XML-Signatures and the Presentation Problem

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Sichere Telekooperation

XML-Signatures and the Presentation Problem

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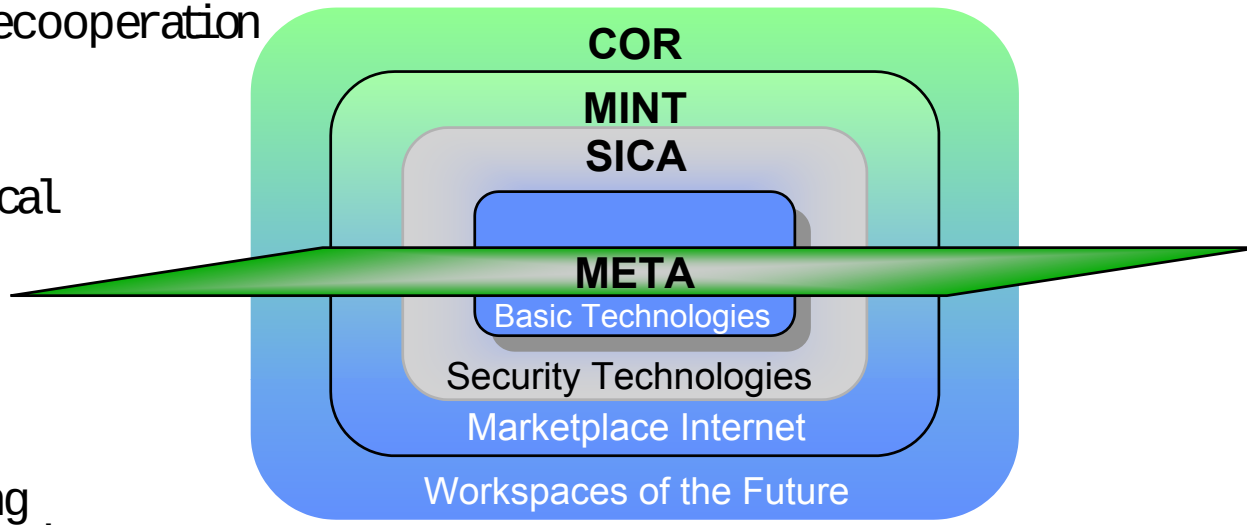
Sichere Telekooperation

Fraunhofer Institute Secure Telecooperation (SIT)

- Development of security technologies
- Incorporation of security technologies in pre-existing applications
- Realisation of innovative forms of telecooperation
- Activities based on XML, e.g.
  - TMF - Telematikplatform for medical research networks: Medical data in XML
  - Media@com (e-government): X.509 authentication protocol
  - Diploma- and PhD theses about XML-Encryption, secure auctioning systems using XML-Dsig, presentation problem, *etc.*



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Our collaboration:

Thomas Kunz

- Studies in informatics Uni Frankfurt/Main
- Since 2001 research assistant at SIT.MINT
- Themes: secuity in e-business processes, security-solicies

Ulrich Pordesch

- Studies in informatics TU-Darmstadt
- Since 1997 PhD student/researcher at SIT
- Schwerpunkt: judicial requirement analysis
- PhD Dissertation (TU-Ilmenau): Die elektronische Form und das Präsentationsproblem (the electronic form and the presentation problem)

Dr. Andreas U. Schmidt

- Studies in mathematics and physics, University Frankfurt/Main, 1999 PhD in Mathematics
- 1999/2000 researcher at the GMD Institute SIT, AG MINT. Subject: digital signatures in XML
- 2000/01/02 research stays in ZA (UDW) and Italy (Univ. Pisa)
- since october 2002 researcher at SIT.MINT. subject: security-policies

Overview

1. Common Content- and Signature Formats
2. The Presentation Problem
3. Pros and Cons of XML as Content- and Signature Format
4. Remaining Problems and Possible Solutions

Usual Content Formats

Word processors: Word

Spreadsheets: Excel

E-Mail: Mime-ASCII

Internet: HTML

Financial data exchange: EDIFACT

Archiving: PDF

Fax/Scan: TIFF

Pictures: JPEG, GIF

„Security properties“

- No secured authenticity/integrity
- Content and authorship repudiable
- No judicial proofs

