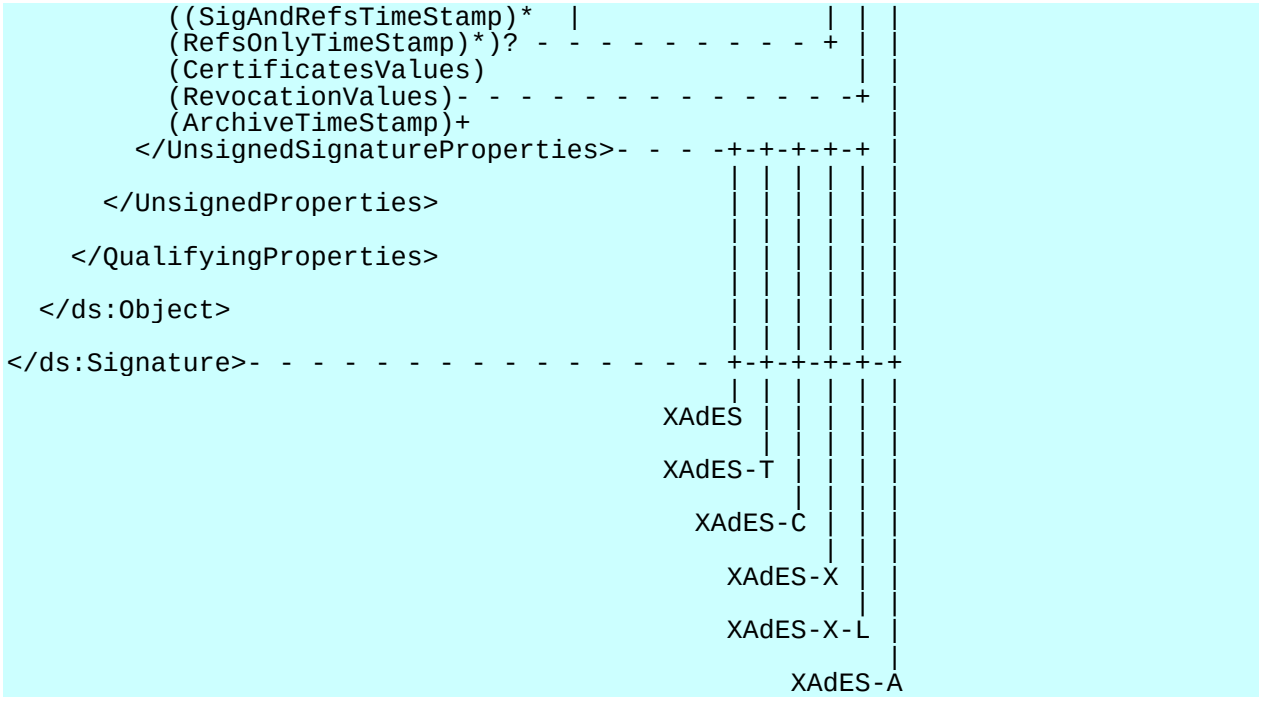




B.3 Archival electronic signatures (XAdES-A)

Archival signatures in accordance with the present document MUST incorporate `CertificateValues`, `RevocationValues` and one or more `ArchiveTimeStamp` unsigned properties. They MAY contain other properties. Each `ArchiveTimeStamp` element contains a time-stamp token covering among other elements, those ones that contain validation data (see clause 7.7). These forms are used for archival of signatures. Successive time-stamps protect the whole material against vulnerable hashing algorithms or the breaking of the cryptographic material or algorithms.

Below follows the structure of a XAdES-A built on a XAdES-X-L, as an example of the most complete archival form:


((SigAndRefsTimeStamp)*
(RefsOnlyTimeStamp)*)?
(CertificatesValues)
(RevocationValues)
(ArchiveTimeStamp)+
</UnsignedSignatureProperties>
</UnsignedProperties>
</QualifyingProperties>
</ds:Object>
</ds:Signature>
XAdES
XAdES-T
XAdES-C
XAdES-X
XAdES-X-L
XAdES-A

Annex C (normative): Schema definitions

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema targetNamespace="http://uri.etsi.org/01903/v1.2.1#"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns="http://uri.etsi.org/01903/v1.2.1#"
xmlns:ds="http://www.w3.org/2000/09/xmldsig#" elementFormDefault="qualified">

  <xsd:import namespace="http://www.w3.org/2000/09/xmldsig#"
schemaLocation="http://www.w3.org/TR/2002/REC-xmldsig-core-20020212/xmldsig-
core-schema.xsd">

<!-- Start auxiliary types definitions: AnyType, ObjectIdentifierType,
EncapsulatedPKIDataType and TimestampType-->

<!-- Start AnyType -->

  <xsd:element name="Any" type="AnyType"/>
  <xsd:complexType name="AnyType" mixed="true">
    <xsd:sequence minOccurs="0" maxOccurs="unbounded">
      <xsd:any namespace="##any" processContents="lax"/>
    </xsd:sequence>
    <xsd:anyAttribute namespace="##any"/>
  </xsd:complexType>

<!-- End AnyType -->

<!-- Start ObjectIdentifierType-->

  <xsd:element name="ObjectIdentifier" type="ObjectIdentifierType"/>
  <xsd:complexType name="ObjectIdentifierType">
    <xsd:sequence>
      <xsd:element name="Identifier" type="IdentifierType"/>
      <xsd:element name="Description" type="xsd:string" minOccurs="0"/>
      <xsd:element name="DocumentationReferences"
type="DocumentationReferencesType" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:complexType name="IdentifierType">
    <xsd:simpleContent>
      <xsd:extension base="xsd:anyURI">
        <xsd:attribute name="Qualifier" type="QualifierType"
use="optional"/>
      </xsd:extension>
    </xsd:simpleContent>
  </xsd:complexType>
  <xsd:simpleType name="QualifierType">
    <xsd:restriction base="xsd:string">
      <xsd:enumeration value="OIDAsURI"/>
      <xsd:enumeration value="OIDAsURN"/>
    </xsd:restriction>
  </xsd:simpleType>
  <xsd:complexType name="DocumentationReferencesType">
    <xsd:sequence maxOccurs="unbounded">
      <xsd:element name="DocumentationReference" type="xsd:anyURI"/>
    </xsd:sequence>
  </xsd:complexType>

<!-- End ObjectIdentifierType-->

<!-- Start EncapsulatedPKIDataType-->

  <xsd:element name="EncapsulatedPKIData" type="EncapsulatedPKIDataType"/>
  <xsd:complexType name="EncapsulatedPKIDataType">
    <xsd:simpleContent>
      <xsd:extension base="xsd:base64Binary">
```

```
          <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
        </xsd:extension>
      </xsd:simpleContent>
    </xsd:complexType>

