Security Record

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Greg Cannon	Crossmatch
Jeff Stapleton	Innove
Anne Wang	Cogent Systems
Mike McCabe	NIST

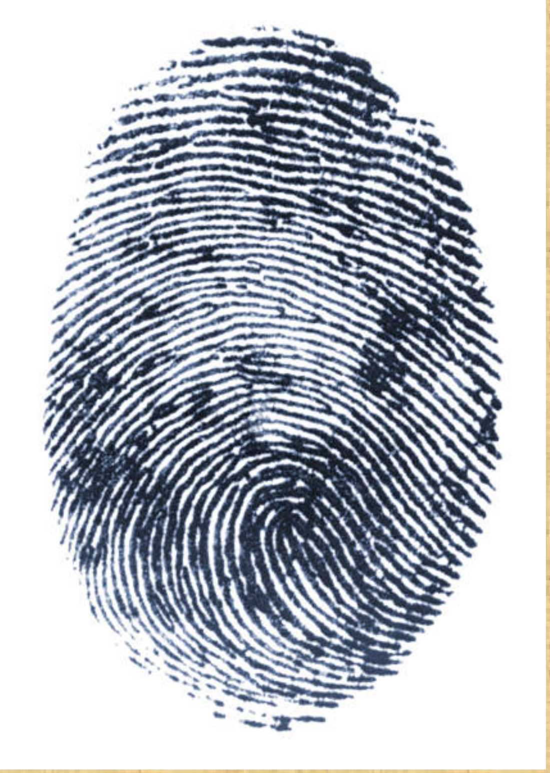
Why Security?

- Protect Document Integrity
- Connect Personal Data to Biometric Data
- Security at the Document Level
- Personal Responsibility

Words

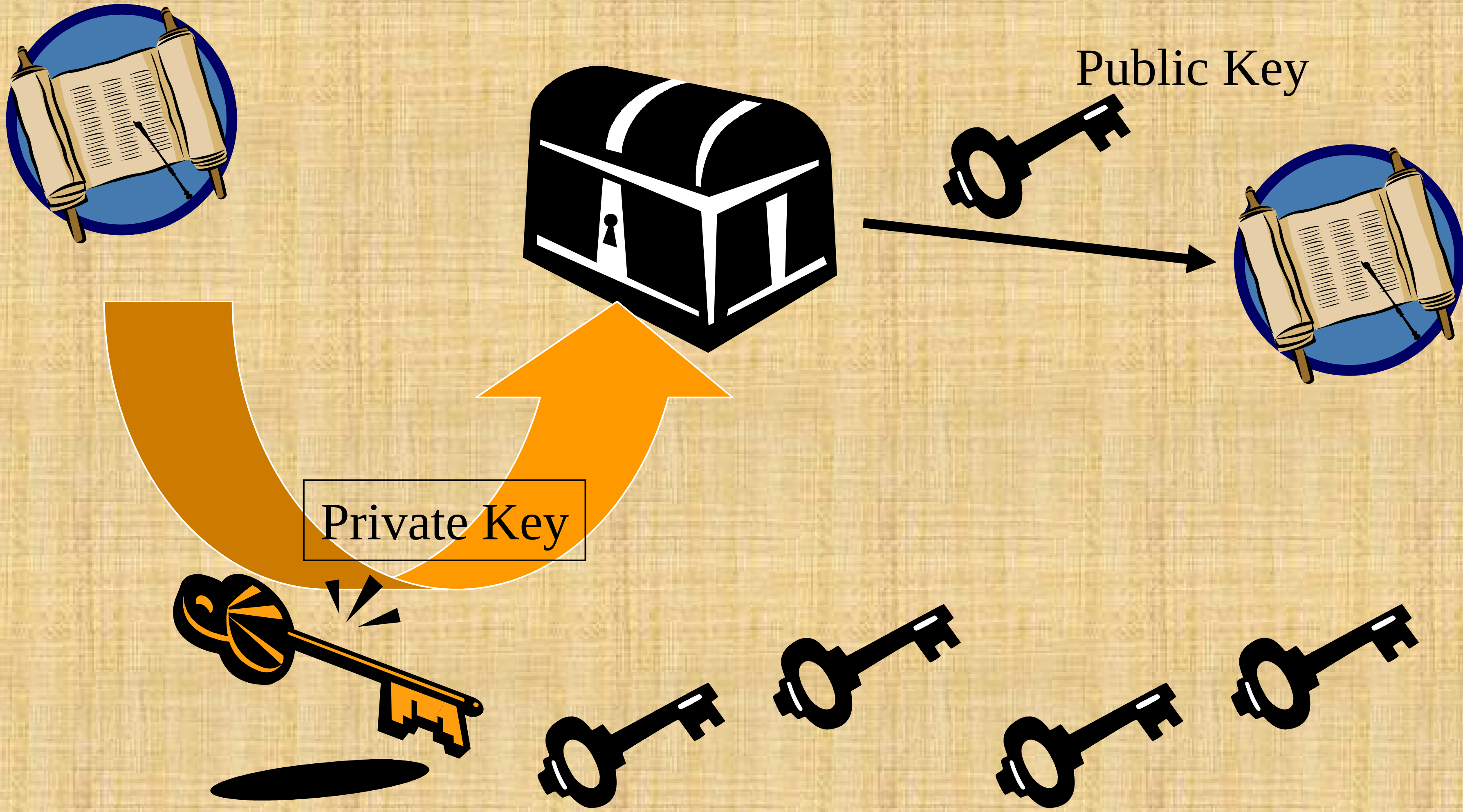
- Hash or Digest
- Digital Signature
  - Public/Private Key Cryptography
- Certificates
- Certificate Authorities
- Time Stamp Authorities

What is a Hash or Digest?



- Digested data
  - Small but reproducible
  - Fixed size for a given method
- Small changes in input lead to large changes in output
- Hard to make the same digest from different data
- One way