Therefore even today in many use cases

- Print
- Sign
- Scan, and/or archive as paper …

Common Signature Formats (I): CMS

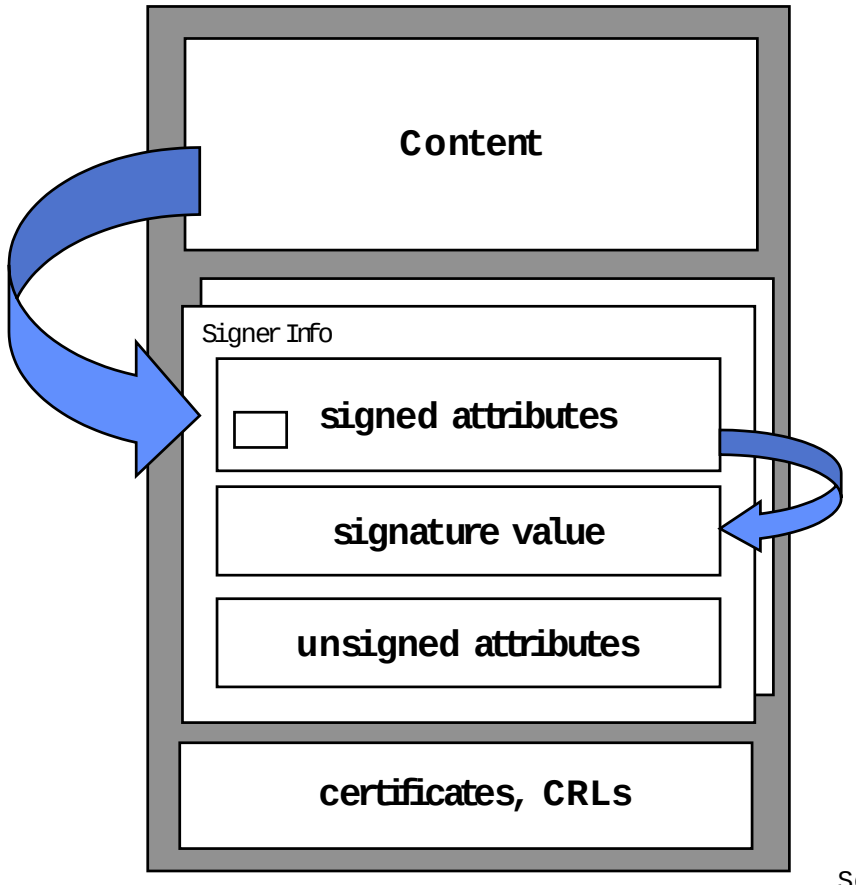
ASN.1-Syntax, binary coding

Signature generation

- Hash content (e.g. file)
- Hash the hash value and further attributes (time, used algorithms, content formta)
- Generate signature value
- Add certificates and further attributes (endorsing signature, time stamp,..)....

Form CMS-Container: Content integrated or external

Numerous ASN.1-based standards for attributes, certificates, CRLs, ...



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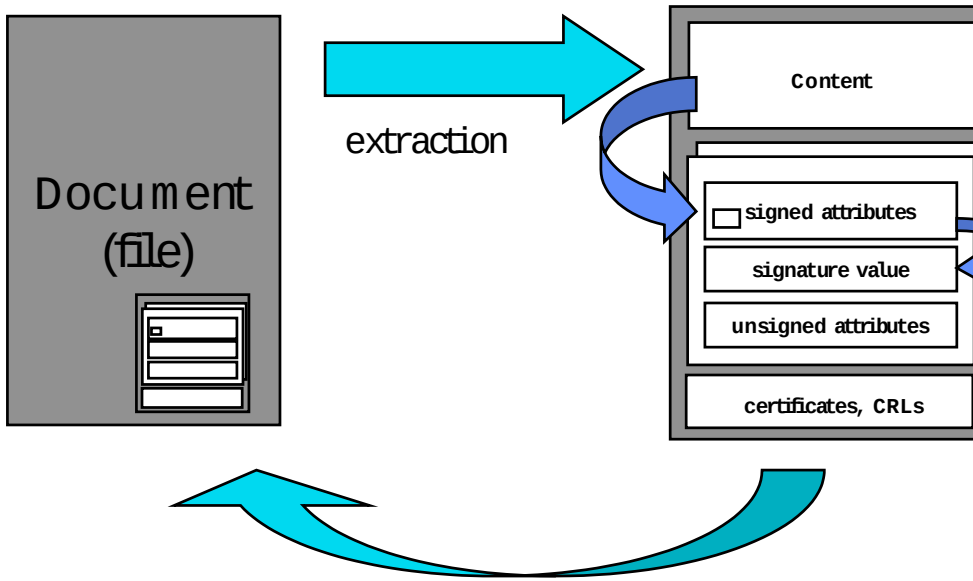
Common Signature Formates (II): Usage

a) Signed message within a file in CMS format

b) Document remains unchanged, signature placed in additional file in CMS format

c) Integration in usual document formats

- Selection, transformation coding of document data by application yields signable content
- Signature is placed into document file, document format (syntax) is extended by a CMS-block for that
- Example: PDF