<!-- End EncapsulatedPKIDataType -->

<!-- Start TimeStampType -->

    <xsd:element name="TimeStamp" type="TimeStampType"/>
    <xsd:complexType name="TimeStampType">
      <xsd:sequence>
        <xsd:element name="Include" type="IncludeType" maxOccurs="unbounded"/>
        <xsd:element ref="ds:CanonicalizationMethod" minOccurs="0"/>
        <xsd:choice>
          <xsd:element name="EncapsulatedTimeStamp"
type="EncapsulatedPKIDataType"/>
          <xsd:element name="XMLTimeStamp" type="AnyType"/>
        </xsd:choice>
      </xsd:sequence>
      <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
    </xsd:complexType>

    <xsd:complexType name="IncludeType">
      <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
      <xsd:attribute name="referencedData" type="xsd:boolean" use="optional"/>
    </xsd:complexType>

<!-- End TimeStampType -->

<!-- End auxiliary types definitions-->

<!-- Start container types -->

<!-- Start QualifyingProperties -->

    <xsd:element name="QualifyingProperties" type="QualifyingPropertiesType"/>

    <xsd:complexType name="QualifyingPropertiesType">
      <xsd:sequence>
        <xsd:element name="SignedProperties" type="SignedPropertiesType"
minOccurs="0"/>
        <xsd:element name="UnsignedProperties" type="UnsignedPropertiesType"
minOccurs="0"/>
      </xsd:sequence>
      <xsd:attribute name="Target" type="xsd:anyURI" use="required"/>
      <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
    </xsd:complexType>

<!-- End QualifyingProperties -->

<!-- Start SignedProperties-->

    <xsd:element name="SignedProperties" type="SignedPropertiesType"/>

    <xsd:complexType name="SignedPropertiesType">
      <xsd:sequence>
        <xsd:element name="SignedSignatureProperties"
type="SignedSignaturePropertiesType"/>
        <xsd:element name="SignedDataObjectProperties"
type="SignedDataObjectPropertiesType" minOccurs="0"/>
      </xsd:sequence>
      <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
    </xsd:complexType>

<!-- End SignedProperties-->

<!-- Start UnsignedProperties-->

<xsd:element name="UnsignedProperties" type="UnsignedPropertiesType" />
```

```
  <xsd:complexType name="UnsignedPropertiesType">
    <xsd:sequence>
      <xsd:element name="UnsignedSignatureProperties"
        type="UnsignedSignaturePropertiesType" minOccurs="0"/>
        <xsd:element name="UnsignedDataObjectProperties"
          type="UnsignedDataObjectPropertiesType" minOccurs="0"/>
    </xsd:sequence>
    <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
  </xsd:complexType>

<!-- End UnsignedProperties-->

<!-- Start SignedSignatureProperties-->

<xsd:element name="SignedSignatureProperties"
  type="SignedSignaturePropertiesType" />

<xsd:complexType name="SignedSignaturePropertiesType">
  <xsd:sequence>
    <xsd:element name="SigningTime" type="xsd:dateTime" minOccurs="0"/>
    <xsd:element name="SigningCertificate" type="CertIDListType"
minOccurs="0"/>
    <xsd:element name="SignaturePolicyIdentifier"
type="SignaturePolicyIdentifierType" minOccurs="0"/>
    <xsd:element name="SignatureProductionPlace"
type="SignatureProductionPlaceType"
     minOccurs="0"/>
    <xsd:element name="SignerRole" type="SignerRoleType" minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<!-- End SignedSignatureProperties-->


<!-- Start SignedDataObjectProperties-->

<xsd:element name="SignedDataObjectProperties"
  type="SignedDataObjectPropertiesType"/>

<xsd:complexType name="SignedDataObjectPropertiesType">
  <xsd:sequence>
    <xsd:element name="DataObjectFormat" type="DataObjectFormatType"
      minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="CommitmentTypeIndication"
      type="CommitmentTypeIndicationType" minOccurs="0"
      maxOccurs="unbounded"/>
    <xsd:element name="AllDataObjectsTimeStamp" type="TimeStampType"
      minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="IndividualDataObjectsTimeStamp" type="TimeStampType"
      minOccurs="0" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<!-- End SignedDataObjectProperties-->


<!-- Start UnsignedSignatureProperties-->

<xsd:element name="UnsignedSignatureProperties"
  type="UnsignedSignaturePropertiesType"/>

<xsd:complexType name="UnsignedSignaturePropertiesType">
  <xsd:sequence>
    <xsd:element name="CounterSignature" type="CounterSignatureType"
      minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="SignatureTimeStamp" type="TimeStampType"
      minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="CompleteCertificateRefs"
      type="CompleteCertificateRefsType" minOccurs="0"/>
    <xsd:element name="CompleteRevocationRefs"
      type="CompleteRevocationRefsType" minOccurs="0"/>
```

```
    <xsd:element name="AttributeCertificateRefs"
      type="CompleteCertificateRefsType" minOccurs="0"/>
    <xsd:element name="AttributeRevocationRefs"
      type="CompleteRevocationRefsType" minOccurs="0"/>
    <xsd:choice>
      <xsd:element name="SigAndRefsTimeStamp" type="TimeStampType"
        minOccurs="0" maxOccurs="unbounded"/>
      <xsd:element name="RefsOnlyTimeStamp" type="TimeStampType"
        minOccurs="0" maxOccurs="unbounded"/>
    </xsd:choice>
    <xsd:element name="CertificateValues"
      type="CertificateValuesType" minOccurs="0"/>
    <xsd:element name="RevocationValues" type="RevocationValuesType"
      minOccurs="0"/>
    <xsd:element name="ArchiveTimeStamp" type="TimeStampType"
      minOccurs="0" maxOccurs="unbounded"/>
  </xsd:sequence>
  </xsd:complexType>


<!-- End UnsignedSignatureProperties-->


<!-- Start UnsignedDataObjectProperties-->

<xsd:element name="UnsignedDataObjectProperties"
  type="UnsignedDataObjectPropertiesType" />

<xsd:complexType name="UnsignedDataObjectPropertiesType">
  <xsd:sequence>
    <xsd:element name="UnsignedDataObjectProperty" type="AnyType"
      minOccurs="0" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<!-- End UnsignedDataObjectProperties-->

<!-- Start QualifyingPropertiesReference-->

<xsd:element name="QualifyingPropertiesReference"
  type="QualifyingPropertiesReferenceType"/>

<xsd:complexType name="QualifyingPropertiesReferenceType">
  <xsd:sequence>
    <xsd:element ref="ds:Transforms" minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>

<!-- End QualifyingPropertiesReference-->

<!-- End container types -->


<!-- Start SigningTime element -->
  <xsd:element name="SigningTime" type="xsd:dateTime"/>

<!-- End SigningTime element -->

<!-- Start SigningCertificate -->
  <xsd:element name="SigningCertificate" type="CertIDListType"/>
  <xsd:complexType name="CertIDListType">
    <xsd:sequence>
      <xsd:element name="Cert" type="CertIDType" maxOccurs="unbounded"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:complexType name="CertIDType">
    <xsd:sequence>
      <xsd:element name="CertDigest" type="DigestAlgAndValueType"/>
      <xsd:element name="IssuerSerial" type="ds:X509IssuerSerialType"/>
```