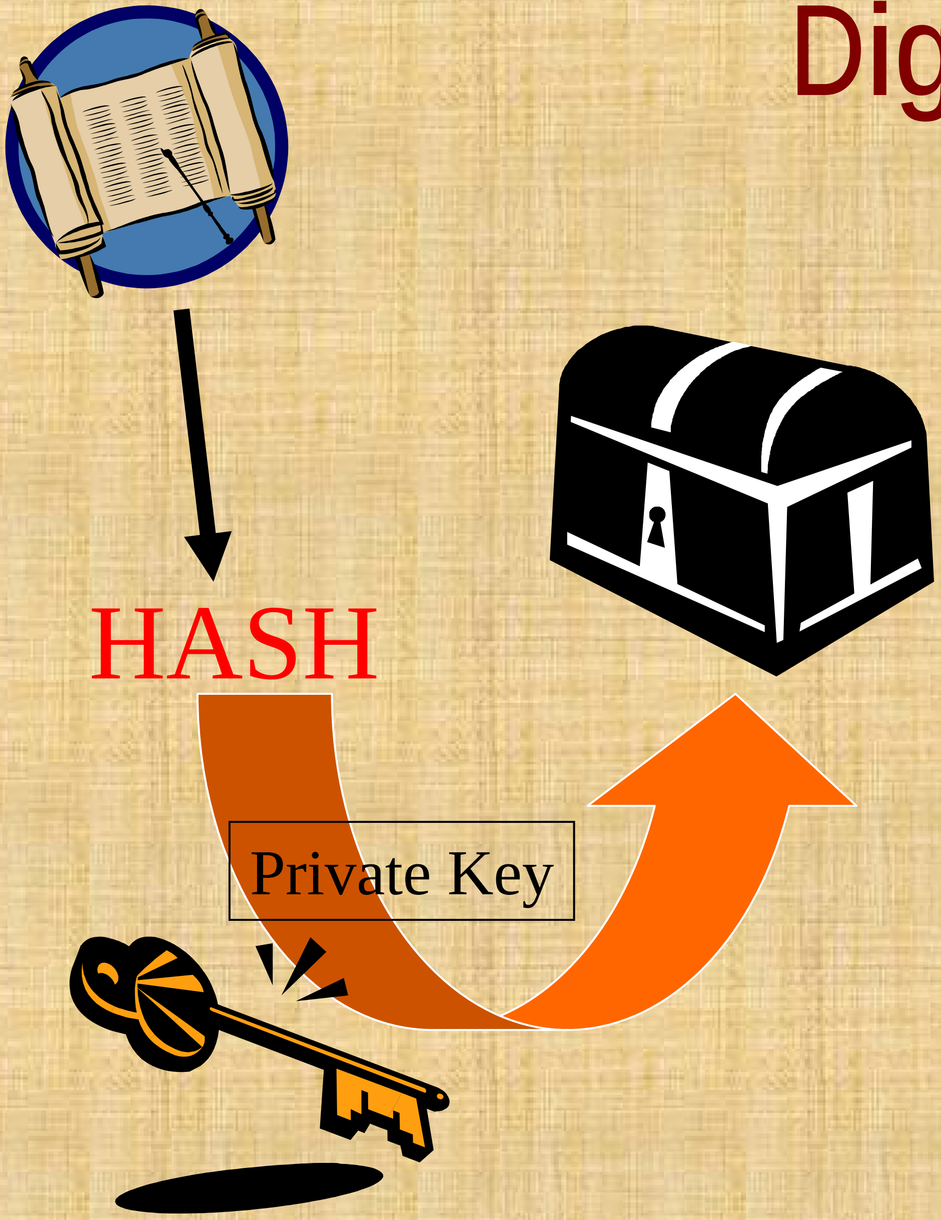
Public/Private Key Cryptography



Public Key

Private Key

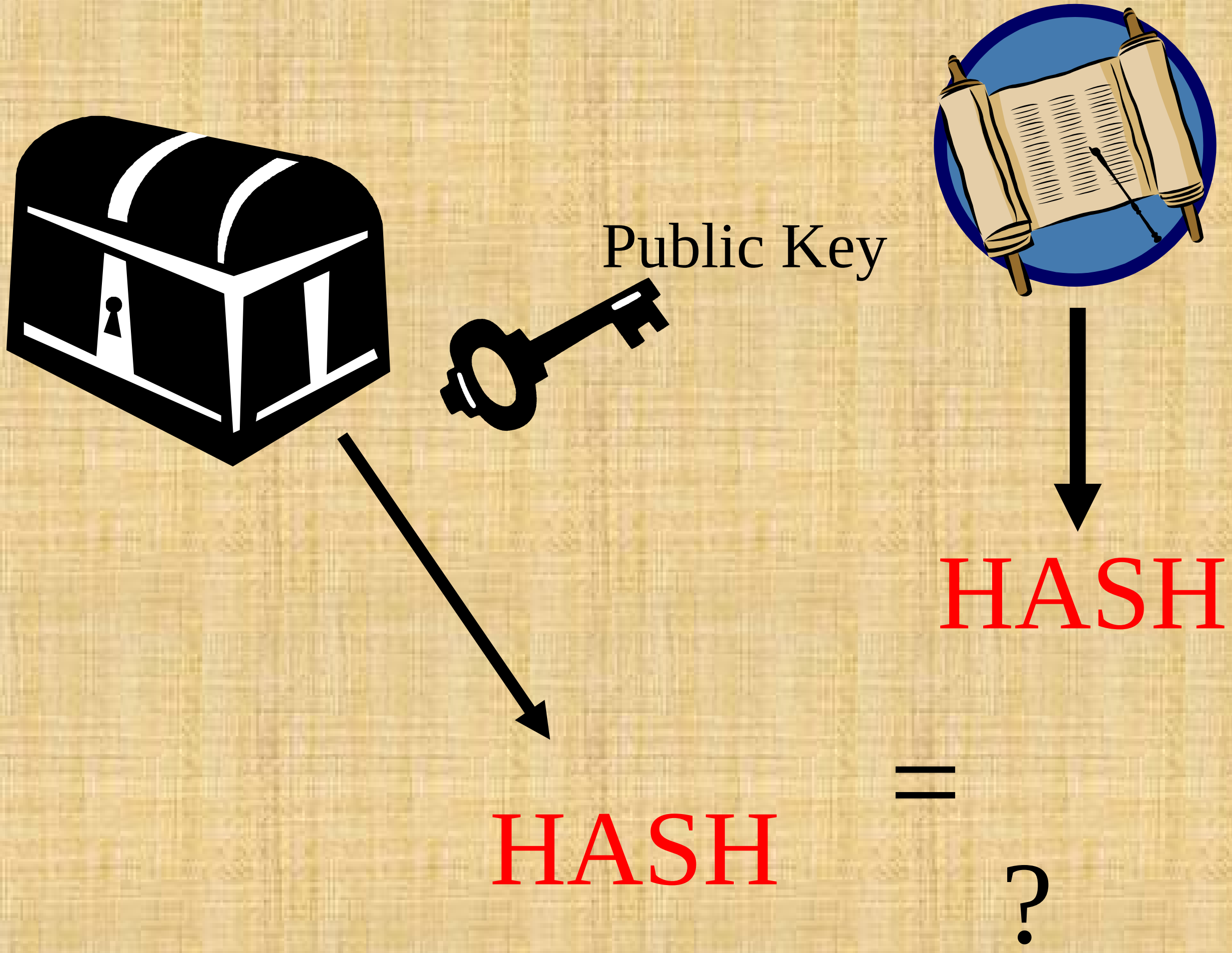
Digital Signature