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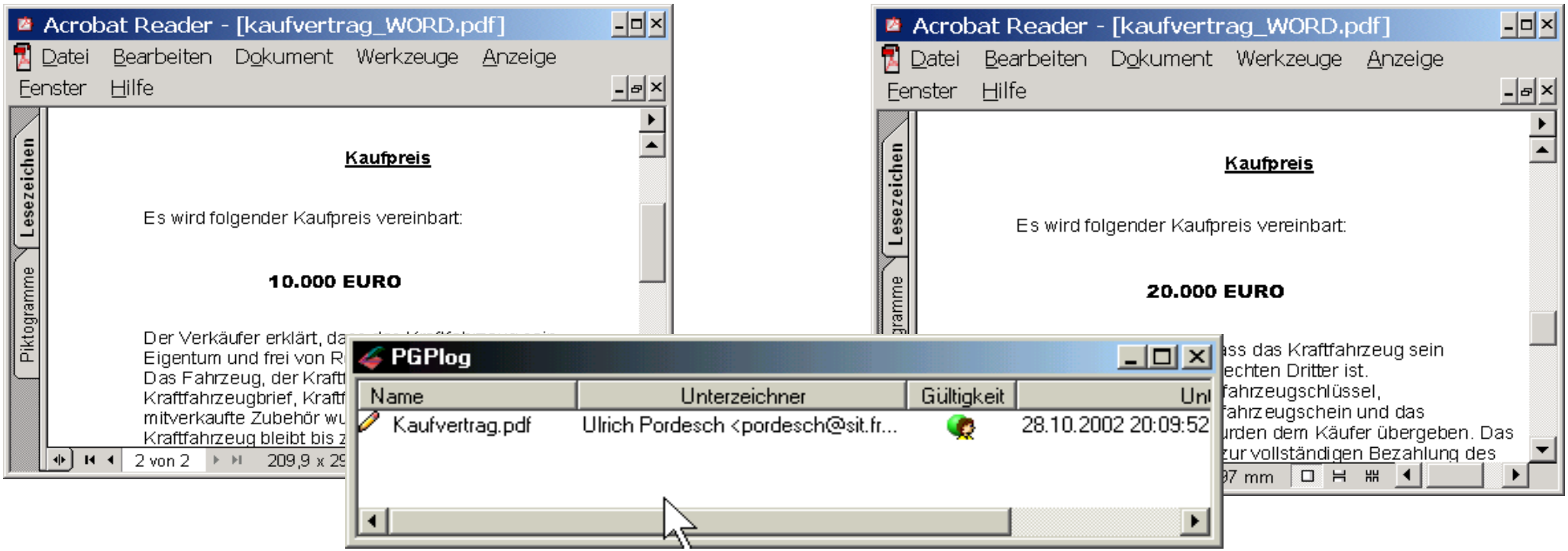
The Presentation Problem (I)



Two presentations of the very same signed document contents differ significantly and lead to (legally) incommensurable interpretations.