```
      </xsd:sequence>
      <xsd:attribute name="URI" type="xsd:anyURI" use="optional"/>
    </xsd:complexType>
    <xsd:complexType name="DigestAlgAndValueType">
      <xsd:sequence>
        <xsd:element ref="ds:DigestMethod"/>
        <xsd:element ref="ds:DigestValue"/>
      </xsd:sequence>
    </xsd:complexType>

<!-- End SigningCertificate -->

<!-- Start SignaturePolicyIdentifier -->

    <xsd:element name="SignaturePolicyIdentifier"
type="SignaturePolicyIdentifierType"/>
    <xsd:complexType name="SignaturePolicyIdentifierType">
      <xsd:choice>
        <xsd:element name="SignaturePolicyId" type="SignaturePolicyIdType"/>
        <xsd:element name="SignaturePolicyImplied"/>
      </xsd:choice>
    </xsd:complexType>
    <xsd:complexType name="SignaturePolicyIdType">
      <xsd:sequence>
        <xsd:element name="SigPolicyId" type="ObjectIdentifierType"/>
        <xsd:element ref="ds:Transforms" minOccurs="0"/>
        <xsd:element name="SigPolicyHash" type="DigestAlgAndValueType"/>
        <xsd:element name="SigPolicyQualifiers"
type="SigPolicyQualifiersListType" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="SigPolicyQualifiersListType">
      <xsd:sequence>
        <xsd:element name="SigPolicyQualifier" type="AnyType"
maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:complexType>
    <xsd:element name="SPURI" type="xsd:anyURI"/>
    <xsd:element name="SPUserNotice" type="SPUserNoticeType"/>
    <xsd:complexType name="SPUserNoticeType">
      <xsd:sequence>
        <xsd:element name="NoticeRef" type="NoticeReferenceType"
minOccurs="0"/>
        <xsd:element name="ExplicitText" type="xsd:string" minOccurs="0"/>
      </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="NoticeReferenceType">
      <xsd:sequence>
        <xsd:element name="Organization" type="xsd:string"/>
        <xsd:element name="NoticeNumbers" type="IntegerListType"/>
      </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="IntegerListType">
      <xsd:sequence>
        <xsd:element name="int" type="xsd:integer" minOccurs="0"
maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:complexType>

<!-- End SignaturePolicyIdentifier -->


<!-- Start CounterSignature -->
    <xsd:element name="CounterSignature" type="CounterSignatureType"/>
    <xsd:complexType name="CounterSignatureType">
      <xsd:sequence>
        <xsd:element ref="ds:Signature"/>
      </xsd:sequence>
    </xsd:complexType>

<!-- End CounterSignature -->
```

```
<!-- Start DataObjectFormat -->

  <xsd:element name="DataObjectFormat" type="DataObjectFormatType"/>
  <xsd:complexType name="DataObjectFormatType">
    <xsd:sequence>
      <xsd:element name="Description" type="xsd:string" minOccurs="0"/>
      <xsd:element name="ObjectIdentifier" type="ObjectIdentifierType"
minOccurs="0"/>
      <xsd:element name="MimeType" type="xsd:string" minOccurs="0"/>
      <xsd:element name="Encoding" type="xsd:anyURI" minOccurs="0"/>
    </xsd:sequence>
    <xsd:attribute name="ObjectReference" type="xsd:anyURI" use="required"/>
  </xsd:complexType>

<!-- End DataObjectFormat -->

<!-- Start CommitmentTypeIndication -->

  <xsd:element name="CommitmentTypeIndication"
type="CommitmentTypeIndicationType"/>
  <xsd:complexType name="CommitmentTypeIndicationType">
    <xsd:sequence>
      <xsd:element name="CommitmentTypeId" type="ObjectIdentifierType"/>
      <xsd:choice>
        <xsd:element name="ObjectReference" type="xsd:anyURI" minOccurs="0"
maxOccurs="unbounded"/>
        <xsd:element name="AllSignedDataObjects"/>
      </xsd:choice>
      <xsd:element name="CommitmentTypeQualifiers"
type="CommitmentTypeQualifiersListType" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:complexType name="CommitmentTypeQualifiersListType">
    <xsd:sequence>
      <xsd:element name="CommitmentTypeQualifier" type="AnyType"
minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
  </xsd:complexType>

<!-- End CommitmentTypeIndication -->

<!-- Start SignatureProductionPlace -->

  <xsd:element name="SignatureProductionPlace"
type="SignatureProductionPlaceType"/>
  <xsd:complexType name="SignatureProductionPlaceType">
    <xsd:sequence>
      <xsd:element name="City" type="xsd:string" minOccurs="0"/>
      <xsd:element name="StateOrProvince" type="xsd:string" minOccurs="0"/>
      <xsd:element name="PostalCode" type="xsd:string" minOccurs="0"/>
      <xsd:element name="CountryName" type="xsd:string" minOccurs="0"/>
    </xsd:sequence>
  </xsd:complexType>

<!-- End SignatureProductionPlace -->

<!-- Start SignerRole -->

<xsd:element name="SignerRole" type="SignerRoleType"/>
<xsd:complexType name="SignerRoleType">
  <xsd:sequence>
    <xsd:element name="ClaimedRoles" type="ClaimedRolesListType"
      minOccurs="0"/>
    <xsd:element name="CertifiedRoles" type="CertifiedRolesListType"
      minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="ClaimedRolesListType">
  <xsd:sequence>
```

```
    <xsd:element name="ClaimedRole" type="AnyType" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="CertifiedRolesListType">
  <xsd:sequence>
    <xsd:element name="CertifiedRole" type="EncapsulatedPKIDataType"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<!-- End SignerRole -->


   <xsd:element name="AllDataObjectsTimeStamp" type="TimeStampType"/>

   <xsd:element name="IndividualDataObjectsTimeStamp" type="TimeStampType"/>

   <xsd:element name="SignatureTimeStamp" type="TimeStampType"/>

<!-- Start CompleteCertificateRefs -->

<xsd:element name="CompleteCertificateRefs"
type="CompleteCertificateRefsType"/>

<xsd:complexType name="CompleteCertificateRefsType">
  <xsd:sequence>
    <xsd:element name="CertRefs" type="CertIDListType" />
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>

<!-- End CompleteCertificateRefs -->


<!-- Start CompleteRevocationRefs-->

<xsd:element name="CompleteRevocationRefs"
type="CompleteRevocationRefsType"/>

<xsd:complexType name="CompleteRevocationRefsType">
  <xsd:sequence>
    <xsd:element name="CRLRefs" type="CRLRefsType" minOccurs="0"/>
    <xsd:element name="OCSPRefs" type="OCSPRefsType" minOccurs="0"/>
    <xsd:element name="OtherRefs" type="OtherCertStatusRefsType"
minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>