HASH

Private Key

Digital Signature



Public Key

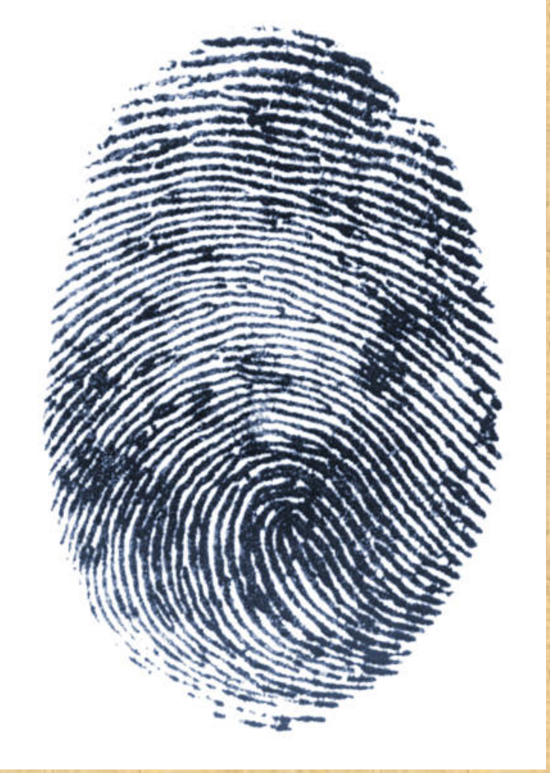
HASH

HASH

=

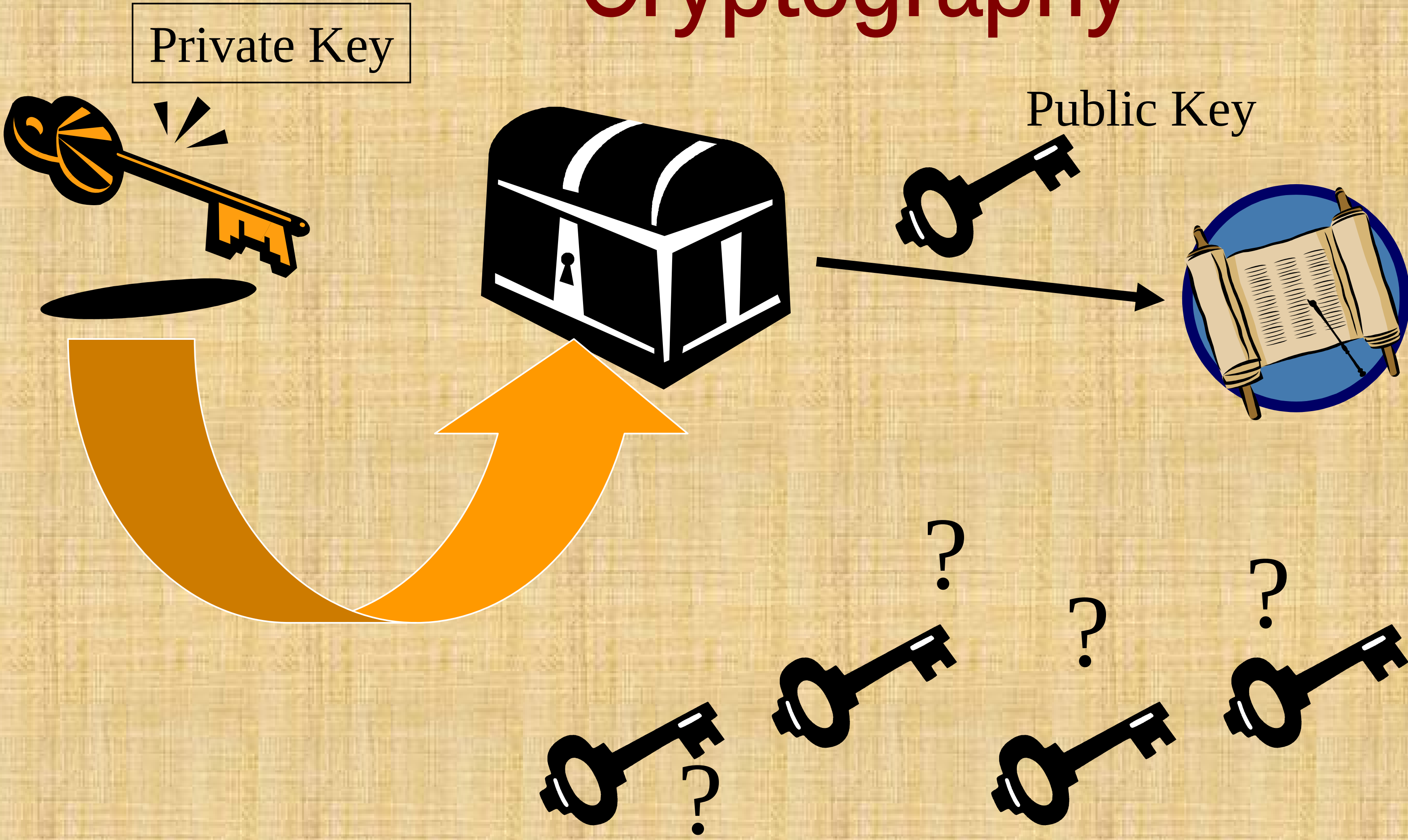
?