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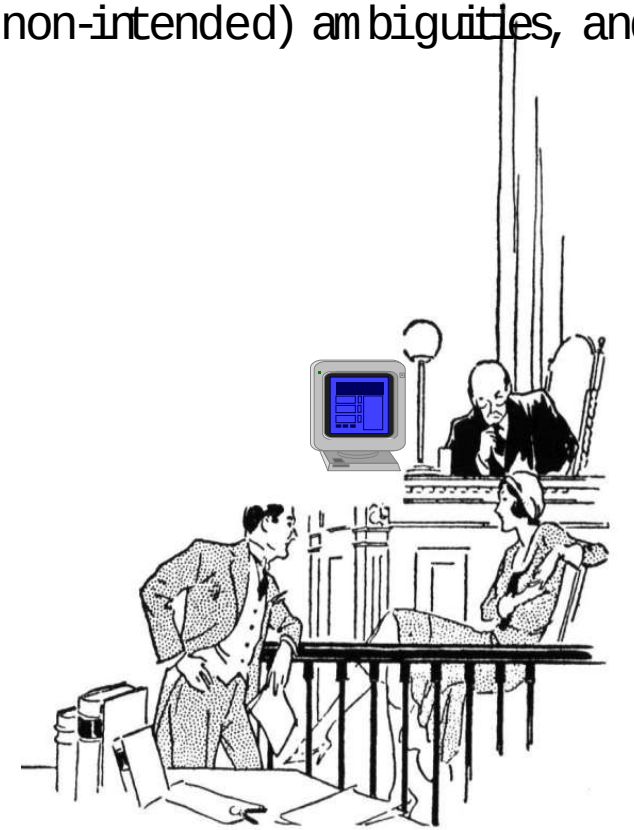
The Presentation Problem (II)

A variety of possible presentations results from (intended and non-intended) ambiguities, and misrepresentation due to error and/or abuse.

Unique presciptions are lacking for

- Data format and syntax
- Presentation of content
- User interface
- User-system-interaction

In conclusion: Judicial value of signed data might be limited, although it contains a technically correct digital signature



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Presentation Problem with Common Formats

Content format

- Content itself is mostly non-unique concerning representation; but worse:
- **What** is signed is often not recognizable:
  - Origin, selection, transformation, coding is opaque
  - Content is not human-readable, syntax and pertinent semantics are not disclosed
- With CMS-signatures: Only one file can be signed, but not, for instance, stylesheets, txtual descriptions, presentational variants, etc.

Signature format

- Content format *can* be defined (as a MIME-type), but is often not used properly („data“)
- Differing content formats can be used in parallel signatures
- Signature data itself is implementation dependent

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XML as Signature- and Content-Format

The common standard of IETF and W3C for XML-Signatures
(XMLDsig, W3C Recommendation 12.4.2002) provides a format for signatures of:

- Structured (XML) and unstructured data in single or multiple files
- from different application contexts (interoperability),
- in a multitude of variants (enveloped, enveloping, detached, selected content, ...)
- Web-wide distributed or local,
- mobile or with fixed location,
- with low demands on implementations,
- using established as well as advanced cryptographc standards,
- with open-source implementations

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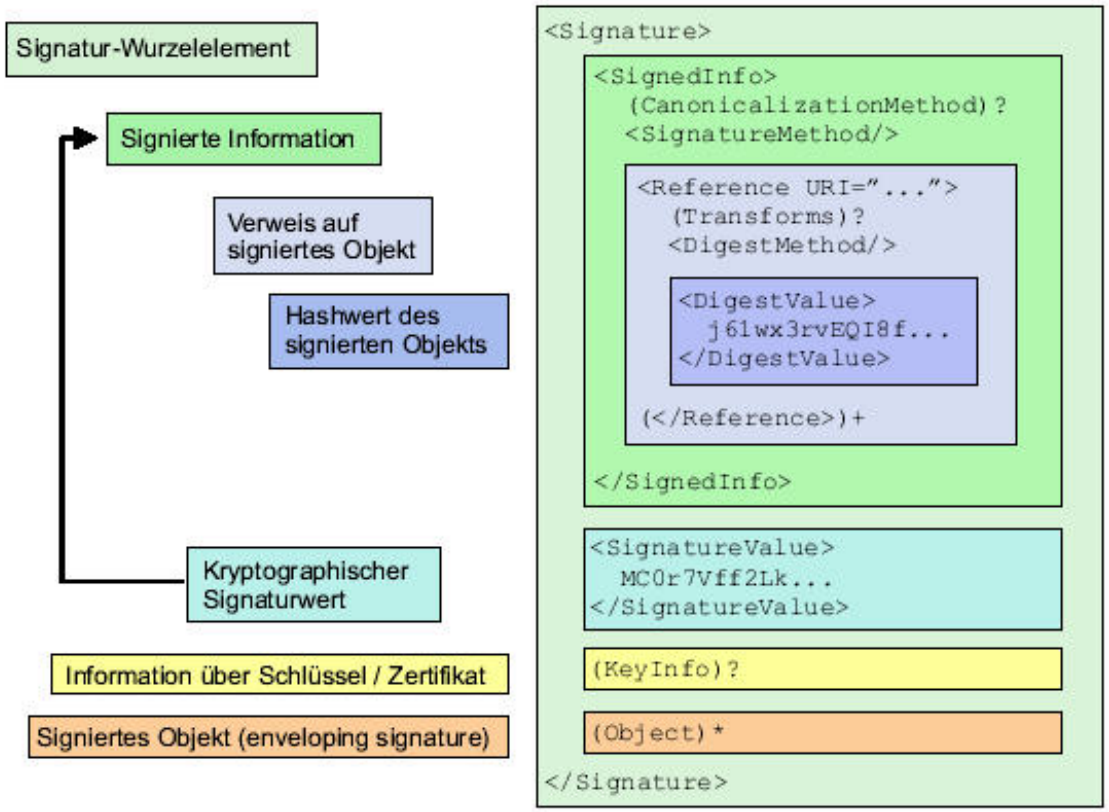
Basic Structure of XML-Signatures (XMLDSig)