<xsd:complexType name="CRLRefsType">
  <xsd:sequence>
    <xsd:element name="CRLRef" type="CRLRefType" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="CRLRefType">
  <xsd:sequence>
    <xsd:element name="DigestAlgAndValue" type="DigestAlgAndValueType"/>
    <xsd:element name="CRLIdentifier" type="CRLIdentifierType"
minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="CRLIdentifierType">
  <xsd:sequence>
    <xsd:element name="Issuer" type="xsd:string"/>
    <xsd:element name="IssueTime" type="xsd:dateTime" />
    <xsd:element name="Number" type="xsd:integer"  minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="URI" type="xsd:anyURI" use="optional"/>
```

```
</xsd:complexType>

<xsd:complexType name="OCSPRefsType">
  <xsd:sequence>
    <xsd:element name="OCSPRef" type="OCSPRefType" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="OCSPRefType">
  <xsd:sequence>
    <xsd:element name="OCSPIdentifier" type="OCSPIdentifierType"/>
    <xsd:element name="DigestAlgAndValue" type="DigestAlgAndValueType"
      minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="OCSPIdentifierType">
  <xsd:sequence>
    <xsd:element name="ResponderID" type="xsd:string"/>
    <xsd:element name="ProducedAt" type="xsd:dateTime"/>
  </xsd:sequence>
  <xsd:attribute name="URI" type="xsd:anyURI" use="optional"/>
</xsd:complexType>

<xsd:complexType name="OtherCertStatusRefsType">
  <xsd:sequence>
    <xsd:element name="OtherRef" type="AnyType" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<!-- End CompleteRevocationRefs-->


<xsd:element name="SigAndRefsTimeStamp" type="TimeStampType"/>

<xsd:element name="RefsOnlyTimeStamp" type="TimeStampType"/>

<!-- Start CertificateValues -->

<xsd:element name="CertificateValues" type="CertificateValuesType"/>

<xsd:complexType name="CertificateValuesType">
   <xsd:choice minOccurs="0" maxOccurs="unbounded">
     <xsd:element name="EncapsulatedX509Certificate"
type="EncapsulatedPKIDataType"/>
      <xsd:element name="OtherCertificate" type="AnyType"/>
    </xsd:choice>
    <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>

<!-- End CertificateValues -->

<!-- Start RevocationValues-->

<xsd:element name="RevocationValues" type="RevocationValuesType"/>

<xsd:complexType name="RevocationValuesType">
  <xsd:sequence>
    <xsd:element name="CRLValues" type="CRLValuesType" minOccurs="0"/>
    <xsd:element name="OCSPValues" type="OCSPValuesType" minOccurs="0"/>
    <xsd:element name="OtherValues" type="OtherCertStatusValuesType"
minOccurs="0"/>
  </xsd:sequence>
  <xsd:attribute name="Id" type="xsd:ID" use="optional"/>
</xsd:complexType>

<xsd:complexType name="CRLValuesType">
  <xsd:sequence>
     <xsd:element name="EncapsulatedCRLValue" type="EncapsulatedPKIDataType"
       maxOccurs="unbounded"/>
  </xsd:sequence>
```

```
</xsd:complexType>

<xsd:complexType name="OCSPValuesType">
  <xsd:sequence>
      <xsd:element name="EncapsulatedOCSPValue"
        type="EncapsulatedPKIDataType" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
<xsd:complexType name="OtherCertStatusValuesType">
  <xsd:sequence>
    <xsd:element name="OtherValue" type="AnyType" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<!-- End RevocationValues-->

<xsd:element name="ArchiveTimeStamp" type="TimeStampType"/>


</xsd:schema>
```

Annex D (informative): DTD

```
<?xml version="1.0" encoding="UTF-8"?>

<!ENTITY % Any.ANY ' '>
<!ENTITY % XMLTimeStamp.ANY ' '>

<!-- Start Any -->

<!ELEMENT Any (#PCDATA   %Any.ANY;)*>

<!-- End Any -->

<!-- Start ObjectIdentifier -->

<!ELEMENT ObjectIdentifier (Identifier, Description?,
DocumentationReferences?)>
<!ELEMENT Identifier (#PCDATA)>
<!ATTLIST Identifier
  Qualifier (OIDAsURI | OIDAsURN) #IMPLIED
>
<!ELEMENT Description (#PCDATA)>
<!ELEMENT DocumentationReferences (DocumentationReference)+>
<!ELEMENT DocumentationReference (#PCDATA)>

<!-- End ObjectIdentifier -->

<!-- Start EncapsulatedPKIData -->

<!ELEMENT EncapsulatedPKIData (#PCDATA)>
<!ATTLIST EncapsulatedPKIData
  Id ID #IMPLIED
  Encoding CDATA #IMPLIED
>

<!-- End EncapsulatedPKIData -->

<!-- Start TimeStamp -->

<!ELEMENT TimeStamp (Include+, CanonicalizationMethod?,
(EncapsulatedTimeStamp | XMLTimeStamp))>
<!ATTLIST TimeStamp
  Id ID #IMPLIED
>

<!ELEMENT EncapsulatedTimeStamp (#PCDATA)>
<!ATTLIST EncapsulatedTimeStamp
  Id ID #IMPLIED
  Encoding CDATA #IMPLIED
>

<!ELEMENT Include EMPTY>
<!ATTLIST Include
  URI CDATA #REQUIRED
  referencedData CDATA #IMPLIED
>

<!ELEMENT XMLTimeStamp (#PCDATA  %XMLTimeStamp.ANY; )*>

<!-- End TimeStamp -->

<!-- Start container types -->

<!-- Start QualifyingProperties -->

<!ELEMENT QualifyingProperties (SignedProperties?, UnsignedProperties?)>
```

```
<!ATTLIST QualifyingProperties
   Target CDATA #REQUIRED
   Id ID #IMPLIED
>

<!ELEMENT SignedProperties (SignedSignatureProperties,
SignedDataObjectProperties?)>
<!ATTLIST SignedProperties
   Id ID #IMPLIED
>

<!ELEMENT UnsignedProperties (UnsignedSignatureProperties?,
UnsignedDataObjectProperties?)>
<!ATTLIST UnsignedProperties
   Id ID #IMPLIED
>

<!-- End QualifyingProperties -->

<!-- Start SignedSignatureProperties, SignedDataObjectProperties,
UnsignedSignatureProperties, UnsignedDataObjectProperties -->

<!ELEMENT SignedSignatureProperties (SigningTime?, SigningCertificate?,
SignaturePolicyIdentifier?, SignatureProductionPlace?, SignerRole?)>
<!ATTLIST SignedSignatureProperties
   Id ID #IMPLIED
>

<!ELEMENT SignedDataObjectProperties (DataObjectFormat*,
CommitmentTypeIndication*, AllDataObjectsTimeStamp*,
IndividualDataObjectsTimeStamp*)>
<!ATTLIST SignedDataObjectProperties
   Id ID #IMPLIED
>