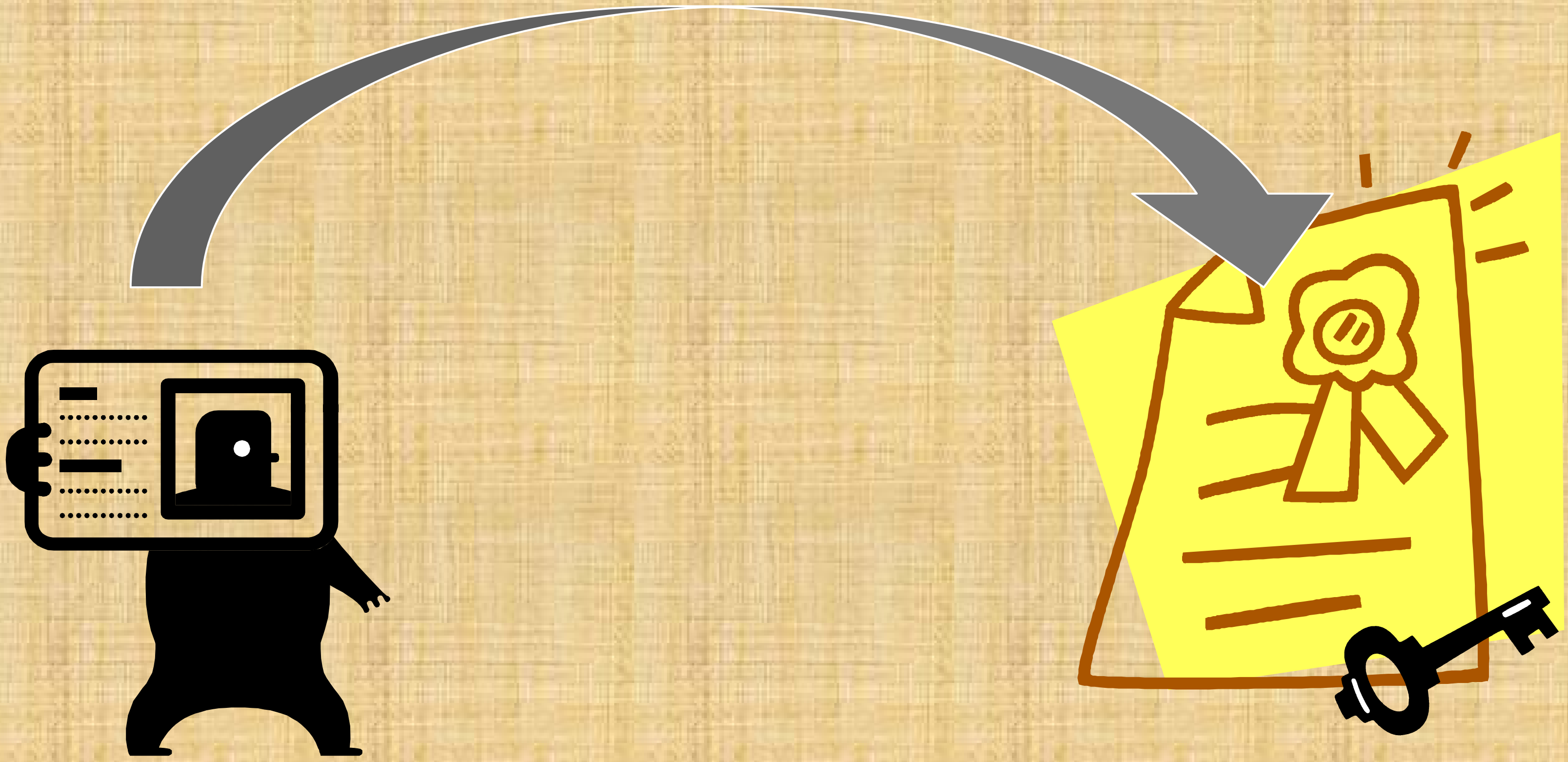
Digital Signature



- Confidence that the signed data has not changed
- Non-repudiation

Public/Private Key Cryptography



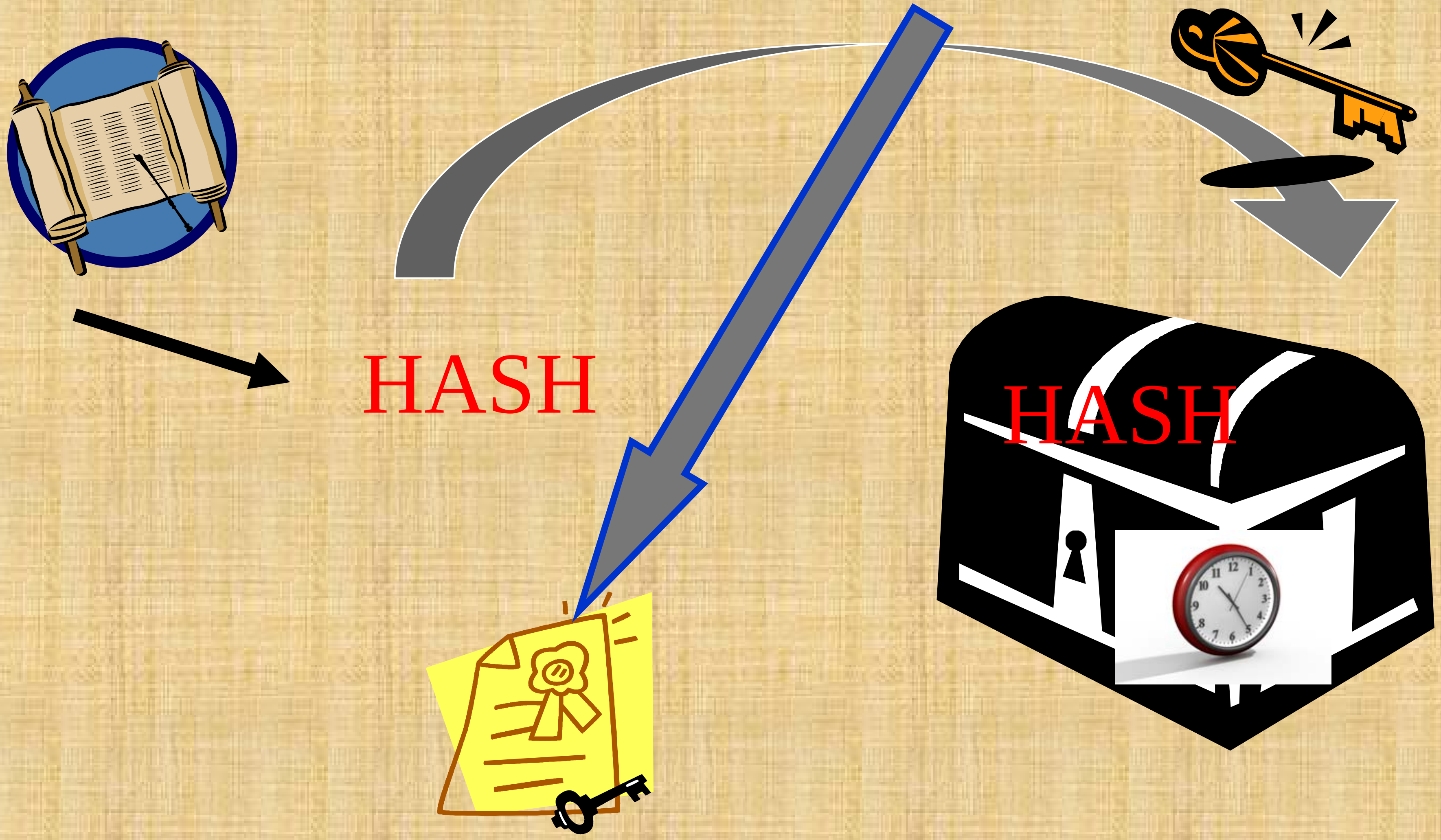


Certificate Authority

Identity

Certificate

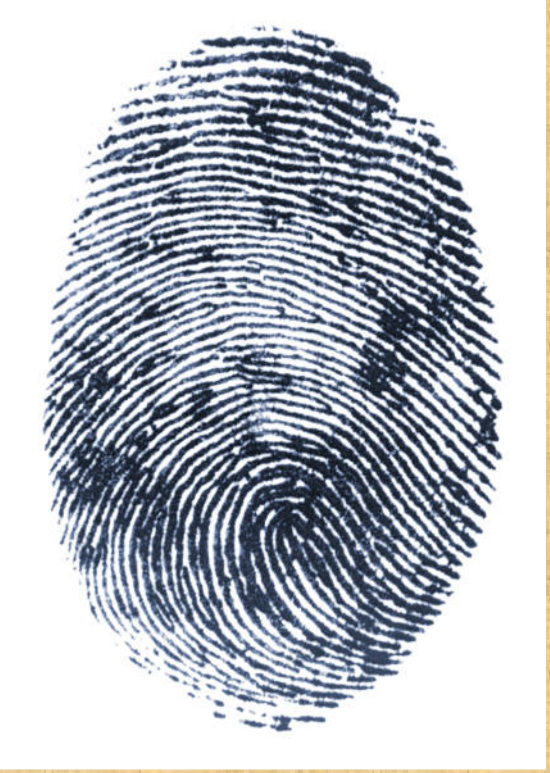
Time Stamp Authority



The Security Record

- New Record
  - Compatibility with earlier versions
- Optional
  - At the Document level
- Zero to Many
  - As document travels upstream

Security Record

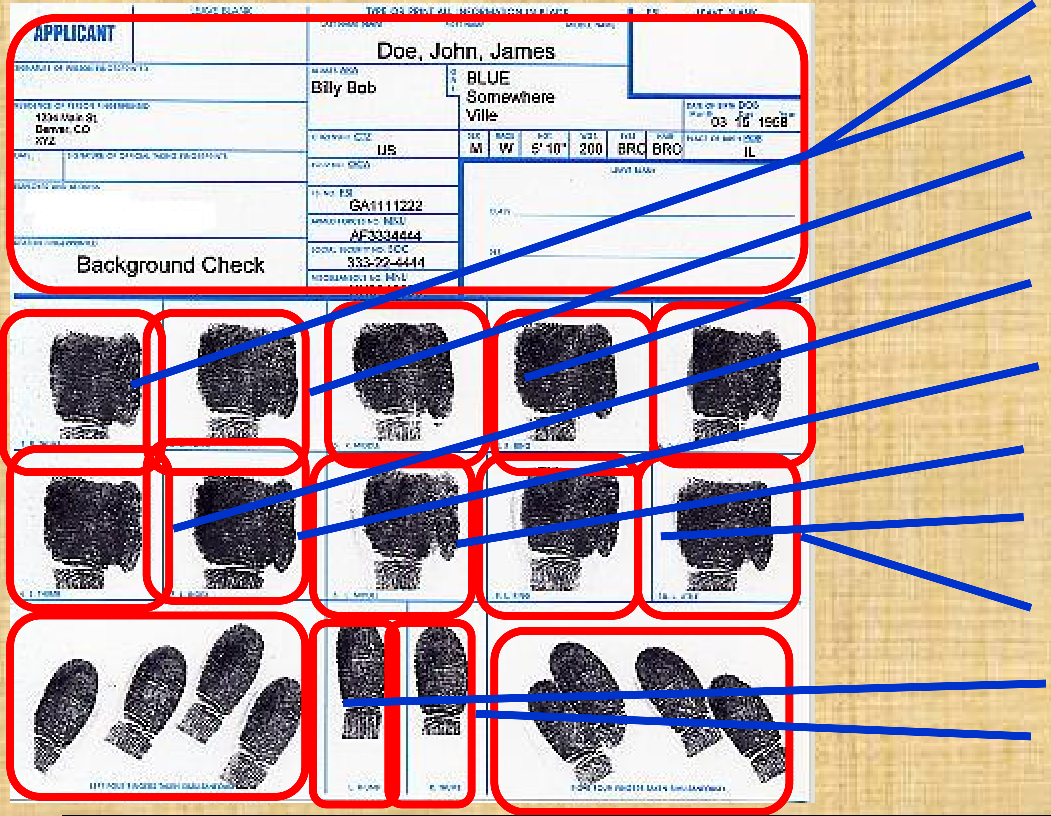


- Set of Hashes
  - Linked to record by IDC and Type
- Signature over the Set of Hashes
- Algorithms as per policy
  - NIST SP 800-57
  - NIST SP 800-73