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XML Components Associated to the Presentation Problem

Syntax: schema

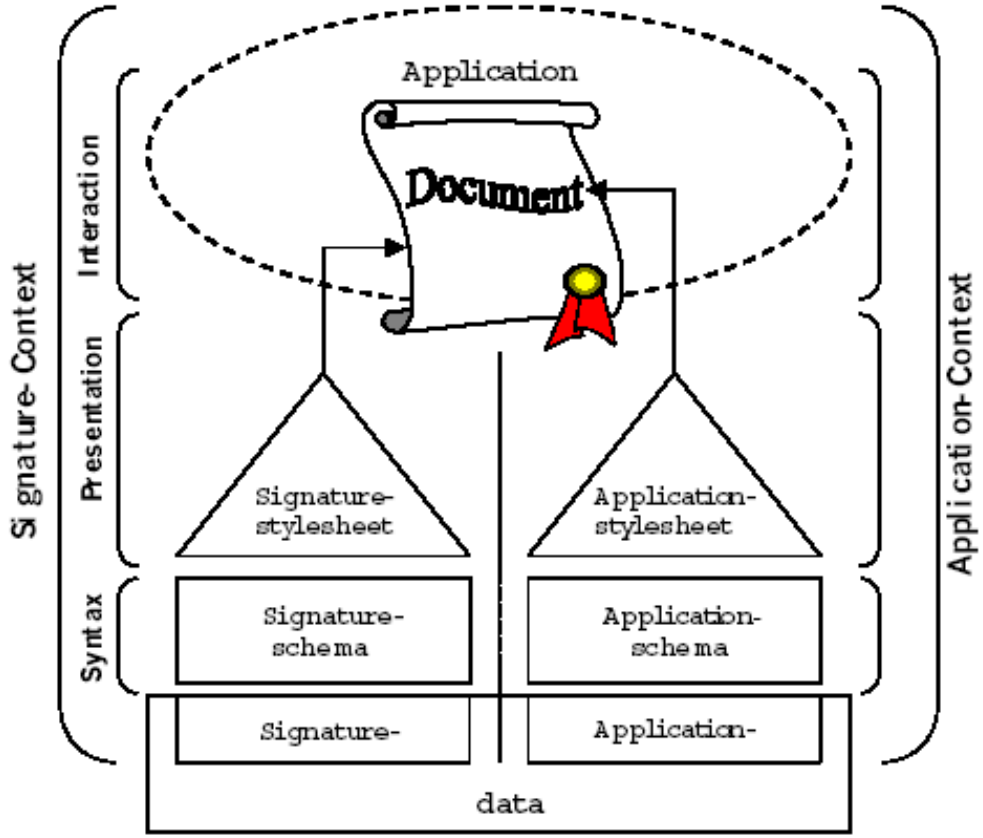
- Old: DTD – SGML's `heritage´
- XML-Schema
  Syntax descriptions for XML in XML

Presentation: Stylesheets

- CSS - for presentation of (X)HTML in the Web browser
- XSL Extensible Stylesheet Language:

  XSL Transformations
  (XML to XML, text, or (X)HTML)

  XSL Formatting Language: detailed presentation prescriptions for XML-Documents



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Advantages of XML Pertaining to the Presentation Problem

- **Separation of signature- and application context:**

  Syntax and presentation can be determined sepearately for Application data and signature data

  These components can be made attributable – by (XML)-signatures – to responsible parties
- Transparent codierung (human readable [?] XML)
- Adapted presentation variants possible by association to stylesheets
- Uniqueness of syntax through use of namespaces (fixing semantic context of the XML-elements)