<!ELEMENT UnsignedSignatureProperties (CounterSignature*,
SignatureTimeStamp*, CompleteCertificateRefs?, CompleteRevocationRefs?,
AttributeCertificateRefs?, AttributeRevocationRefs?, (SigAndRefsTimeStamp* |
RefsOnlyTimeStamp*), CertificateValues?, RevocationValues?,
ArchiveTimeStamp*)>
<!ATTLIST UnsignedSignatureProperties
   Id ID #IMPLIED
>

<!ELEMENT UnsignedDataObjectProperties (UnsignedDataObjectProperty*)>
<!ATTLIST UnsignedDataObjectProperties
   Id ID #IMPLIED
>

<!ELEMENT UnsignedDataObjectProperty (#PCDATA   %Any.ANY;)*>

<!-- End SignedSignatureProperties, SignedDataObjectProperties,
UnsignedSignatureProperties, UnsignedDataObjectProperties -->

<!-- Start QualifyingPropertiesReference -->

<!ELEMENT QualifyingPropertiesReference (Transforms?)>
<!ATTLIST QualifyingPropertiesReference
   URI CDATA #REQUIRED
   Id ID #IMPLIED
>

<!-- End QualifyingPropertiesReference -->

<!-- End container types -->

<!-- Start SigningTime -->

<!ELEMENT SigningTime (#PCDATA)>

<!-- End SigningTime -->
```

```
<!-- Start SigningCertificate -->

<!ELEMENT SigningCertificate (Cert+)>
<!ELEMENT Cert (CertDigest, IssuerSerial)>
<!ATTLIST Cert
  URI CDATA #IMPLIED
>
<!ELEMENT CertDigest (DigestMethod, DigestValue)>
<!ELEMENT IssuerSerial (X509IssuerName, X509SerialNumber)>
<!ELEMENT X509IssuerName (#PCDATA)>
<!ELEMENT X509SerialNumber (#PCDATA)>

<!-- End SigningCertificate -->

<!-- Start SignaturePolicyIdentifier -->

<!ELEMENT SignaturePolicyIdentifier (SignaturePolicyId |
SignaturePolicyImplied)>
<!ELEMENT SignaturePolicyImplied ANY>
<!ELEMENT SignaturePolicyId (SigPolicyId, Transforms?, SigPolicyHash,
SigPolicyQualifiers?)>
<!ELEMENT SigPolicyId (Identifier, Description?, DocumentationReferences?)>
<!ELEMENT SigPolicyHash (DigestMethod, DigestValue)>
<!ELEMENT SigPolicyQualifiers (SigPolicyQualifier+)>
<!ELEMENT SigPolicyQualifier (#PCDATA %Any.ANY; )*>

<!-- End SignaturePolicyIdentifier -->

<!-- Start SPURI and SPUserNotice -->

<!ELEMENT SPURI (#PCDATA)>
<!ELEMENT SPUserNotice (NoticeRef?, ExplicitText?)>
<!ELEMENT NoticeRef (Organization, NoticeNumbers)>
<!ELEMENT ExplicitText (#PCDATA)>
<!ELEMENT Organization (#PCDATA)>
<!ELEMENT NoticeNumbers (int*)>
<!ELEMENT int (#PCDATA)>

<!-- End SPURI and SPUserNotice -->

<!-- Start CounterSignature -->

<!ELEMENT CounterSignature (Signature)>

<!-- End CounterSignature -->

<!-- Start DataObjectFormat -->

<!ELEMENT DataObjectFormat (Description?, ObjectIdentifier?, MimeType?,
Encoding?)>
<!ATTLIST DataObjectFormat
  ObjectReference CDATA #REQUIRED
>
<!ELEMENT MimeType (#PCDATA)>
<!ELEMENT Encoding (#PCDATA)>

<!-- End DataObjectFormat -->

<!-- Start CommitmentTypeIndication -->

<!ELEMENT CommitmentTypeIndication (CommitmentTypeId, (ObjectReference* |
AllSignedDataObjects), CommitmentTypeQualifiers?)>
<!ELEMENT CommitmentTypeId (Identifier, Description?,
DocumentationReferences?)>
<!ELEMENT ObjectReference (#PCDATA)>
<!ELEMENT AllSignedDataObjects ANY>
<!ELEMENT CommitmentTypeQualifiers (CommitmentTypeQualifier*)>
<!ELEMENT CommitmentTypeQualifier (#PCDATA %Any.ANY; )*>

<!-- End CommitmentTypeIndication -->
```

```
<!-- Start SignatureProductionPlace -->

<!ELEMENT SignatureProductionPlace (City?, StateOrProvince?, PostalCode?,
CountryName?)>
<!ELEMENT City (#PCDATA)>
<!ELEMENT StateOrProvince (#PCDATA)>
<!ELEMENT PostalCode (#PCDATA)>
<!ELEMENT CountryName (#PCDATA)>

<!-- End SignatureProductionPlace -->

<!-- Start SignerRole -->

<!ELEMENT SignerRole (ClaimedRoles?, CertifiedRoles?)>
<!ELEMENT ClaimedRoles (ClaimedRole+)>
<!ELEMENT CertifiedRoles (CertifiedRole+)>
<!ELEMENT ClaimedRole (#PCDATA %Any.ANY; )*>
<!ELEMENT CertifiedRole (#PCDATA)>
<!ATTLIST CertifiedRole
   Id ID #IMPLIED
   Encoding CDATA #IMPLIED
>

<!-- End SignerRole -->

<!-- Start AllDataObjectsTimeStamp, IndividualDataObjectsTimeStamp,
SignatureTimeStamp -->

<!ELEMENT AllDataObjectsTimeStamp (Include+, CanonicalizationMethod?,
(EncapsulatedTimeStamp | XMLTimeStamp))>
<!ATTLIST AllDataObjectsTimeStamp
   Id ID #IMPLIED
>

<!ELEMENT IndividualDataObjectsTimeStamp (Include+, CanonicalizationMethod?,
(EncapsulatedTimeStamp | XMLTimeStamp))>
<!ATTLIST IndividualDataObjectsTimeStamp
   Id ID #IMPLIED
>

<!ELEMENT SignatureTimeStamp (Include+, CanonicalizationMethod?,
(EncapsulatedTimeStamp | XMLTimeStamp))>
<!ATTLIST SignatureTimeStamp
   Id ID #IMPLIED
>

<!-- End AllDataObjectsTimeStamp, IndividualDataObjectsTimeStamp,
SignatureTimeStamp -->

<!-- Start CompleteCertificateRefs -->

<!ELEMENT CompleteCertificateRefs (CertRefs)>
<!ATTLIST CompleteCertificateRefs
   Id ID #IMPLIED
>
<!ELEMENT CertRefs (Cert+)>

<!-- End CompleteCertificateRefs -->

<!-- Start AttributeCertificateRefs -->

<!ELEMENT AttributeCertificateRefs (CertRefs)>
<!ATTLIST AttributeCertificateRefs
   Id ID #IMPLIED
>