The Security Record

- Uses Cryptographic Message Syntax (CMS)
  - Also used in
    - Secure email (S/MIME)
    - SSL/TLS (https://)
    - PIV Card
  - PKCS#7 since 1991 RSA
  - ASN.1 BER encoding

Hash of Each Record



APPLICANT

Doe, John, James

Billy Bob

BLUE
Somewhere
Ville

1234 Main St
Denver, CO
XYZ

DOB 03 15 1968

US

SEX	RACE	HGT	WGT	EYES	HAIR
M	W	5' 10"	200	BRO	BRO

IL

GA1111222

AF3334444

333-22-4444

Background Check

####### HASH ######

####### HASH ######

####### HASH ######

####### HASH ######

####### HASH ######

####### HASH ######

####### HASH ######

####### HASH ######

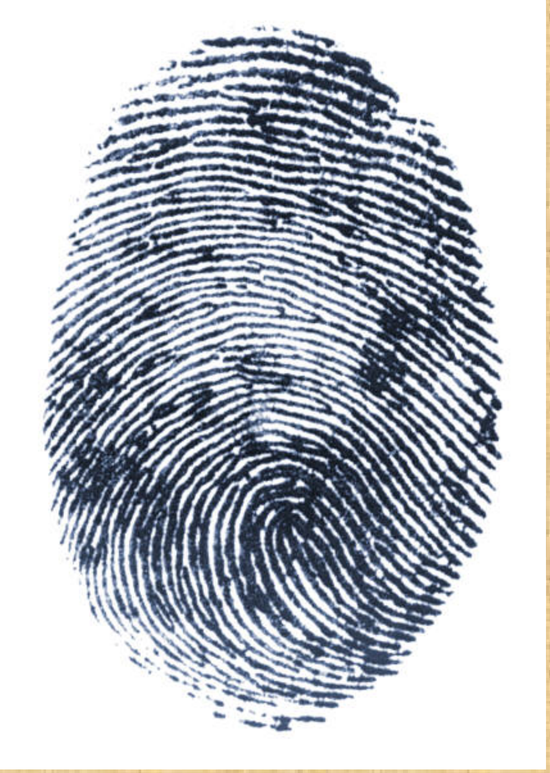
####### HASH ######

####### HASH ######

####### HASH ######

Signature

Using Security with PKI

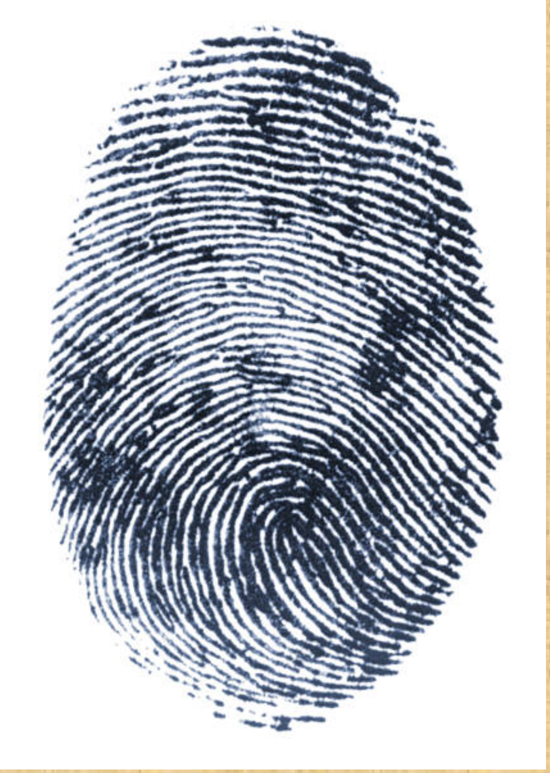


- Booking/Enrollment Officer
  - State or Local or National PKI
  - Upstream confidence
- Upstream Agents
  - Downstream confidence

Using Security without PKI

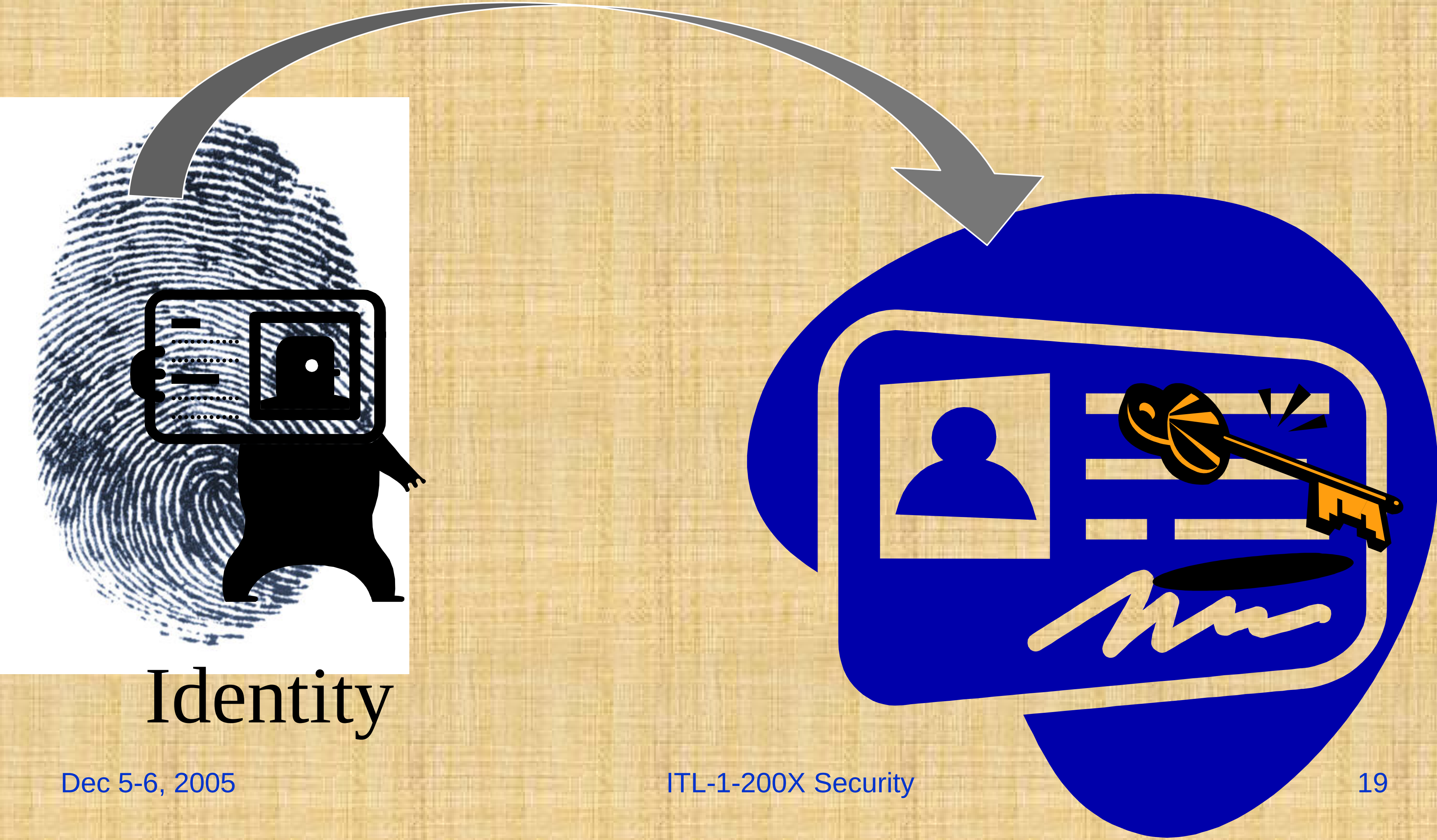
- Booking Officer
  - Self-Signed certificate
    - Password or otherwise protected
- Upstream Agents
  - Self-signed certificates stamp as received/sent