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Further Advantages of XML-DSig

- Signing of multiple data objects enables authentication of associated stylesheets and schema definitions
- Transformations (XSLT): data objects can be changed before signing them: inessential and potentially damaging parts can be eliminated (e.g. script code)
- Transparent selection of content parts before signing via Xpath (powerful)
- Transparent normalisation

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XML-Signatures: Flexibility *vs.* Security

Flexibility

- Explicit re-coding, execution of externally defined Operations before signing
- Content-selection with XPath/XPath Filters: useful for forms and workflow applications where parts of documents are to be signed by various parties
- Canonicalization: re-codings that keep the signature invariant – should also leave the semantics of the content invariant

(In)security

- Does the application of c14n, transformations, selction operations really leave the semantics of the signed content unaffected? The signed doc might have a meaning which differs from the original one.
- C14n and XPath even create problems on the syntactic level, i.e. for interoperability: Even for simple use-cases, XPath expressions become unintelligible and error-prone.
  (Standard was developed with emphasis on lightweight implementation and high functional power)
- On higher semantic levels: What is it, really that is signed – the XMLDSig standard knows not of content types. This meaning has to be provided within the application context.

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Requirements w.r.t. Presentation Problem

- **Signed Stylesheets:** The authenticity of the stylesheet used for the presentation must be ensured by digitally signing it
- **Binding of Context:** Syntax (Schema) and presentation must be **bound** to the signed XML data, i.e. their usage must be explicitly prescribed *and* signed.
  XMLDSig has no high-level semantics for that.
- Otherwise: Integrity of context components becomes a problem
  (is the singed stylesheet the same that has been used for presentation?)
- **Ambiguity:** To which level of detail shall context components be presented, if they are signed? E.g. Should also signed stylesheets be presented?
- **Presentation of Signature:**
  - Should there be a unique, application independent (standardized, „officially regulated“) presentation of signature, certificates, timestamps, etc. ?
- **Interaction level is underspecified:** Even advanced XML form description languages do not specify user interaction; it is usually implemented by scripting languages.

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XAdES (ETSI – Specification)

Extension of W3C-specification (success doubtful) by signature attributes

- ASN.1-time stamps, -certificates, - CRLs
- Counter signatures

Assignment of data formats (signed)

- Text descriptions of data
- Format specification via Object Identifier (OID) or MIME-Type with encoding

```
<ds:Object>
    <QualfyingProperties>
      <SignedProperties>
        <SignedSignatureProperties>
          (SigningTime)
          (SigningCertificate)
          (SignaturePolicyIdentifier)
          (SignatureProductionPlace)?
          (SignerRole)?
        </SignedSignatureProperties>
        <SignedDataObjectProperties>
          (DataObjectFormat)*
          (CommitmentTypeIndication)*
          (AllDataObjectsTimeStamp)*
          (IndividualDataObjectsTimeStamp)*
        </SignedDataObjectProperties>
      </SignedProperties>

    </QualifyingProperties>
</ds:Object>
```


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Further Directions

Syntax and presentation of signed data

- Depends too much on applications for central prescriptions.
  Should there be guidelines?
- Evaluation, registration, and certification (by digital signatures) of stylesheets and schemas for applications
- Presentation of signature (nontrivial due to the large variety of signature types):

  „Officially prescribed" stylesheets for signature presentation could form a base infrastructure for XML signature applications.
- Binding of context elements: A meta standard based on XMLDSig could provide pertinent semantics and functionality.
- Expressive elements for user interaction...