<!-- End AttributeCertificateRefs -->

<!-- Start CompleteRevocationRefs -->
```

```
<!ELEMENT CompleteRevocationRefs (CRLRefs?, OCSPRefs?, OtherRefs?)>
<!ATTLIST CompleteRevocationRefs
  Id ID #IMPLIED
>
<!ELEMENT CRLRefs (CRLRef+)>
<!ELEMENT OCSPRefs (OCSPRef+)>
<!ELEMENT OtherRefs (OtherRef+)>

<!ELEMENT CRLRef (DigestAlgAndValue, CRLIdentifier?)>
<!ELEMENT OCSPRef (OCSPIdentifier, DigestAlgAndValue?)>
<!ELEMENT OtherRef (#PCDATA %Any.ANY; )*>

<!ELEMENT DigestAlgAndValue (DigestMethod, DigestValue)>
<!ELEMENT CRLIdentifier (Issuer, IssueTime, Number?)>
<!ATTLIST CRLIdentifier
  URI CDATA #IMPLIED
>
<!ELEMENT OCSPIdentifier (ResponderID, ProducedAt)>
<!ATTLIST OCSPIdentifier
  URI CDATA #IMPLIED
>

<!ELEMENT Issuer (#PCDATA)>
<!ELEMENT IssueTime (#PCDATA)>
<!ELEMENT Number (#PCDATA)>
<!ELEMENT ResponderID (#PCDATA)>
<!ELEMENT ProducedAt (#PCDATA)>

<!-- End CompleteRevocationRefs -->

<!-- Start AttributeRevocationRefs -->

<!ELEMENT AttributeRevocationRefs (CRLRefs?, OCSPRefs?, OtherRefs?)>
<!ATTLIST AttributeRevocationRefs
  Id ID #IMPLIED
>

<!-- End AttributeRevocationRefs -->

<!-- Start SigAndRefsTimeStamp, RefsOnlyTimeStamp  -->

<!ELEMENT SigAndRefsTimeStamp (Include+, CanonicalizationMethod?,
(EncapsulatedTimeStamp | XMLTimeStamp))>
<!ATTLIST SigAndRefsTimeStamp
  Id ID #IMPLIED
>

<!ELEMENT RefsOnlyTimeStamp (Include+, CanonicalizationMethod?,
(EncapsulatedTimeStamp | XMLTimeStamp))>
<!ATTLIST RefsOnlyTimeStamp
  Id ID #IMPLIED
>

<!-- End SigAndRefsTimeStamp, RefsOnlyTimeStamp  -->

<!-- Start CertificateValues -->

<!ELEMENT CertificateValues (EncapsulatedX509Certificate |
OtherCertificate)*>
<!ATTLIST CertificateValues
  Id ID #IMPLIED
>

<!ELEMENT EncapsulatedX509Certificate (#PCDATA)>
<!ATTLIST EncapsulatedX509Certificate
  Id ID #IMPLIED
  Encoding CDATA #IMPLIED
>
<!ELEMENT OtherCertificate (#PCDATA %Any.ANY;)*>

<!-- End CertificateValues -->
```

```
<!-- Start RevocationValues -->

<!ELEMENT RevocationValues (CRLValues?, OCSPValues?, OtherValues?)>
<!ATTLIST RevocationValues
   Id ID #IMPLIED
>

<!ELEMENT CRLValues (EncapsulatedCRLValue+)>
<!ELEMENT OCSPValues (EncapsulatedOCSPValue+)>
<!ELEMENT OtherValues (OtherValue+)>

<!ELEMENT EncapsulatedCRLValue (#PCDATA)>
<!ATTLIST EncapsulatedCRLValue
   Id ID #IMPLIED
   Encoding CDATA #IMPLIED
>
<!ELEMENT EncapsulatedOCSPValue (#PCDATA)>
<!ATTLIST EncapsulatedOCSPValue
   Id ID #IMPLIED
   Encoding CDATA #IMPLIED
>
<!ELEMENT OtherValue (#PCDATA %Any.ANY;  )*>

<!-- End RevocationValues -->

<!-- Start ArchiveTimeStamp -->

<!ELEMENT ArchiveTimeStamp (Include+, CanonicalizationMethod?,
(EncapsulatedTimeStamp | XMLTimeStamp))>
<!ATTLIST TimeStamp
   Id ID #IMPLIED
>

<!-- End ArchiveTimeStamp -->
```

Annex E (informative): Incorporation of qualifying properties

As stated in the normative part of the present document, new elements have been defined to incorporate properties (both signed and unsigned) that qualify the whole signature, the signer or individual signed data objects: `QualifyingProperties`, `SignedProperties`, `UnsignedProperties`, `SignedSignatureProperties`, `UnsignedSignatureProperties`, `SignedDataObjectProperties` and `UnsignedDataProperties`.

Annex E shows an example of direct incorporation of qualifying properties and one example of indirect incorporation of these properties.

Below follows the resulting general structure of direct incorporation:

```
<ds:Signature ID?>

  <ds:SignedInfo>
    <ds:CanonicalizationMethod/>
    <ds:SignatureMethod/>
    (<ds:Reference URI? >
      (<ds:Transforms>)?
      <ds:DigestMethod>
      <ds:DigestValue>
    </Reference>)+
  </ds:SignedInfo>

  <ds:SignatureValue>

  (<ds:KeyInfo>)?

  <ds:Object>

    <QualifyingProperties>

      <SignedProperties>

        <SignedSignatureProperties>
          <!-- Collection of signed XML elements with
          properties qualifying the signature or the
          signer -->
        </SignedSignatureProperties>

        <SignedDataObjectProperties>
          <!-- Collection of signed XML elements with
          properties individually qualifying signed data
          objects -->
         </SignedDataObjectPropertiesSigned>

      </SignedProperties>

      <UnsignedProperties>

        </UnsignedSignatureProperties>
          <!-- Collection of unsigned XML elements with
          properties qualifying signature or signer -->
        </UnsignedSignatureProperties>

        <UnSignedDataObjectProperties>
          <!-- Collection of unsigned XML elements with
          properties individually qualifying signed
```

```
          data objects -->
        </UnSignedDataObjectProperties>

      </UnsignedProperties>

    </QualifyingProperties>

  </ds:Object>

</ds:Signature>
```

Below follows an example showing the inclusion of three sets of qualifying properties:

- The first one includes signed properties qualifying the signature, namely:
  - the time of signature production (element `SigningTime`);
  - a restricted set of references to certificates to be used in verifying a signature. This also includes a reference to the certificate containing the public key corresponding to the private key used in the signature computation (element `SigningCertificate`);
  - an identification of the signature policy under which the signature has been produced and will have to be verified (element `SignaturePolicyIdentifier`).
- The second one includes signed properties qualifying the signed data object, namely:
  - a time-stamp of the signed data object, proving that the content has been produced before the time indicated in the time-stamp (element `AllDataObjectsTimeStamp`);
  - an indication of the format of the signed object (element `DataObjectFormat`).
- The third one includes unsigned properties qualifying the signature, namely:
  - a time-stamp on the electronic signature itself, proving that the signature was produced before the time indicated by such time-stamp (element `SignatureTimeStamp`);
  - the references to the full set of CA certificates that the verifier of the electronic signature has used to validate the electronic signature (element `CompleteCertificateRefs`);
  - the references to the revocation material (CRLs or OCSP responses) used in the validation of the signer and CA certificates used the full to validate the electronic signature (element `CompleteRevocationRefs`);
  - the time-stamp generated over the electronic signature with the aforementioned qualifying information (element `SigAndRefsTimeStamp`);
  - the full set of CA certificates that the verifier of the electronic signature has used to validate the electronic signature (element `CertificateValues`);
  - the revocation material (CRLs or OCSP responses) used in the validation of the signer and CA certificates used the full to validate the electronic signature (element `RevocationValues`).