Implementation

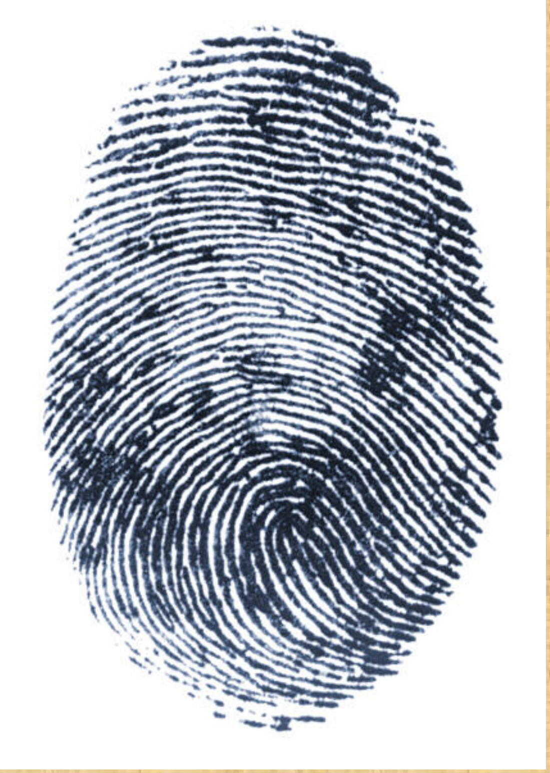


- CMS Signature
  - Microsoft CryptoApi
  - OpenSSL
  - Java
  - RSA, Certicom
  - PIV Card
- Certificate Authority
  - Microsoft Server CA
  - OpenSSL CA

PIV Enrollment and Infrastructure

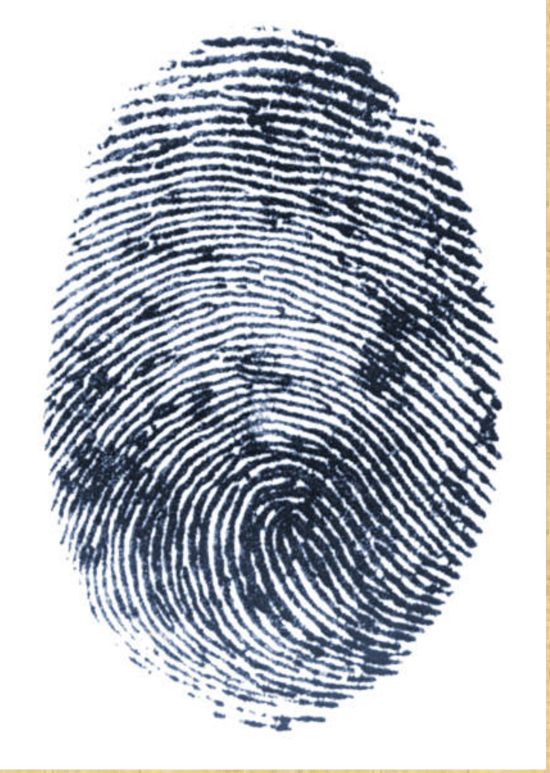


Summary



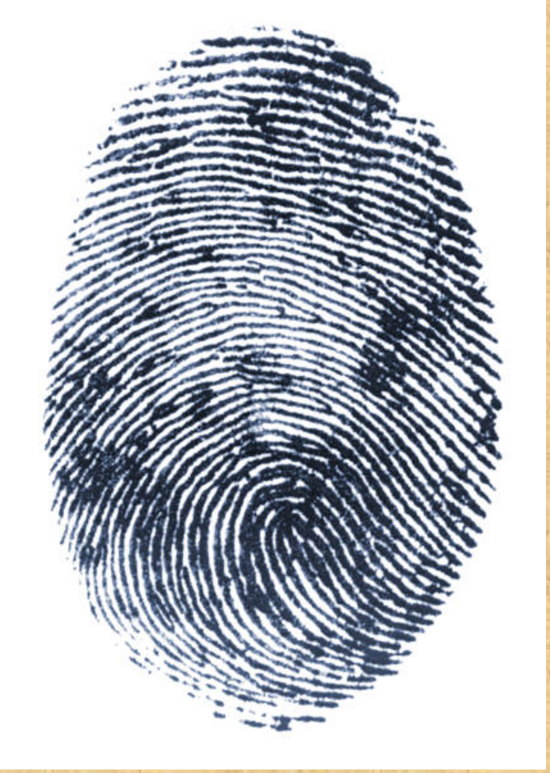
- Strengthen Security by Embedding Security within the Document
- Straight forward to implement

Security Committee



- Greg Cannon
  - Crossmatch Technologies
- Michael McCabe
  - NIST
- Jeff Stapleton
  - Innove
- Anne Wang
  - Cogent Systems
- Kevin Wilson
  - BSI2000

Questions & Discussion



New Record

- 17.001:4 character length<gs>
- 17.002:IDC character<gs>
- Optional unsigned attributes
- 17.050:Signing OID<gs>
- 17.051:Signature or Timestamp<gs>
- 17.052:Digest OID<gs>
- Optional signed attributes
- 17.096:size of 17.050 through 17.096<gs>
- 17.097:character count of IDC to follow<gs>
- 17.098:IDC<us>hash<rs>IDC<us>hash<rs>…<gs>
- 17.099:CMS<gs>