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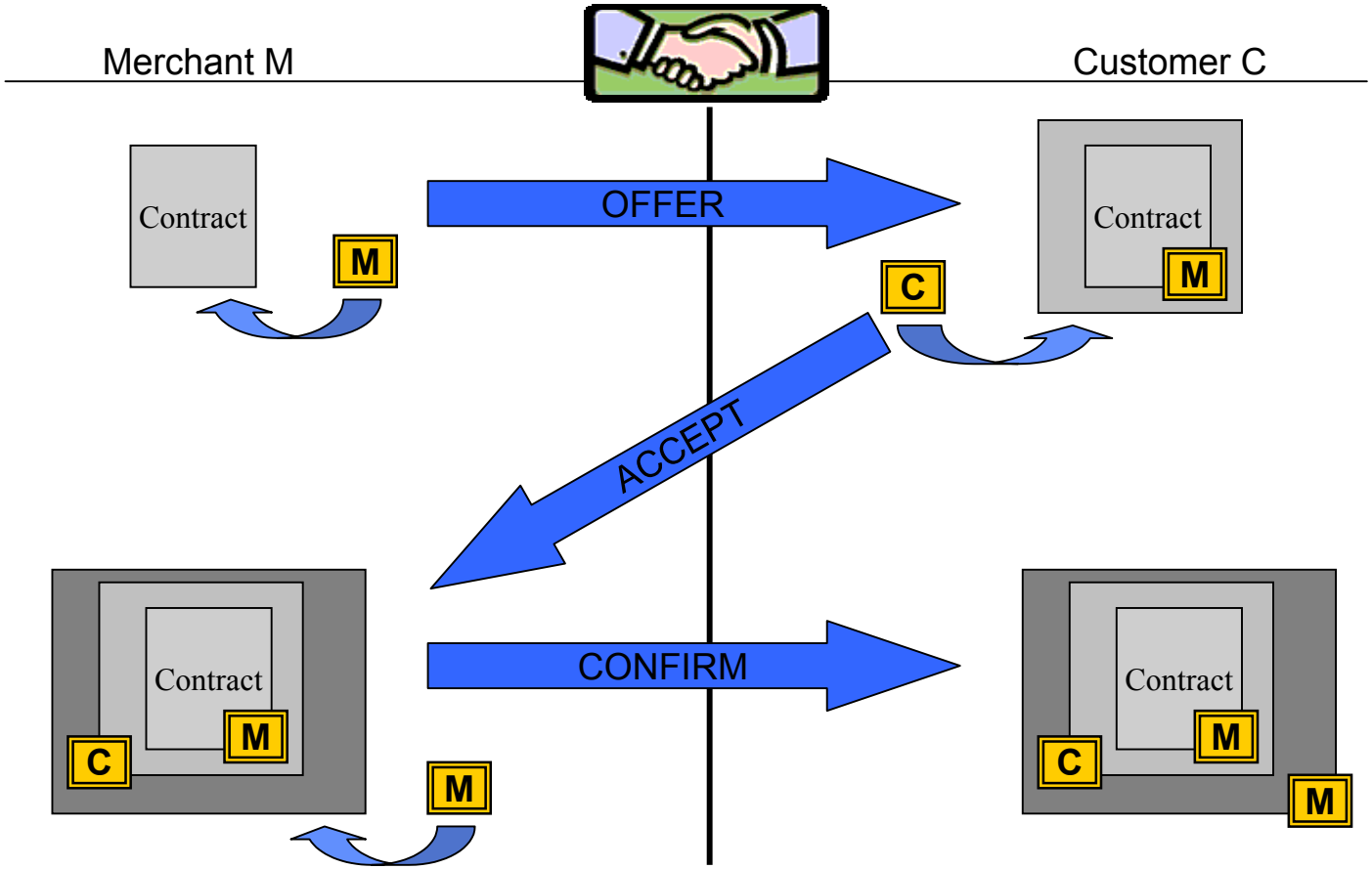
An Example: BaKo – A Protocol for Mutual Non-Repudiation



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Presentation of Signatures: Doubly Signed ACCEPT Document

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Presentation of Signature: Detailed

XML-Signature (detaillierte Darstellung)	
Signature Information	
Canonicalization Algorithm	http://www.w3.org/TR/2000/CR-xml-c14n-20001026
Signature Algorithm	http://www.w3.org/2000/09/xmldsig#rsa-sha1
Reference URI: #ts245908	
Transformation:	http://www.w3.org/TR/2000/CR-xml-c14n-20001026
Digest Algorithm:	http://www.w3.org/2000/09/xmldsig#sha1
Digest Value:	[illegible]
Reference URI: #245908	
Transformation:	http://www.w3.org/TR/2000/CR-xml-c14n-20001026
Digest Algorithm:	http://www.w3.org/2000/09/xmldsig#sha1
Digest Value:	[illegible]
Signature Value:	
[illegible]	
X509 Certificate Information	
Issuer Name:	CN=Certifier, O=www.certifier.com, L=Frankfurt, C=DE
Serial Number:	1
Signer (Subject Name):	CN=Merchant, O=www.merchant.com, L=Darmstadt, C=DE
Object ID: ts245908	

Angebot ID: [illegible]	
Datum:	03.12.2000
Uhrzeit:	17:32:33

Object ID: 245908

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