```
[s01]<ds:Signature Id="SignatureId"
xmlns:ds="http://www.w3.org/2000/09/xmldsig#>
[s02]  <ds:SignedInfo Id="SignedInfoId">
[s03]    <ds:CanonicalizationMethod Algorithm="http://www.w3.org/TR/2001/REC-
xml-c14n-20010315"/>
[s04]    <ds:SignatureMethod
Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1"/>
[s05]    <ds:Reference URI="http://www.etsi.org/docToBeSigned"
Id="FirstSignedDocument">
[s06]      <ds:DigestMethod
Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
[s07]      <ds:DigestValue>… … …</ds:DigestValue>
[s08]    </ds:Reference>
```

```
[s09]    <ds:Reference URI="#SignedPropertiesId"
Type="http://uri.etsi.org/01903/v1.2.1#SignedProperties">
[s10]      <ds:DigestMethod
Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
[s11]      <ds:DigestValue>… … …</ds:DigestValue>
[s12]    </ds:Reference>
[s13]  </ds:SignedInfo>
[s14]  <ds:SignatureValue Id="SignatureValueId">… … … </ds:SignatureValue>
[s15]  <ds:KeyInfo>… … …</ds:KeyInfo>
[s16]  <ds:Object >

[s17]     <QualifyingProperties  Id="QualifyingPropertiesId"
Target="#SignatureId" xmlns="http://uri.etsi.org/01903/v1.2.1#"
xmlns:ds="http://www.w3.org/2000/09/xmldsig#">

[s18]      <SignedProperties Id="SignedPropertiesId">
[s19]        <SignedSignatureProperties >
[s20]          <SigningTime>… … …</SigningTime>
[s21]          <SigningCertificate>… … …</SigningCertificate >
[s22]          <SignaturePolicyIdentifier>… … …</ SignaturePolicyIdentifier >
[s23]        </SignedSignatureProperties>
[s24]        <SignedDataObjectProperties>
[s25]          <DataObjectFormat>… … …</DataObjectFormat>
[s26]          <AllDataObjectsTimeStamp Id="AllDataObjectsTimeStampId">… … …
</AllDataObjectsTimeStamp>
[s27]        </SignedDataObjectProperties>
[s28]      </SignedProperties>
[s29]      <UnsignedProperties >
[s30]        <UnsignedSignatureProperties>
[s31]          <SignatureTimeStamp
Id="SignatureTimeStampId">…  …  …</SignatureTimeStamp>
[s32]          <CompleteCertificateRefs Id="CompleteCertificateRefsId">…  …
…</CompleteCertificateRefs>
[s33]          <CompleteRevocationRefs
Id="CompleteRevocationRefsId">…  …  …</CompleteRevocationRefs>
[s34]          <SigAndRefsTimeStamp
Id="SigAndRefsTimeStampId">… … …</SigAndRefsTimeStamp>
[s35]          <CertificateValues
Id="CertificateValuesId">…  …  …  …</CertificateValues>
[s36]          <RevocationValues
Id="RevocationValuesId">…  …  …</RevocationValues>
[s37]        </UnsignedSignatureProperties>
[s38]      </UnsignedProperties>
[s39]    </QualifyingProperties>
[s40]  </ds:Object>
[s41]</ds:Signature>
```

[s01] Beginning of the XML signature. The namespace by default is the namespace defined in XML-DIGSIG.

[s02]-[s13] The `ds:SignedInfo` element contains the information that is actually signed.

[s03] The `ds:CanonicalizationMethod` element indicates the algorithm used to get a canonical representation of the *SignedInfo* element before being signed.

[s04] The `ds:SignatureMethod` indicates the algorithms used to sign *SignedInfo*.

[s05] to [s16] `ds:Reference` elements contain the digest value and indication on the digest algorithm for each data object that has to be (indirectly) signed. Each one also has a reference to the corresponding data object. These elements also have the *Id* attribute that can be used to make individual references each one of them.

[s05-s08] The first `ds:Reference` element. Its URI attribute references the data object that has to be signed. `ds:DigestMethod` indicates the digest algorithm (sha1 in this case) and `ds:DigestValue` contains the digest value filtered in base 64.

[s09-s12] The second `ds:Reference` element. Its URI attribute points to the `SignedProperties` element (using the URI attribute) that contains the whole set of signed properties. `ds:DigestMethod` indicates the digest algorithm (sha1 in this case) and `ds:DigestValue` contains the digest value filtered in base. This means that the digest value of that `SignedProperties` is included in `SignedInfo` and in consequence signed when this element is signed. The `ds:Type` attribute indicates that this element is a reference to the SignatureProperties element as mandated in clause 6.3.1.

[s14] `ds:SignatureValue` contains the computed digital signature of `ds:SignedInfo` in base 64.

[s15] `ds:KeyInfo` contains cryptographic material to verify the signature.

[s16-s40] `ds:Object` contains three elements with the properties qualifying both the signature and the signed data object.

[s17-39] `QualifyingProperties` contains the full set of qualifying properties both signed (`SignedProperties`) and unsigned (Uns`ignedProperties`). The namespace by default is changed for this element and its contents to the one defined as namespace by default in the schema definition given in the present document in order not to have to qualify the whole set of elements. Additionally, as elements already defined in [3] are used in the definitions, its namespace is also defined (prefix `ds`).

[s18-s28] `SignedProperties` contains the whole set of qualifying properties that are signed grouped in two sequences. The first one (`SignedSignatureProperties`) contains all the signed properties that qualify the signature. The second one (`SignedDataObjectProperties`) contains all the signed properties that individually qualify each signed data object.

[s19-ss23] `SignedSignatureProperties` contains all the signed properties that qualify the signature (`SigningTime`, `SigningCertificate`, `SignaturePolicyIdentifier`).

[s20] `signingTime` contains the value of the signing instant when the signature has been computed.

[s21] `SigningCertificate` contains, as stated above, a restricted set of references to certificates to be used in verifying a signature.

[s24-27] `SignedDataObjectProperties` contains all the signed properties that individually qualify each signed data object (`AllDataObjectsTimeStamp, DataObjectFormat`).

[s25] `DataObjectFormat` identifies the format of the signed data object.

[s26] `AllDataObjectsTimeStamp` is a time-stamp issued for the signed data object.

[s29-38] `UnsignedProperties` contains the whole set of qualifying properties that are NOT signed

[s30-s37] `UnsignedSignatureProperties` the whole set of unsigned properties that qualify the signature.

[s31] `SignatureTimeStamp` contains a time-stamp for the signature itself.

[s32] `CompleteCertificateRefs` contains references to CA certificates in the certification path used to verify the signature.

[s33] `CompleteRevocationRefs` contains references to revocation information used to verify the signature.

[s34] `SigAndRefsTimeStamp` contains a time-stamp over the XAdES-C form of the electronic signature.

[s35] `CertificateValues` contains the values of the certificates referenced in `CompleteCertificateRefs`.

[s36] `RevocationValues` contains the revocation data used to validate the electronic signature.

NOTE: The tree shown in the example above does not explicitly show certain optional XML elements (like `ds:Transforms` For a complete description of this tree see XML-Signature Core Syntax and Processing [3].

Below will follow the example of indirect incorporation of all the unsigned properties. In this example, the signed properties will be directly incorporated into the `ds:Signature` element as in the previous example. However, the unsigned properties will be separately stored in other place. To incorporate these properties use is made of the `QualifyingPropertiesReference` element pointing to the element containing them.

Below follows the contents of the XAdES itself that could be located, for instance, at the URI http://uri.etsi.org/01903/v1.2.1/Indirect-Incorporation/Signature2:

```
[s01]<ds:Signature Id="Signature2Id"
xmlns:ds="http://www.w3.org/2000/09/xmldsig#>
[s02]  <ds:SignedInfo Id="SignedInfoId">
 [s03]    <ds:CanonicalizationMethod
Algorithm="http://www.w3.org/TR/2001/REC-xml-c14n-20010315"/>
[s04]    <ds:SignatureMethod
Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1"/>
[s05]    <ds:Reference URI="http://www.etsi.org/docToBeSigned"
Id="FirstSignedDocument">
[s06]      <ds:DigestMethod
Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
[s07]      <ds:DigestValue>… … …</ds:DigestValue>
[s08]    </ds:Reference>
[s09]    <ds:Reference URI="#SignedPropertiesId"
Type=http://uri.etsi.org/01903/v1.2.1#SignedProperties>
[s10]      <ds:DigestMethod
Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
[s11]      <ds:DigestValue>… … …</ds:DigestValue>
[s12]    </ds:Reference>
[s13]  </ds:SignedInfo>
[s14]  <ds:SignatureValue Id="SignatureValueId">… … … </ds:SignatureValue>
[s15]  <ds:KeyInfo>… … …</ds:KeyInfo>

[s16]  <ds:Object >
[s17]     <QualifyingProperties  Id="QualifyingProperties"
Target="#SignatureId" xmlns="http://uri.etsi.org/01903/v1.2.1#"
xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
[s18]      <SignedProperties Id="SignedPropertiesId">
[s19]        <SignedSignatureProperties >
[s20]          <SigningTime>… … …</SigningTime>
[s21]          <SigningCertificate>… … …</SigningCertificate >
[s22]          <SignaturePolicyIdentifier>… … …</SignaturePolicyIdentifier >
[s23]        </SignedSignatureProperties>
[s24]        <SignedDataObjectProperties>
[s25]          <DataObjectFormat>… … …</DataObjectFormat>
[s26]          <AllDataObjectsTimeStamp Id="AllDataObjectsTimeStampId">… … …
</AllDataObjectsTimeStamp>
[s27]        </SignedDataObjectProperties>
[s28]      </SignedProperties>
[s29]    </QualifyingProperties>

[s30]    <QualifyingPropertiesReference
URI="http://uri.etsi.org/01903/v1.2.1/Indirect-
Incorporation/example1#QualifyingPropertiesId">
[s31]      <ds:Transforms>… … …</ds:Transforms>
[s32]    </QualifyingPropertiesReference>
[s33]  </ds:Object>
[s34]</ds:Signature>
```

[s1-s29] These lines are the same as in the first example. They show how the signed properties are directly incorporated.

[s30-s32] These lines show how to indirectly incorporate the unsigned properties stored in other place using the `QualifyingPropertiesReference` element.

[s30] The `URI` attribute contains the URI pointing to the `QualifyingProperties` element that contains those qualifying properties that are being indirectly incorporated. In this case, it points to a file that could be found in http://uri.etsi.org/01903/v1.2.1/Indirect-Incorporation/example1, which contains this element.

[s31] The `ds:Transforms` element contains the whole set of transformations to compute on the file where the unsigned properties are stored.

This example ends showing that part of the file that could be found in http://uri.etsi.org/01903/v1.2.1/Indirect-Incorporation/example1 that contains the `QualifyingProperties` element referenced in the `QualifyingPropertiesReference`.

```
<!-- This is the part of the file found in
http://uri.etsi.org/01903/v1.2.1/Indirect-Incorporation/example1 that
contains the QualifyingProperties element containing the unsigned properties
that are indirectly incorporated in the advanced electronic signature -->

[si]     <QualifyingProperties Id="QualifyingPropertiesId"
Target="http://uri.etsi.org/01903/v1.2.1/Indirect-
Incorporation/Signature2#Signature2Id"
xmlns="http://uri.etsi.org/01903/v1.2.1#"
xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
[si+1]      <UnsignedProperties >
[si+2]        <UnsignedSignatureProperties>
[si+3]          <SignatureTimeStamp
Id="SignatureTimeStampId">…  …  …</SignatureTimeStamp>
[si+4]          <CompleteCertificateRefs Id="CompleteCertificateRefsId">…  …
…</CompleteCertificateRefs>
[si+5]          <CompleteRevocationRefs
Id="CompleteRevocationRefsId">…  …  …</CompleteRevocationRefs>
[si+6]          <SigAndRefsTimeStamp
Id="SigAndRefsTimeStampId">… … …</SigAndRefsTimeStamp>
[si+7]          <CertificateValues
Id="CertificateValuesId">…  …  …  …</CertificateValues>
[si+8]          <RevocationValues
Id="RevocationValuesId">…  …  …</RevocationValues>
[si+9]        </UnsignedSignatureProperties>
[si+10]     </UnsignedProperties>
[si+11]  </QualifyingProperties>

<!-- Below would follow the rest of the file -->
```

In the example above the `QualifyingProperties` element is shown that is part of the file that could be found in http://uri.etsi.org/01903/v1.2.1/Indirect-Incorporation/example1 and that is pointed by the `URI` element in the `QualifyingPropertiesReference` in the advanced electronic signature.

Annex F (informative): Bibliography

- Directive 1999/93/EC of the European Parliament and of the Council of 13 December 1999 on a Community framework for electronic signatures.
- IETF RFC 2634: "Enhanced Security Services for S/MIME".
- IETF RFC 2396: "Uniform Resource Identifiers (URI): Generic Syntax".
- IETF RFC 3061: "A URN Namespace of Object Identifiers".
- W3C 12-2000 (W3C Candidate Recommendation, December 2000): "The Platform for Privacy Preferences 1.0 (P3P1.0) Specification".

History

Document history		
V1.1.1	February 2002	Publication
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