	Type 19 Record
LENGTH (LEN)	19.001:0907<gs>
IMAGE DESIGNATION CHARACTER (IDC)	19.002:16<gs>
optional unsigned attributes	
SIGNING OID (SSO)	19.050:1.2.840.113549.7.2<gs>
CONTENT TYPE (SCT)	19.051:01<gs>
DIGEST OID (DGO)	19.052:1.3.14.3.2.26<gs>
optional signed attributes	
LENGTH OF SIGNED ATTR (LAS)	19.096:10<gs>
COUNT OF DIGESTS (CDI)	19.097:17<gs>
LIST OF DIGEST (LDI)	19.098:
	-1<us>01<us><20 binary bytes><rs>
	00<us>02<us><20 binary bytes><rs>
	01<us>04<us><20 binary bytes><rs>
	02<us>04<us><20 binary bytes><rs>
	03<us>04<us><20 binary bytes><rs>
	04<us>04<us><20 binary bytes><rs>
	05<us>04<us><20 binary bytes><rs>
	06<us>04<us><20 binary bytes><rs>
	07<us>04<us><20 binary bytes><rs>
	08<us>04<us><20 binary bytes><rs>
	09<us>04<us><20 binary bytes><rs>
	10<us>04<us><20 binary bytes><rs>
	11<us>04<us><20 binary bytes><rs>
	12<us>04<us><20 binary bytes><rs>
	13<us>04<us><20 binary bytes><rs>
	14<us>04<us><20 binary bytes><rs>
	15<us>04<us><20 binary bytes><gs>
CMS (SignedData) (AUT)	19.099:<335 binary bytes of DER encoded CMS>

Summary of Tables 2 and 3 From SP 800-57

Cryptographic Strength	**Symmetric Algorithm**	**Hash Algorithm**	**ECC Algorithms**	**RSA/DSA/DH Algorithms**
56-bits	DES	-	-	-
80-bits	3DES-2K	SHA-1 (160)	160-bits	1024-bits
112-bits	3DES-3K	SHA-2 (224)	224-bits	2048-bits
128-bits	AES-128	SHA-2 (256)	256-bits	3072-bits
192-bits	AES-192	SHA-2 (384)	384-bits	7680-bits
256-bits	AES-256	SHA-2 (512)	512-bits	15360-bits

ECC SignedData Example

Field	Value	Size
OID_1	OID cms-ct-signed-data { 1 . 2 . 840 . 113549 . 1 . 7 . 2 }	9 bytes
$Version_2$	Version number (1)	1 byte
OID_3	OID fips-sha1 { 1 . 3 . 14 . 3 . 2 . 26 }	5 bytes
OID_4	OID cms-ct-data { 1 . 2 . 840 . 113549 . 1 . 7 . 1}	9 bytes
Detached $Data_5$	File content is not encapsulated in the SignedData object	0 bytes
$Version_6$	Version number (1)	1 byte
OID_7	OID pkix-at-common-name { 2 . 5 . 4 . 3 }	3 bytes
Subject $Name_8$	Issuer common name “Subject”	7 bytes
Serial $Number_9$	Serial number hex “78 8C 29 19 99 25 FA 0B”	8 bytes
OID_{10}	OID fips-sha1 { 1 . 2 . 14 . 3 . 2 . 26 }	5 bytes
OID_{11}	OID ecdsa-with-sha1 { 1 . 2 . 840 . 10045 . 4 . 1 }	7 bytes
$Signature_{12}$	ECDSA 328-bit digital signature from 163-bit ECC public key	41 bytes

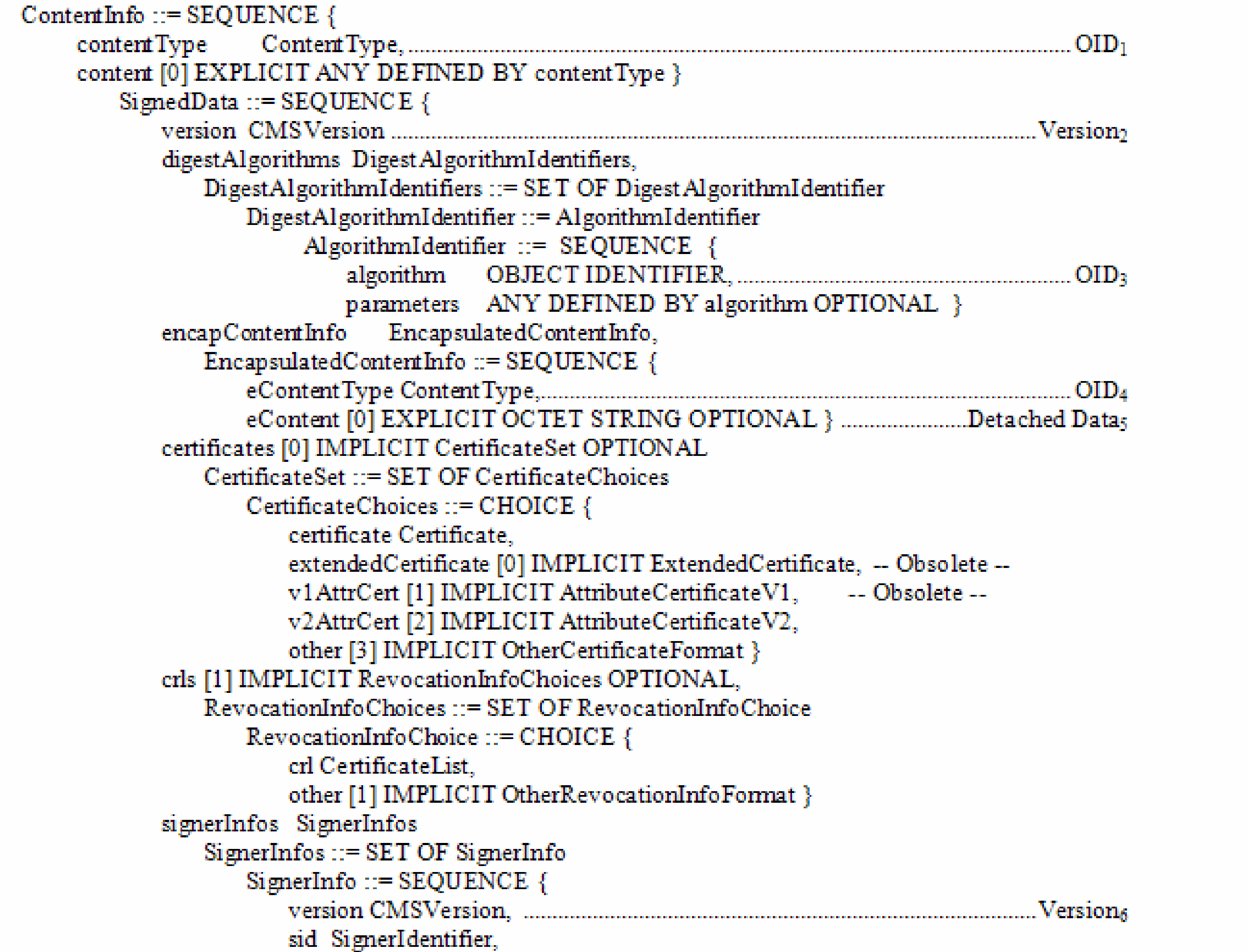
References

- RFC3852 Cryptographic Message Syntax (July 2004, supersedes RFC3369, RFC2630, PKCS#7 1.5)
- NIST SP 800-57 Recommendation for Key
- Management (8/2005)
- ISO/IEC 8824:2001 (All parts) | ITU-T Recommendation X.680-series (2000), Information Technology - Abstract Syntax Notation One (ASN.1)
- [8825] ISO/IEC 8825-1:2001 | ITU-T Recommendation X.690 (2000), Information Technology - ASN.1 Encoding Rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)

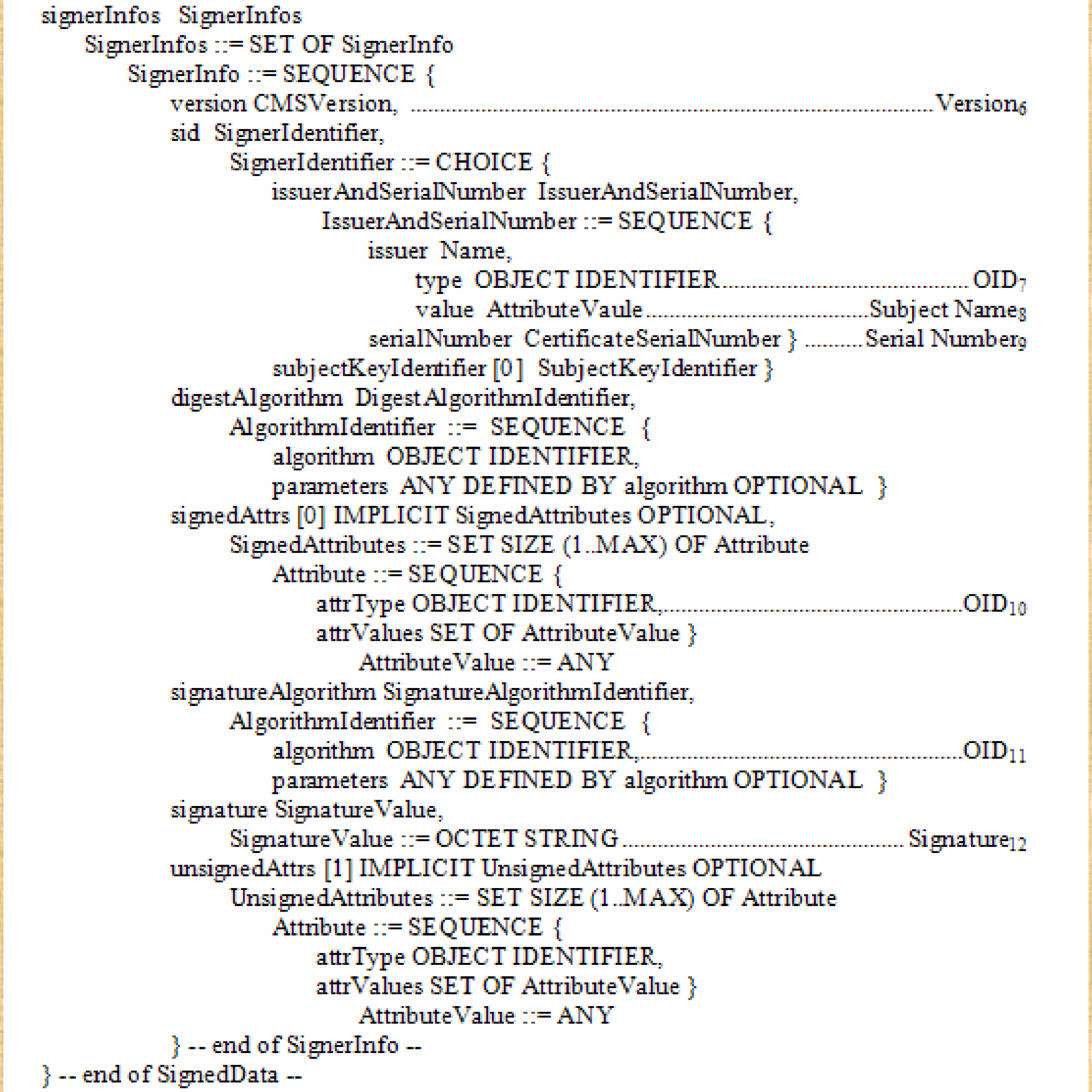
References continued

- ANSI X9.95-2005 Trusted Time Stamp Management and Security

CMS Structure



```
ContentInfo ::= SEQUENCE {
    contentType     ContentType, ............................................................................................. OID1
    content [0] EXPLICIT ANY DEFINED BY contentType }
        SignedData ::= SEQUENCE {
            version  CMSVersion .................................................................................................Version2
            digestAlgorithms  DigestAlgorithmIdentifiers,
                DigestAlgorithmIdentifiers ::= SET OF DigestAlgorithmIdentifier
                    DigestAlgorithmIdentifier ::= AlgorithmIdentifier
                        AlgorithmIdentifier  ::=  SEQUENCE  {
                            algorithm      OBJECT IDENTIFIER, ........................................................... OID3
                            parameters     ANY DEFINED BY algorithm OPTIONAL  }
            encapContentInfo      EncapsulatedContentInfo,
                EncapsulatedContentInfo ::= SEQUENCE {
                    eContentType ContentType,.......................................................................................... OID4
                    eContent [0] EXPLICIT OCTET STRING OPTIONAL } ......................Detached Data5
            certificates [0] IMPLICIT CertificateSet OPTIONAL
                CertificateSet ::= SET OF CertificateChoices
                    CertificateChoices ::= CHOICE {
                        certificate Certificate,
                        extendedCertificate [0] IMPLICIT ExtendedCertificate,  -- Obsolete --
                        v1AttrCert [1] IMPLICIT AttributeCertificateV1,        -- Obsolete --
                        v2AttrCert [2] IMPLICIT AttributeCertificateV2,
                        other [3] IMPLICIT OtherCertificateFormat }
            crls [1] IMPLICIT RevocationInfoChoices OPTIONAL,
                RevocationInfoChoices ::= SET OF RevocationInfoChoice
                    RevocationInfoChoice ::= CHOICE {
                        crl CertificateList,
                        other [1] IMPLICIT OtherRevocationInfoFormat }
            signerInfos   SignerInfos
                SignerInfos ::= SET OF SignerInfo
                    SignerInfo ::= SEQUENCE {
                        version CMSVersion,  .....................................................................................Version6
                        sid  SignerIdentifier,
```



```
signerInfos  SignerInfos
     SignerInfos ::= SET OF SignerInfo
          SignerInfo ::= SEQUENCE {
               version CMSVersion, .............................................................................Version6
               sid  SignerIdentifier,
                      SignerIdentifier ::= CHOICE {
                           issuerAndSerialNumber  IssuerAndSerialNumber,
                                IssuerAndSerialNumber ::= SEQUENCE {
                                     issuer  Name,
                                          type  OBJECT IDENTIFIER...........................................OID7
                                          value  AttributeVaule.................................Subject Name8
                                     serialNumber  CertificateSerialNumber } ..........Serial Number9
                           subjectKeyIdentifier [0]  SubjectKeyIdentifier }
               digestAlgorithm  DigestAlgorithmIdentifier,
                      AlgorithmIdentifier  ::=  SEQUENCE  {
                           algorithm  OBJECT IDENTIFIER,
                           parameters  ANY DEFINED BY algorithm OPTIONAL  }
               signedAttrs [0] IMPLICIT SignedAttributes OPTIONAL,
                      SignedAttributes ::= SET SIZE (1..MAX) OF Attribute
                           Attribute ::= SEQUENCE {
                                attrType OBJECT IDENTIFIER,.............................................OID10
                                attrValues SET OF AttributeValue }
                                     AttributeValue ::= ANY
               signatureAlgorithm SignatureAlgorithmIdentifier,
                      AlgorithmIdentifier  ::=  SEQUENCE  {
                           algorithm  OBJECT IDENTIFIER,..............................................OID11
                           parameters  ANY DEFINED BY algorithm OPTIONAL  }
               signature SignatureValue,
                      SignatureValue ::= OCTET STRING ......................................... Signature12
               unsignedAttrs [1] IMPLICIT UnsignedAttributes OPTIONAL
                      UnsignedAttributes ::= SET SIZE (1..MAX) OF Attribute
                           Attribute ::= SEQUENCE {
                                attrType OBJECT IDENTIFIER,
                                attrValues SET OF AttributeValue }
                                     AttributeValue ::= ANY
               } -- end of SignerInfo --
} -- end of SignedData --
```